How chatbots are used in recruitment and selection practices?

Document:
TFM-205MEM

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Degree:
Master's in Technology and Engineering Management

Examination session:
Spring, 2022
Abstract

In the modern era, Artificial Intelligence (AI) has affected different functions of businesses, including Human Resources, in recruitment processes. With Chatbots (conversational agents) systems in place, HR can perform tasks like identifying, selecting, and interviewing talented candidates with more speed and consequently focus on strategic goals more effectively. This study aims to assess the current state of chatbot usage in HR processes in organisations, particularly in Higher Education Institutions (HEIs). For Part I, the chatbot’s role is evaluated in detail for each stage of recruitment (i.e., sourcing, screening, selection and onboarding of candidates). Moreover, we will discuss how chatbot providers develop this service in terms of needed technical technologies and communicational aspects. The findings will help identify the best practices in developing better chatbots that align with the demands of modern hiring. In addition, we investigate chatbots’ impact on higher education with the rise of online learning and the Covid-19 pandemic. In part two, we develop a chatbot using the Google DialogFlow platform to support the admission process for prospective PhD students in the Doctoral Management Program of the UPC. This FAQ bot will be implemented as a supplementary channel in the doctoral program website to understand students’ queries and provide predefined answers. A survey is conducted based on the TAM framework to assess the chatbot’s functionality, quality, and intention of use. Based on the responses and findings, we will discuss how chatbots are a viable option to create new innovative services that are helpful for both candidates and educators. In the end, based on lessons learned, we propose conclusions, discussion and several recommendations for these intelligent systems. It is hoped that this work will open up new research possibilities for future optimisations in the fields of chatbots and recruitment in the future.

Keywords: Chatbots, Natural Language Processing, Artificial Intelligence, Recruitment, Higher Education Institutions
Resumen

En la era moderna, la Inteligencia Artificial (IA) ha afectado a diferentes funciones de las empresas, incluida la de Recursos Humanos, en los procesos de contratación. Con los sistemas de Chatbots (agentes conversacionales) implementados, HR puede realizar tareas como identificar, seleccionar y entrevistar a personas candidatas talentosas con más velocidad y, en consecuencia, enfocarse en objetivos estratégicos de manera más efectiva.

Este estudio tiene como objetivo evaluar el estado actual del uso de chatbots en los procesos de recursos humanos en las organizaciones, particularmente en las Instituciones de Educación Superior (IES). Para la Parte I, el rol del chatbot se evalúa en detalle para cada etapa del reclutamiento (i.e., planificación, abastecimiento, selección, verificación de referencias, selección e incorporación de candidatos). Además, discutiremos cómo los proveedores de chatbots desarrollan este servicio en términos de tecnologías técnicas necesarias y aspectos de comunicación. Los hallazgos ayudarán a identificar las mejores prácticas para desarrollar mejores chatbots que se alineen con las demandas de la contratación moderna. Además, investigamos el impacto de los chatbots en la educación superior con el aumento del aprendizaje en línea y la pandemia de Covid-19. En la segunda parte, desarrollamos un chatbot utilizando la plataforma Google DialogFlow para apoyar el proceso de admisión de futuros estudiantes de doctorado en el Programa de Gestión de Doctorado de la UPC. Este bot de preguntas frecuentes se implementará como un canal complementario en el sitio web del programa de doctorado para comprender las consultas de los estudiantes y proporcionar respuestas predefinidas. Se realiza una encuesta basada en el marco TAM para evaluar la funcionalidad, la calidad y la intención de uso del chatbot. Según las respuestas y los hallazgos, analizaremos cómo los chatbots son una opción viable para crear nuevos servicios innovadores que sean útiles tanto para los personas candidatas como para los educadores. Al final, en base a las lecciones aprendidas, proponemos conclusiones, discusión y varias recomendaciones para estos sistemas inteligentes. Se espera que este trabajo abra nuevas posibilidades de investigación para futuras optimizaciones en los campos de los chatbots y el reclutamiento en el futuro.

Palabras clave: Chatbots, Procesamiento del Lenguaje Natural, Inteligencia Artificial, Recrutamiento, Instituciones de Educación Superior
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List of abbreviations / Glossary

AI    Artificial intelligence
NLP   Natural Language Processing
NLU   Natural Language Understanding
HRM   Human Resource Management
HCM   Human Capital Management
HR    Human Resource
R&S   Recruitment and Selection
TAM   Technology Acceptance Model
PEOU  Perceived Ease of Use
PU    Perceived Usefulness
PEnj  Perceived Enjoyment
ITU   Intention to use
Introduction

“Acquiring the right talent is the most important key to growth. Hiring was – and still is – the most important thing we do.”

- Marc Benioff, Founder and CEO of Salesforce
I. Background

Nowadays, many industries are using artificial intelligence (AI) to improve their processes and performance (Allal-Chérif et al., 2021). Ranging from financial services, e-commerce, tourism to healthcare, digital technologies are transforming routines. These new technologies have been recognized in Human Resources (HR) strategies such as recruiting, training, job replacement, and work performance (Vrontis et al., 2021). As the competition for talented employees rises, the resources for finding these individuals remain the same (Allal-Chérif et al., 2021), which means that the speed and cost of recruiting the best candidates have become crucial for organisations. As a result, labour recruitment and selection have risen to the top of management's priority list (Black & Esch, 2020; Kulkarni & Che, 2019). Hiring the proper fit among candidates is one of the most challenging tasks for talent hunters, considering the skillful candidates who are already in the working yet open to proposals to change jobs (Allal-Chérif et al., 2021).

With the emergence of the internet, the approach to hiring new employees has changed significantly. In web-based recruitment, companies can reach both active and passive job candidates, and the applicants can apply for many job vacancies (Black & Esch, 2020). Automated process, therefore, has expanded the volume of job applications received by companies. While this method generates a vast and diversified pool of candidates (Wilson & Daugherty, 2018), sifting through that many resumes is a time-consuming endeavour (Black & Esch, 2020). The implementation of Artificial Intelligence (AI) in companies, due to technological advancements in Industry 4.0, provides solutions to cope with this scalability barrier. Several authors examined the prospects and new implications of AI for talent acquisition. For instance, Vardarlier & Zafer (2020) pointed out that AI accelerates the recruitment process and increases the probability of perfect matching. Since AI applications can automate certain tasks, it gives the opportunity for HR professionals to focus on decision-making responsibilities and act as supervisors in specific processes (Hemalatha & Kumari, 2021; Kulkarni & Che, 2019). These new tools are primarily utilised for time-consuming and repetitive tasks that help save costs and time for companies (Nawaz & Gomes, 2019; Ibrahim & Hassan, 2019). Also, Albert (2019) highlighted that companies are mostly adopting AI to use chatbots/CRM apps, admin-related task automation, and screening software (CVs and videos) for their recruiting and selection processes (R&S).

When you apply for a company position in today’s world, AI will likely be involved in the hiring process (Black & Esch, 2020). According to a recent Gartner report (2019), by 2022, 35% of companies will leverage AI capabilities like conversational user experience and natural language processing (NLP) in their recruitment process to simplify the job application process. NLP empowers the machines to interpret, learn, communicate and automate processes in any written natural language (Navigli, 2018; Hemalatha & Kumari, 2021). It allows making chatbot applications user-friendly and understanding user queries in real-time (Srimathi & Krishnamoorthy, 2019). Moreover, multiple studies have found that chatbots' perceived humanity promotes user experience and adoption of these technologies. As a result, recently, authors have been focusing on how to increase the effectiveness of these systems and improve the quality of human-robot interactions (Van Esch et al., 2019; Schildknecht et al., 2018). With the development of NLP and Deep Learning techniques, conversational AI applications (also known as a chatbot) are more used in the recruitment process (Allal-Chérif et al., 2021; Albert, 2019; Allouch, 2021). Chatbots help save time and cost for the initial point of contact between a candidate and a company, such as a career
website, job offers, frequent questions, and eventually the application submission (Laurim et al., 2021; Nawaz & Gomes, 2019). Recruiting chatbots can facilitate communication with candidates by arranging assessments, and interviews, asking open questions about their skills, background, and expectations once they apply for available roles. Using conversational agents in the recruiting process will demand an emphasis on emotional intelligence, social skills, and learning how to interact effectively (Vardarlier & Zafer 2020).

Machine learning and deep learning techniques are trending research areas of AI applications that companies are leveraging in their workplace in various processes (Srimathi & Krishnamoorthy, 2019). Thus, these technologies can be used in any organisation to address recruitment challenges, such as universities, to recruit the best-fitting PhD candidates. Most communications between potential students and higher education centres are managed manually, which is a time-consuming process that burdens the admissions director and professors (Nguyen et al., 2021). To meet the demands of students, higher education institutions currently manage their applications through extensive information on websites, email notifications, and help desks. (Srimathi & Krishnamoorthy, 2019). The adoption of chatbot technology by higher education not only can help them to recruit proper PhD candidates but also has been associated with several benefits, including improving student motivation, attention, encouraging collaborative learning, promoting communication with peers, and increasing student’s sense of ease (Studente et al., 2020). The same advantages of using a chatbot for HR professionals may be applied to the admissions committee; faculty would have more time for research and decision making rather than sifting through resumes and research proposals.
II. Problematization

Intelligent automation technologies revolutionised the approach to evaluating job applicants and enhanced organisational performance; however, these opportunities bring considerable challenges at a technological and ethical level (Vrontis et al., 2021). Several issues remain unsolved concerning AI technologies’ accuracy, moral judgments, and legal and privacy implications (Laurim et al., 2021). Although using chatbots in HR activities is becoming widespread, many companies are still reluctant to adopt them for practical utilisation (Upadhyay & Khandelwal, 2018). One such explanation is the adaptation problem of digital tools, which some recruiters might sense as a threat to their roles (Vardarlier & Zafer, 2020; Li et al., 2021). Another point to consider is the higher volume of applications which makes the assessment process more complex (Black & van Esch, 2020). Moreover, to guarantee that selection delivers a sustainable competitive advantage, job applicants must be evaluated based on relevant competencies. Without using AI tools, the risk of human bias leading to incorrect judgement may become inevitable (Tambe et al., 2019; Houser, 2019). To recap, failing to overcome the obstacles of AI technologies in recruitment and selection results in a failure to achieve long-term competitive advantage for companies. Therefore, a chatbot implemented in these processes needs to possess particular requirements to add value to the companies.

Nevertheless, how much evidence do we have about using chatbots in business? Furthermore, how much evidence do we have about using chatbots in recruitment? Due to the current technological level, it remains complicated for chatbots to offer more human understanding, recognize specific sentiment qualities, and deal with humour. (Canhoto & Clear, 2020). However, some studies (Altemeyer, 2019; Tambe et al., 2019) pointed out that the best recruitment results may be obtained by balancing the roles of humans and AI. Chatbots can act as an assistant who takes up the most repetitive jobs in recruitment processes, releasing recruiters to focus on strategic and decision-related work. Although, businesses should understand the orientation targeted from chatbot deployment in their recruitment procedures regarding its compatibility with the objectives. Indeed, identifying and evaluating existing findings would enable an enhanced AI solution design and smoother deployment in recruitment. Furthermore, a clear foundation for how chatbots might improve the experience of both HR professionals and candidates would be feasible.
III. Purpose and Research Questions

It is important to note that the R&S consists of several phases (e.g., planning, sourcing, screening, selection, reference, background check, offering, and onboarding), each requiring a distinct use of chatbots that must be customised according to the specific task (Albert, 2019; Nawaz & Gomes, 2019; Kulkarni, & Che, 2019). This study has a twofold aim. First, it seeks to offer an overview of the current state of chatbots usage in recruitment and selection (R&S) processes. Second, it will offer a chatbot prototype to use in the selection process of PhD students at the Doctoral Management Program of the UPC. For this reason, this study is going to be divided into three parts. The first part is called “Chatbots usage in recruitment and selection processes”, and the second part is called “A chatbot prototype implementation in recruitment and selection of PhD candidates”. In the last Part, the lessons learned from the whole study will be discussed.

The research questions that arise from the abovementioned aims are the following:

Part I: Chatbots usage in recruitment and selection processes.

How are chatbots used in recruitment and selection processes? What are the benefits and challenges of using chatbots in those HR processes? How can a chatbot be sensed as friendly and trustworthy when engaging with users? Also, to narrow the scope of analysis and implementation, we will answer the following question: How are chatbots used in recruitment and selection processes in higher education institutions?

Part II: A chatbot prototype implementation in recruitment and selection of PhD candidates

Is a chatbot an option for those involved in selecting and recruiting PhD candidates within a doctoral program? If so, how can a chatbot assist PhD candidates in finding the necessary information in an easy and friendly way? Moreover, how can a chatbot help professors and administrative staff when dealing with the selection and recruitment of PhD candidates?

Thus, this research provides a practical contribution to chatbot implementation that would create value for both HR professionals and job candidates. At last, it is hoped that the findings will give AI and NLP developers valuable insights when creating chatbots for recruiting objectives. It is noteworthy to mention that there is a gap in the literature since it has not been widely investigated how chatbots can be utilised in universities’ admission processes, specifically for PhD prospective students.
Part I

Chatbots usage in Recruitment and Selection Processes

“It is difficult to think of a major industry that AI will not transform.”

- Andrew Ng, Global leader in AI
1. Context

The fast growth of the digital economy has resulted in the introduction of a range of new and novel technical approaches to improve recruitment processes (Woods et al., 2020). Moreover, the COVID period has pushed technology innovation in recruiting, transforming HR activities and candidate expectations (Laurim et al., 2021). Many firms want to attract the best talents while cutting costs and time to hire, which has resulted in the use of new AI tools such as chatbots in the hiring process (Li et al., 2021).

This section will examine the literature on emerging trends of AI applications in recruiting and selection processes. Namely, we will discuss the current state of chatbot usage in those processes while covering the key concepts in the chatbot usage based on the hiring team and candidates’ perspectives.

2. Methodology

We have conducted an academic literature review to examine the literature on emerging trends of AI applications in recruiting and selection processes. To offer an overview of the usage of chatbots in recruiting and selection processes, we have conducted a Google Search. Below, both information searches are explained.

2.1 Academic literature review

Below, the steps followed for retrieving, selecting, classifying, and analysing studies on the use of chatbot in business and HR processes are explained.

Step 1: Retrieving and selecting relevant literature

Below are documented the steps we followed for retrieving the relevant literature (see, Figure 1). Since Scopus is one of the most used databases in bibliometric analysis (Giermindl et al., 2021), we started our search in this database. The search string used was:

```
TITLE-ABS-KEY (chatbot*) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
```

This expression includes the word “chatbot” in title, abstract, and keywords. We focused on retrieving academic articles written in English within the Business, Management and Accounting subject area. This criteria is used to obtain a wide range of publications related to chatbots. In sum, this approach gave us the benefit to identify different themes related to chatbots in the literature. From this search, performed in April 2021, we obtained 120 articles.

As this field of study is growing rapidly, we decided to repeat our search after two months and the result in June 2021 gave us 126 articles. Among these, 109 articles were published from 2019 up to now. The former clearly shows that recently the interest on this topic is increasing at a fast pace. Having the ability to go digital and advancements in natural language processing are facilitating the adoption of chatbot for any type of organisation.
A four-step process was followed to filter only relevant studies from the pool of 126 articles. First, we went through the articles to check for duplicates. Since there were no duplicates, we proceeded to the next step. Second, we manually screened the title, keywords, and abstract of all documents, considering their contribution to our research goal. The papers that only mentioned the search terms as an expression or in a general analysis context without a clear focus on chatbots usage in recruitment or higher education were excluded. Next, we excluded publications primarily related to technical aspects of building chatbots, methods, and algorithms following the second step. Also, we excluded papers that examined the use of chatbots in business sectors such as customer service or healthcare. Lastly, we assessed the articles’ quality and eligibility in terms of methodology and results, which resulted in selecting those considered highly relevant for the research purposes. It should be noted that all these steps were performed firstly by the author and secondly by one of the supervisors. Finally, all researchers involved in this research discussed the exclusion of the articles and jointly agreed on the same. Among all the 126 articles, only three papers were selected for further analysis, and one of them was removed due to the impossibility to get the full text (it should be said that we have requested the document directly from the authors, but we never get an answer). So, only two articles were left in the sample.
Since two articles did not suffice to offer a proper discussion on the topic, we expanded our search using the same inclusion/exclusion criteria to the Web of Science database. We managed to retrieve four interesting articles (see, Table 1).
Table 1
Information of the selected articles from Scopus and Web of Science

<table>
<thead>
<tr>
<th>Subject</th>
<th>Article</th>
<th>Authors</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of chatbot in businesses and higher education</td>
<td>Personalization of Student Support Services using Chatbot</td>
<td>Srimathi, H., &amp; Krishnamoorthy, A</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>Artificial intelligence, robotics, advanced technologies, and human resource management: a systematic review</td>
<td>Vrontis, D., Christofi, M., Pereira, V., Tarba, S., Makrides, A., &amp; Trichina, E</td>
<td>2021</td>
</tr>
<tr>
<td></td>
<td>Exploring the Potential of Chatbots in Higher Education: A Preliminary Study</td>
<td>Studente, S., Ellis, S., &amp; Garivaldis, S. F</td>
<td>2020</td>
</tr>
<tr>
<td>Use of chatbot in recruitment</td>
<td>Intelligent recruitment: How to identify, select, and retain talents from around the world using artificial intelligence</td>
<td>Allal-Chérif, O., Aránega, A. Y., &amp; Sánchez, R. C</td>
<td>2021</td>
</tr>
</tbody>
</table>

During the following months and in the attempt to complement the results, the author identified and retrieved more relevant articles using backward search from reading the obtained papers, that is, by reviewing the references of the articles first selected. We limit the publication date from 2017 to 2022, in order to focus on the most recent literature on chatbots and recruitment.

Step 2: Data extraction and coding

A two-step approach was followed to extract the relevant information from the articles included in our final database. First, we created a conceptual map to show the different usages of chatbots in business by considering the articles' keywords and abstracts. Then, we did a content analysis of each of the articles selected by means of a template or review matrix. This was done to ensure that each article was thoroughly analysed and that required information was extracted in a uniform manner. One author mined the data in an Excel worksheet. Later, another author reviewed the worksheet, and mismatches were sorted out. The author categorised the obtained articles into four sections. Based on the research questions, the references are in one of the following sections: 1) E-recruitment and Digital HR; 2) AI, Chatbots, NLP, Human-Robot interaction technologies; 3) Chatbots in recruitment and selection; 4) Chatbots in higher education. We collected more than 70 relevant references from April 2021 to March 2022.
2.2 Google Search

Since there are few scientific articles related to companies using chatbots in the recruitment processes, we decided to expand our search. It is interesting to note that this technology is relatively new and developing rapidly, making it challenging to stay updated. Moreover, according to a Guardian report (2017), the majority of top AI researchers left academia for the business sector; therefore, their knowledge and expertise were not shared with the rest of researchers and society. Thus, we decided to use the Google search engine to identify relevant information on this end. First, a search strategy was applied, then results were screened and assessed in terms of our research objectives, and finally, we synthesised our findings.

Step 1: Retrieving and selecting relevant information

The author applied the search using several keywords related to our research questions. The main search expression that allowed us to retrieve relevant information were as follows:

“chatbots use for recruitment”
“chatbots and hiring”
“chatbots for talent acquisition”
“chatbots for university admission”
“chatbots for higher education”.

These expressions were chosen because they can provide us with different information like the providers and the customers of these services. The outcome of this type of search consists of a huge amount of unstructured data. In fact, the first search term mentioned returned 484,000 results from Google and 3,560 in Google Scholar. Most of the webpages were companies that provide chatbot services for recruitment processes. However, the author found some articles and interesting publications that are among the references of this study.

Step 2: Data extraction

Following the same method for filtering the articles, the author inspected the title, keywords, and the concept of the web pages. In this part, the author focused on the relevant context, such as using AI-enabled applications in recruitment. In particular, the chatbot implication in various recruitment and selection processes was chosen to understand more about the business usage. Next, the reports from well-known consulting firms, chatbot companies, and websites were screened. We conducted more than 25 references from this search, ranging from recruitment-based companies like LinkedIn and Monster to chatbot providers like HireVue and Inbenta. The chatbots developed by Microsoft and Apple are examined to see how they approach human-robot interaction and ethical challenges. Also, some articles that compare various chatbots were inspected, such as research AImultiple and topbots.com website, which provides in-depth analysis of these technologies. From the media, we covered the second season of the MIT Technology Review podcast “In Machines We Trust” which investigates automated hiring practices. Among these reports, we found intriguing case studies about the digital transformation in recruitment and how HRs are utilising chatbots in their processes. The next step was to identify relevant information based on their references to avoid misleading data. Once we gathered all the information, the author analysed and extracted outcomes to minimise the information gaps in this study.
We believe this approach would broaden the perspective in this area by focusing on both academia and practical usage in business. Based on our research questions, a total number of 95 references is used during this study. These results are categorised and shown in our literature review and findings to offer a structured information flow.
3. Literature Review

3.1 The Modernization of Recruitment

In recent years, particularly during the pandemic of Covid-19, remote working, and global diversity are some of the major variables impacting talent acquisition. We witnessed digitalization, AI, and robotics moving forward on a fast track. In response to these breakthroughs, businesses must adopt their strategic approach to acquiring the best employees for open roles based on competency and cultural fit (Majumder & Mondal, 2021). The HR department’s primary purpose is to create successful placements in the recruiting process and hire the most qualified candidate after necessary screening (Walford-Wright & Scott-Jackson, 2018). Thus, we review the transformation of recruitment and talent selection in this section.

According to Black and van Esch (2020), the recruitment process has transformed from Analog recruitment to Digital Recruiting 3.0. After traditional recruiting methods, such as paper-based job advertisements, the internet helped HR evolve and adapt to the world’s needs. In the mid-1990s, when the internet provided digital job boards with detailed job descriptions and spread them widely, the method for searching for jobs transformed, known as Digital recruiting 1.0. The next phase began with the creation of online platforms such as Indeed. In Digital Recruiting 2.0, the job advertisements are categorised based on specific roles the skills. In this period, professional social platforms like LinkedIn were born that helped recruiters to share best practices and find job seekers. From the standpoint of job seekers, these platforms helped them expand their professional network and find desired roles more conveniently. From 2010 to 2015, the age of digital recruiting 3.0 began when AI first entered the HR profession. According to the latest Global Talent Trends from LinkedIn (2022), we are experiencing the Great Reshuffle era, where the challenge for recruiters is to help preserve and evolve their organisation’s culture while hiring at scale. Companies must make sure new hires add to their culture rather than subtract from it.

Several phases within the recruitment and selection process have been identified that AI implications might be useful. For instance, Hmound & Laszlo (2019) discussed the use of AI applications in multiple stages of recruitment. Table 2 introduces the main phases in recruitment with their sub-processes in which AI implications have the potential to be developed. Based on these stages, we will evaluate the use of AI and, in particular, the chatbots’ usage in the following domains.
Table 2

Processes to consider based on each stage of recruitment and selection flow

<table>
<thead>
<tr>
<th>Stage of R&amp;S</th>
<th>Sub Process domains</th>
</tr>
</thead>
</table>
| Sourcing Workforce           | - Posting job vacancy in relevant channels
                                 - Match jobs with applicants
                                 - Address candidates doubts and questions
                                 - Resume information extraction                                           |
| Screening and Shortlisting   | - Classify applicants
                                 - Filter suitable candidates from a large volume of candidate pool
                                 - Assessment of applicants (i.e. personality test, technical test)       |
| Selection and Decision making| - Interview with technical expert and hiring manager
                                 - Predict future performance
                                 - Discover implicit knowledge                                             |
| Offering decision and Onboarding | - Update rejected candidates
                                  - HR allocation to proper positions and projects
                                  - Contract for chosen candidates                                         |

*Note. Adapted from “Will artificial intelligence take over human resources recruitment and selection,” by Hmoud & Laszlo (2019)*

### 3.2 AI Applications in Recruitment

There has been a growth in investment to use AI in a variety of cases, including governance, manufacturing, customer service, finance, healthcare, education, insurance, travel, and communications. In fact, such investment is expected to increase to $77.6 billion in 2022 (Loureiro et al., 2021).

In general, AI is described as a system’s capacity to accurately perceive external input, process the data and learn from it, and after that, apply that knowledge to achieve defined goals (Kaplan & Haenlein, 2019). According to Canhoto and Clear (2020), AI applications have three components in common (see Figure 2). The first of these components is input data, which can be unstructured, such as images, text or conversations, and structured inputs, like transaction data (Paschen, Pitt, & Kietzmann, 2020). The second key AI component is the machine learning (ML) algorithm, the computational procedure that processes the data inputs. The last component, the output, is the decision resulting from the computation process. The result could be a single entity such as a score or a selection for further actions by human analysts. Also, some AI systems have the autonomy to act based on the result, like self-driving.
Figure 2
Key components of an AI solution

Table 3
AI Applications in Recruitment & Selection

<table>
<thead>
<tr>
<th>Stage</th>
<th>Implication of AI tools in R&amp;S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sourcing</td>
<td>Workforce sourcing: Using automated AI to search and extract information from multiple websites like LinkedIn, Glassdoor to accurately propose job advertisements to qualified applicants (Albert, 2019; Kulkarni, &amp; Che, 2019; Ibrahim and Hassan, 2019; Nawaz and Gomez, 2019)</td>
</tr>
<tr>
<td>Assessment</td>
<td>Resume parsing, keywords extraction, scheduling interviews, screening tools, video screening interviews using facial recognition (Li et al., 2021)</td>
</tr>
<tr>
<td>Selection</td>
<td>Analysis of tone of voice, reference check, word choice and sentiment analysis, AI-Powered psychometric testing. (Li et al., 2021; Hemalatha &amp; Kumari, 2021; Mirowska &amp; Mesnet, 2021)</td>
</tr>
</tbody>
</table>
3.3 Chatbots or Conversational Agents: Definition and characteristics

As a manifestation of artificial intelligence, a chatbot is a virtual and autonomous agent that can communicate with humans or other chatbots (Allal-Chérif et al., 2021). These intelligent systems communicate with users in natural language (text and speech) (Jurafsky & Martin, 2020; Adamopoulou et al., 2020). Chatbot development and power are significantly linked to NLP and pre-training the system on large corpora (Roller et al., 2020; Zhou et al., 2020). Chatbots allow involvement through dialogue, which enhances engagement and customisation (Srimathi & Krishnamoorthy, 2019). According to Jurafsky & Martin (2020), chatbots are categorised into two types: 1) Social chatbots also known as chit chatbots, that simulate human-like communication, 2) Task-oriented dialogue agents that make conversation with users to help complete specific tasks.

Nowadays, chatbots can act as digital assistants (e.g., Siri, Alexa, Google Assistant, Cortana, etc.), give directions, control appliances, find stores, make calls, and set reminders. These bots often provide entertainment value, such as Facebook’s Blender-Bot, a neural chatbot capable of engaging, talking, and showing empathy and personality while maintaining a consistent persona (Roller et al., 2020). Another example is Microsoft’s XiaoIce chatbot (Zhou et al., 2020), designed as a companion for humans to satisfy the need for communication, affection, and social belonging for long-term user engagement (see, Figure 3).

Figure 3
A sample translation conversation from the XiaoIce chatbot

1 [Human] What are you doing, XiaoIce?
   [XiaoIce] Feeling bored (thinking: what's up?)
2 [Human] She refused me today.
   [XiaoIce] What a coincidence! Someone also refused me today.
3 [Human] It happened just now.
   [XiaoIce] What did she say?
4 [Human] She is in love with someone else, her schoolmate in college.
   [XiaoIce] Let me see...You're smart, cute and handsome, why not you?
5 [Human] Maybe I should have told her earlier.
   [XiaoIce] So be earlier next time.
6 [Human] Is there a “next time”?
   [XiaoIce] Why not? There is always a “next time”

Note. Adopted from “The design and implementation of xiaoice, an empathetic social chatbot,” Computational Linguistics” Zhou et al., (2020, p. 55)
Recently, business organisations have faced excessive competitiveness and are adopting new technologies to compete in the market (Black & van Esch, 2020). It is interesting to see what industries have seen the most adoption of chatbot technology. Different sectors are bringing AI, particularly chatbots, into their day-to-day business. For instance, E-commerce and retail, healthcare and medicine, finance and banking, recruitment, academia, insurance, and tourism. According to some reports (mentioned below), these sectors use these technologies to enhance compliance systems, customer interfaces, risk management, and investment strategies. For instance, studies show that the e-commerce industry uses chatbots as an emerging form of customer assistance in online retailing (Rese et al., 2020; Leung et al., 2020). Companies have adopted chatbots to facilitate conversational marketing, in which they automate interactions with customers regarding product selection and help them make decisions through the shopping process (Pantano et al., 2020; Iovine et al., 2020).

3.3.1 Chatbots Specifications

Current technological advancement enables the increasing use of chatbots in several domains, such as education, health system, and customer support (Allouch, 2021). According to Kvale and his colleagues (2019), research presented for chatbot development includes, the development of memory to keep chatbot conversational context, using sentiment analysis to understand user feeling, and development of generative chatbots on the basis of machine learning conducted on large dialogue datasets.

As a result, it is critical to have a thorough understanding of how humans interact with chatbots. Because this technology is new to the general public, their expectations may not be fully satisfied (Rapp, 2021). The topics regarding the usage of chatbots found in the literature range from technical issues, like sentiment analysis, to ethical challenges. Apart from developing the needed technologies like Big Data and NLP to create this service, multiple cases also discuss human-to-machine interaction. They range from customer decision, user engagement, and behaviour, pointing to how conversational skill influences perceived social presence and, ultimately, the anthropomorphism of a chatbot.

In the following, chatbots will be investigated from two perspectives technical needs and social considerations arising from human-robot interaction.

3.3.1.1 Technical Requirements

Several researchers have discussed the various technology needs that chatbots must meet to function. Chatbots must be able to perform basic NLP techniques, including tokenization, language detection, named-entity recognition in combination with deep learning concepts (Kvale et al., 2019; Lokman & Ameedeen, 2019). With these methods and techniques, chatbots can create natural language understanding (NLU) models to encode the user's intent and decide how to respond with a dialogue manager component (Allouch et al., 2021). To produce a relevant output, the system uses a natural language generation (NLG) component, which is often modelled in two phases: content planning (what to say), and sentence realisation (how to say it) (Jurafsky & Martin, 2020). The chatbot's design options and social presence can vary depending on the company and recruiting strategy. The design should be user-oriented and matched with the target group's specific information and needs (Schildknecht et al., 2018).
3.3.1.2 Social Aspects

Aside from technical subjects of natural language understanding and generation, excellent chatbots should be aware of human attributes, notice user emotions, give empathy in their replies, and engage the user (Allouche et al., 2021). While much research on chatbot design focuses on enhancing functional performance and accuracy, the literature has continuously emphasised that the interactional goals of chatbots should also include communication skills (Chaves & Gerosa, 2021). Rapp and his colleagues (2021) suggested that chatbots can be assessed in terms of user experience, satisfaction, engagement, and trust to enhance interaction quality. These authors also argued that beyond the linguistic level of human-robot interaction, where people pay attention to grammar, typing, plausibility, and language style, they also value psychological and interactional factors (such as the ability to lie, be humorous, consciousness, originality, manner, and thoroughness). In sync, sociolinguistics and communication studies, for example, have a lot to offer in terms of chatbot design (Chaves & Gerosa, 2021).

Studies show that, viewing the chatbot as having human-like characteristics (such as empathy and self-disclosure) enhances their conversational experience, mostly by encouraging users to feel more “favourable” (in terms of trust, openness, tolerance, and so on) toward the chatbot (Rapp et al., 2021). It is legitimate to conclude that embodied chatbots used in recruitment and selection processes with a sense of humanity can increase candidate experience and satisfaction. One can say that humanising chatbots will improve candidate participation and willingness to apply for the job.
The increment in AI tools and technologies encourages companies to use task-oriented chatbots in the HR sector. Therefore, more companies have started implementing chatbots in their recruitment processes (Majumder & Mondal, 2021). The following sections dive into how chatbots can be used in talent acquisition and recruitment.

### 3.4 Chatbots in Recruitment

In HR departments, AI is involved in job replacement, human-robot collaboration, training, decision making, and recruiting (Vrontis et al., 2021). Companies must set clear objectives and a roadmap for their recruitment strategy to attract applicants. This phase involves a great deal of data and routine administrative tasks, and chatbots can provide multiple opportunities for enhancing the recruiting process steps (Hmound & Laszlo, 2019).

Within the AI tools applied to recruitment, chatbots are gaining importance. Multiple chatbot functionality in Human Capital Management (HCM) has been considered by researchers, including creation and posting the job advertisement, applicant consultation, screening and evaluation of application documents, scheduling interviews, selection, onboarding, training, FAQ system, feedback management and many more (Majumder & Mondal, 2021; Egorov et al., 2018; Nawaz & Gomes, 2019). Firms may employ recruitment chatbots internally and externally (Schildknecht et al., 2018). An example of an internal application scenario would be assisting a hiring manager in creating and managing job postings, and external use is when a chatbot interacts with candidates. Upadhyay and Khandelwal (2018) demonstrate chatbot interaction with job seekers over the internet using different platforms. As they can get in touch with all the candidates and give feedback, they also enable the company’s communication with the unselected applicants. It should be noted that these chatbots are not going to replace the HR people, but they will complement their actions and tasks (Allal-Chérif et al., 2021; Vrontis et al., 2021). In the following paragraphs, considering the challenges, we will break down R&S phases to see how chatbots may be effectively utilised.

#### 3.4.1 Sourcing the workforce

The first stage of hiring process starts with the role description and planning. In the digital recruitment 3.0 era, companies have the opportunity to use various channels to source the workforce (Hmound & Laszlo, 2019). According to Monster’s “Future of Work” report, in 2022, the top pain point for recruiters before the interview is sourcing quality candidates. Intelligently identifying both active and passive job candidates is critical for companies to create the best possible candidate pool (Black & van Esch, 2020). Job advertisements can spread via professional social media platforms or employee referrals to target high skilled candidates. Online job boards and job fairs facilitate increasing the candidates pool globally to aim for the best fitting applicants. A recent New York Times report (2022) argued that hiring managers and recruiters anticipate intense competition for sourcing new talent after the two years of the pandemic. The role description serves as the initial engagement between applicants and companies, which should attract candidates to apply.

Considering that candidates decide to apply for a posted job, they may have more questions about the role, recruitment processes, department, management, company culture, remote working or on-site job location. Organisations can implement chatbots as a form of question
Chatbots in Recruitment

answering system that can be implemented to address repetitive questions from the candidates. From job-seekers perspective, this system allows them to acquire critical information instantly and supports them through the process. Alternatively, recruiters can use the data to improve their postings and understand the needs of candidates and record contact information for follow-up (Nawaz & Gomes, 2019; Schildknecht et al., 2018).

AI algorithms have mostly embedded the hiring platforms to match job profiles with job seekers’ competencies (Hmound & Laszlo, 2019). AI can help firms to increase the pool of applicants, or target only some specific candidates customized to HR goals (Black & van Esch, 2020). Recruitment chatbots can also ask relevant questions to applicants to reduce the number of candidates for screening, thus making chatbots an effective means for pre-screening the applicants (Mohan, 2019). Likewise, chatbots can engage multiple candidates simultaneously and work 24/7, which is useful when a company’s branches are in different time zones (Egorov et al., 2018).

3.4.2 Screening and Shortlisting

The second stage follows candidate applying and entails skimming through resumes and cover letters. This process involves finding applicants who best fulfil required criteria like skills, experience, academic background, and anticipated candidate-organization fit. Additionally, recruiters should be mindful of equality, diversity, and fairness to reviewing and shortlisting qualified candidates (Leong, 2018). Some authors (e.g., Derous & Ryan, 2019) mention the risk of biased decisions and unlawful discrimination in this stage. For instance, Li and his colleagues (2021) noted that in some cases, recruiters’ bias was impacted by name recognition of the institution attended and past roles of candidates as part of the hiring pipeline. However, AI-controlled software that employs diversity management principles can help prevent social bias and increase equal chances for all applicants (Laurim et al., 2021).

In the era of databases and applicant-tracking technology, software systems sort through job candidates before they make their way to recruiters (Beltran, 2022). One of the main reasons is the large number of applications that companies receive. In 2017, Google received 2 million applications for 14,500 jobs (Black & Van Esch, 2020). This shows that it will be impossible for recruiters to spend time and resources checking all resumes in such cases. The first place candidates might find AI in a hiring process is a system that extracts information from resumes. It tries to predict the most successful applicants and sorts those resumes into a pile (Strong, 2021). According to Hmound and Laszlo (2019), these systems utilise data mining techniques to “tide” the data and retrieve meaningful information. These approaches serve four purposes same as machine learning modeling: association, clustering, classification, and prediction.

AI systems can match the CVs that align with the job requirements. There is no mention of analysing the candidates’ cover letters and motivation letters in the literature. However, with the same approach, organisations can utilise chatbots to evaluate those documents which are mostly longer than resumes. This stage is known as the most time-consuming part of the recruitment process in which chatbots are considered intelligent solutions to automate tasks and reduce costs (Hmound & Laszlo, 2019; Nawaz & Gomes, 2019). After sorting resumes, a chatbot can conduct a short audio or video interview. These are one-way interviews where
an algorithm analyzes a job candidate’s word choice, tone of voice, and sometimes even facial expressions (Strong, 2021). Another use case of chatbots is providing support through assessment tests (Hmound & Laszlo, 2019; Nawaz & Gomes, 2019). The reduction in time-to-hire is game-changing for some firms and beneficial for candidates (Black & Van Esch, 2020). The speed to get on board would be much faster; thus, candidates do not need to wait long to get answers from companies.

3.4.3 Selection and Decision making

After shortlisting candidates, third step include technical assessments and cultural interviews to narrow the number of candidates (Black & Van Esch, 2020; Nawaz & Gomes, 2019). A chatbot may be effectively established during this phase for several reasons: scheduling interviews considering empty calendar slots, background checks, and providing immediate feedback (Ergov et al., 2020). Furthermore, the Covid-19 epidemic has increased the frequency of online social contacts, which caused an acceleration in the adoption of AI evaluation for interviews (Mirowska & Mesnet, 2021). Evidence shows that even chatbots can perform the primary interview with the candidates. For example, Unilever asked the top 33% of candidates who completed the game assessments to participate in a video-recorded interview with a chatbot provided by HireVue (Black & Van Esch, 2020). The chatbot asks applicants multiple questions throughout the interview, and candidates submit their recorded responses. The algorithm examined the verbal content of the candidates’ replies and their word choice, tone of voice, physiological reactions, and facial movements and compared them to those of the company’s successful personnel (Mirowska & Mesnet, 2021). The ability for AI-enabled assessment to efficiently score and rank candidates allows HR teams to focus only on those who met the set threshold (Li et al., 2021). Candidates can participate in the virtual interview on any day or time convenient for them within a few days. This saves substantial time for scheduling and gives applicants more significant control over their experience (Black & Van Esch, 2021).

Several studies show that interacting with AI tools can be enjoyable for candidates. Van Esch and his team (2021) discussed that using modern technology through hiring may offer applicants a feeling of confidence and innovation. A systematic assessment powered by AI would eliminate recruiter bias, emotional factors, improve the ability to screen for candidates’ motivation, and evaluate personality and communication style, thus freeing up recruiters for more specialised hires (Li et al., 2021; Hemalatha & Kumari, 2021). To conclude, a chatbot’s ability to be more objective and do tasks with more speed would increase the efficiency of this step (Upadhyay & Khandelwal, 2018; Van Esch et al., 2019).

3.4.4 Final decision: Feedback and Onboarding selected candidates

One of the most repetitive tasks of recruiters is to provide proper feedback to each candidate. A rejection message can impact a candidate’s perspective on the company’s brand. Several authors (e.g., Black & Van Esch, 2020; Nawaz & Gomes, 2019) discussed that chatbots can make the hiring process smooth and positive, even for the vast majority of candidates who are rejected by companies.
The onboarding phase is the final stage in the recruitment process once the applicant has been chosen and satisfies the requirements. It is a process of providing the new employee with the resources needed to become familiar with the organisation, both socially and professionally. The HR team should perform some repetitive tasks in this phase, such as rejecting the unselected applicants, making the final offer to suitable candidates, creating new employee documents, permitting access to several systems and applications. It can be a problematic situation regarding the vast number of candidates. In this case, chatbots can help selected candidates fit into their role and company with a positive experience (Majumder & Mondal, 2021).
4. Findings

Since the pandemic, there has been a surge in the usage of AI-based job interviews. As demand grows, issues regarding whether these algorithms make fair and unbiased hiring judgments arise. Chatbots must be built to enhance candidate selection, to be meaningful. This implies that, on the one hand, chatbots need to have technological characteristics. On the other hand, they ought to adapt to social setting.

Below we discuss our findings regarding chatbot usage within businesses, recruitment processes, and higher education.

4.1 Overview of chatbots usage in the business domain

According to Allouche et al. (2021), chatbots can operate as customer service sales representatives in the business sector or assist users in particular tasks, including driving, trip planning, learning or medical conditions (see Figure 5). Bavaresco and colleagues (2020) showed in their review article that most studies in chatbot implications focus on e-commerce and providing customer care. They also concluded that the most popular purposes of using chatbots are Q&A, customer assistance, customer interaction, and order, demonstrating that services concentrate on the consumer.

4.2 Main companies providing AI services to HR processes

Many vendors in the market are providing AI services for different functions of the business. The first idea of AI-powered chatbots is to automate various tasks in each sector of companies. Following the other departments’ lead of replacing predictable and repetitive tasks, solution providers are searching for innovative methods to develop tools that align with the demands of the modern human resources division. The main significant challenge for hiring professionals is recruitment and talent acquisition (Udas, 2020). According to the table in the Appendix (Table 7), more than 20 companies professionally provide customised chatbot services to various organisations.

There is AllyO from HireVue company among this list that utilises conversational agents by engaging the workforce through website chat boxes, texting, WhatsApp, emails, and voice. The company claims a 90 percent decrease in the time to hire and a 16 percent increase in new-hire diversity, which profoundly helps the HR and talent acquisition teams. Some of their customers are large organisations such as Intel, PwC, Oracle, and Unilever. Based on the HireVue case study, Unilever has deployed the service in over 53 countries in multiple languages with over 80 percent positive feedback from candidates. Unilever has also been over 1 million pounds in savings in just a year, indicating the power of AI services in hiring processes (HireVue, nd).
Figure 5
Conversational-agent applications

Note. Adapted from “Conversational Agents: Goals, Technologies, Vision and Challenges,” by Allouche et al. (2021, p. 5)
L’Oréal adopted a similar approach to assess the receiving 2 million CVs each year. The company uses Mya Systems Chatbot to ask questions, verify qualifications, and respond to job candidates’ queries regarding business culture, policy, and benefits. After initial screening, the chatbot interactively asked applicants three following questions (Sharma, 2018):

1. Tell us about a project that you worked on and failed. What did you learn from that project?
2. Tell us about the project where you were working with the multi-cultural teams, and what experience did you have?
3. Tell us about a situation where you are convinced about your idea, but your seniors were not. How will you convince them?

After this stage, the AI system created the cultural fit ratings by comparing the responses of candidates and L’Oréal employees. This data was sent into the application tracking system, which assisted the 145 global recruiters to interview the candidates and make a final decision (Black & Van Esch, 2020).

Another use of AI systems is utilised by the U.S. Army in the recruitment of future soldiers through an advanced SGT Star AI system that is rumoured to be able to recognize emotions (Kaplan & Haenlein, 2019). SGT Star is an interactive virtual agent that responds to questions, reviews qualifications, and assigns selected candidates to actual human recruiters.

While technology giants (such as the big four Amazon, Apple, Google, and Facebook) provide AI services or specific platforms to develop chatbots, some companies only specialise in Natural Language Understanding and chatbots. For instance, Inbenta provides their AI services built on a deterministic approach: the machine acts according to specific rules exclusively validated by humans, preventing unethical behaviours and abuses. Inbenta creates a set of conversational solutions for businesses such as chatbots, knowledge management tools, and search engines customised for HR Service Automation (Inbenta Team, 2021). In the Appendix, we can see more companies with their stats and their main customers.

### 4.3 The chatbot role in the recruitment process

After our review of both academic literature and business usage of chatbots in R&S, we concluded this part as our findings. The general application of chatbots is enhancing the interaction with the candidates at all recruitment stages. Based on the academic papers and companies’ study cases, we can summarise the chatbots’ role in the recruitment process as in Figure 6.
Once the candidates submit their resumes on the job portal, the AI system starts to parse and match between candidates’ CVs and job descriptions. At this point, the chatbot can explain the next steps and answer candidates’ inquiries regarding the procedure or the company.

If the system finds a requirement gap needed by the company, it can start a conversation with the candidate to get clarification on the issue. These types of initial questions are also known as knockout questions with a binary response (Hu, 2017). For instance, when a job position requires the candidate to have a work permit or driving licence, the chatbot can initiate a conversation with the candidate to request the information needed. To reshape this process, a chatbot can ask open-ended questions rather than immediately rejecting applications when they are answered “no”. For example, suppose candidates do not have the required years of work experience or language knowledge. In that case, the chatbot can collect more information about their skillset or hands-on experience. This approach can reduce the chance of rejecting potential applicants.

Organisations may also use the chatbot to help with evaluations, psychometric testing, and logical gamification. The chatbot can give instructions to complete mini-cases or questionnaires linked to the relevance of job requirements. Likewise, candidates’ applications can be graded by machines based on the words used, the tone of their voice, and, in some
cases, their facial expressions. In these one-way interviews, candidates hear pre-recorded questions and record their responses in a certain amount of time. HireVue is by far the most important participant in this market, with more than a third of the Fortune 100 customers like Unilever, JP Morgan Chase, Delta Air Lines, and Target (Strong, 2021). The system identifies when applicants switch tabs or the amount of time spent for each question in all these cases. This method of assessments and asking open-ended questions to clarify the gap or explain the expertise is similar to phone screening interviews; therefore, it may supplement or replace the phone interview procedure.

In the final stages of the recruitment process, a chatbot can be utilised to schedule meetings, provide the necessary information regarding technical interviews and give feedback to the candidates on whether they are hired or rejected.

### 4.4 Benefits and Limitations of Chatbot Usage in Recruitment

As mentioned before, the adoption of AI technologies can simulate actual work conditions for evaluation and recruitment (Vrontis et al., 2021). In fact, it provides multiple opportunities to enhance the recruiting process steps (i.e., identify, select and retain talented candidates). Several studies (Allal-Chérif et al., 2021; Vrontis et al., 2021) analyse how different forms of AI can contribute to these processes. Below, according to the providers of AI services identified earlier, we discuss the main advantages of using chatbots in the recruitment process.

**Reaching more candidates and improving their experience:**

Organisations can optimise the job application process instead of filling out lengthy forms and emails that take too much time. Chatbots can rapidly answer simple inquiries and interactively collect candidate information, particularly in the early phases of the application process (Koidan, 2020). This allows faster screening and a smooth transition to rank candidates based on the criteria. Therefore, recruiters will have a broader and more robust pool of candidates with a strong user experience improved by chatbot technology, allowing them to find and interact with the top talents more rapidly (Dilmegani, 2020) and (Strazzulla, 2021). Moreover, this method will remove unconscious biases such as gender, nationality, and age. By eliminating human bias in the selection process, companies can thrive in their cultural fit and diversity with new hirings (Altemeyer, 2019; Walford-Wright & Scott-Jackson, 2018).

Based on a Mya report (Mya, n.d.), Adecco implemented their Chatbot for their warehouse, call centre, and manufacturing roles across the US and Canada to improve efficiency, speed, and conversion rates. After adopting the technology, they stated an 89% screen completion rate, a 79% reduction in time to interview, and an attractive 123% increase in recruiter productivity.
**Speeding up the recruitment process with automation:**

A chatbot can perform multiple tasks to improve the automation processes, such as collecting information from candidates (e.g., their cover letter, preferred start date, salary expectations), asking screening questions about the candidates’ experience and knowledge, ranking candidates (on metrics such as qualifications, engagement, or recent activity), answer FAQs about the job and the application process, and schedule an interview with a human recruiter (Cedex Team, 2021). Organizations can collect this information from thousands of candidates at the same time. Over time, the chatbot’s machine learning component will learn which metrics to look for depending on the data it collects and will rate applicants appropriately (Dilmegani, 2020).

In addition, automated screening reduces staffing costs and enhances the efficiency of the hiring process (Upadhyay & Khandelwal, 2018; Nawaz & Gomes, 2019). This ongoing assistance can boost applicants’ involvement and help the organisation develop an innovative image (Strazzulla, 2021).

**Increasing engagement with candidates:**

Nowadays, candidates understand that they might not interact with humans in the recruiting process. In these touchpoints, the value comes from information exchange (Strazzulla, 2021). Chatbots can contact candidates through desirable channels and, for instance, explain the entire recruiting process to them (Koidan, 2020). It can also demonstrate a positive pre-employment attitude from the company side due to technological services (Van Esch et al., 2019). These simple tasks can increase transparency with structured and documented candidate communication (Dilmegani, 2020).

Almost all of the companies providing and using chatbots mention that engagement with candidates increased significantly after implementing the service. For example, S&P Data, which uses the Ideal chatbot, indicates that “before using Ideal, we had a 20% contact rate. Since switching to the chatbot, we now have an 84% contact rate with candidates” (Ideal, n.d.). Some companies like XOR and Mya point out this specific benefit of implementing and using chatbots for their customers (Mya, n.d.; XOR, n.d.).
Although chatbots may offer some benefits for companies, they could also bring some risks to the table. Some companies point out some exciting challenges they need to overcome (Dilmegani, 2020). Below, we are going to offer an overview of those challenges.

**Lack of Empathy**

Although advanced technologies power chatbots, they fail to understand basic cognitive behaviours like emotions, humour, or sarcasm. Chatbots can automate some recruitment processes, but candidates prefer to have customised and personal interactions with a human recruiter (Dilmegani, 2020). Laurim and her team (2021) mentioned that some applicants prefer to answer questions on the phone or in an interview rather than interacting with a chatbot because they stress out that AI focuses on what words they use.

**Language capabilities**

Chatbots need to have strong language perception skills to understand candidates better and treat everyone fairly (Dilmegani, 2020). However, each person has a unique style while conversing, making it difficult for chatbots to respond accurately.

**Decision-making capabilities**

As AI-powered chatbots get trained from data, they sometimes fail short in places where they have to make decisions independently. Even well-known assistants like Siri and Alexa sometimes fail to provide an accurate answer based on the user's questions. A low-quality chatbot may struggle to answer common inquiries or reply improperly. This would be far more damaging to the company brand than depending on traditional communication methods (Dilmegani, 2020).
4.5 Chatbot usage in Recruitment in Higher Education Institutions

Once we have identified the leading providers of AI-chatbot services in HR processes and explained the benefits and challenges organisations face when using them, we explore how higher education institutions (HEIs) can utilise chatbots.

At certain times, every University staff encounters a rush to keep up with information demand. With the rise of e-learning and online education, universities needed to upgrade their services to keep up with remote students. Moreover, Covid-19 caused campuses to shut down physically and forced them to think of a system to attend to students’ questions appropriately and efficiently.

Indeed, some studies have reviewed chatbot usage in academia and mentioned delivering administrative tasks in educational institutions. Hwang et al. (2020) discussed the integration of AI and education and the use of chatbots for administrative issues to enable students to have easy access to information such as admission processes, scholarships, and tuition fees. Some studies have also been dedicated to examining chatbot usage when providing university student services (e.g., Srimathi & Krishnamoorthy, 2019; Kasthuri & Balaji, 2021). They pointed out that students, in the online era, can benefit from chatbots to get the answers to administrative questions or how to install educational software. Nguyen et al. (2021) introduced a chatbot with deep learning models that help prospective students during admission and provide daily course updates. Staff and teachers can form possible questions that can be raised and create respective answers to train the chatbot. Administrators can lean on AI to admit, preserve, and even build relationships with students (Docken, 2021). Indeed, it has been stated that among the new generation, some students may feel more at ease or safer, mainly when dealing with issues that may be affecting their family, like financial aid or paying tuition fees (Page et al., 2017).

Like companies, universities can also use chatbots to recruit the best talents for their professors, post-doctoral and PhD positions. These systems can significantly reduce lecturers’ administrative workload, allowing them to focus on curriculum improvement and research (Cunningham-Nelson et al., 2019). This means that Chatbot service is an innovative approach to improve teaching and learning and all other aspects of education (Okonkwo & Ade-Ibijola, 2021).

To the best of our knowledge, and despite this technology's potential to identify the quality of recruitment in HEIs, few studies directly mention the implications of chatbots usage in their recruitment processes. For instance, Elnozahy et al. (2019) evaluated a conversational agent that can select students for different programs and provide administrative support on orientation, recruitment, and retention.
Part II

A chatbot prototype implementation in recruitment and selection of PhD candidates

“We’re seeing the arrival of conversational robots that can walk in our world. It’s a golden age of invention.”

- David Hanson, Founder & CEO of Hanson Robotics
1. Context

1.1 Introduction

As discussed in the previous part, chatbots are becoming more common in modern culture, serving as vital components of daily lives, from personal assistants on mobile devices to technical help through online communication channels. In this part, we will implement a chatbot to assist prospective PhD students in the doctoral program at UPC. This FAQ bot is designed to support students in gaining information for primary concerns and spare educators from answering the same questions repeatedly. This part is organised as follows: section one motivates our proposal and discusses the related literature. Section two presents the methodology, requirements, and DialogFlow framework which we used to implement the chatbot. In the last section, we conclude and show our results.

1.2 Motivation

These days, most universities use a website to provide the necessary information for prospective students. A university must constantly deliver exceptional value in the area of higher education services to ensure student candidate satisfaction (Santoso et al., 2018). Educators can use web-based information or social media channels to give candidates descriptions of new academic positions. However, this approach may result in a lack of individual support and dissatisfaction among applicants.

Applying current implications in Natural Language Processing (NLP) and Machine Learning (ML) like a chatbot is one viable option for providing students with correct personal responses independent of a professor, time, and place (Wambsganss et al., 2021). This method of interacting also avoids the need to install or switch between additional social network applications (Pérez-Soler et al., 2019).

Following that idea, we offer an implementation of a dialog-based Question and Answering (Q&A) chatbot using Google’s DialogFlow platform and demonstrate its use in creating an innovative service.
2. Related Work

Today, institutes have started designing their own bots to automate their conversations with the students for various purposes. These chatbots act as a guide by helping the users find an accurate response to their queries. Table 4 summarises some recent works on chatbot uses in the higher education sector. As shown in the table below, all these chatbots are developed through a bot implementation platform. This approach would allow non-technical users to develop chatbots through an interface without much programming and integrate the bot into their channel with application programming interfaces (API) (Ch’ng et al., 2019).

**Table 4**

*Summary of chatbot-based literature for higher education purposes*

<table>
<thead>
<tr>
<th>Literature Title</th>
<th>Chatbot Purpose</th>
<th>Implementation Platform</th>
<th>Deployment Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of Chatbot on University Website Using RASA Framework (Fauzia et al., 2021)</td>
<td>Addressing questions about new student admission</td>
<td>Rasa Framework</td>
<td>Website</td>
</tr>
<tr>
<td>Intelligent Assistants in Higher-Education Environments: The FITEBot, a Chatbot for Administrative and Learning Support (Hien et al., 2018)</td>
<td>Provide responses to students’ questions about education system</td>
<td>DialogFlow</td>
<td>Facebook Messenger</td>
</tr>
<tr>
<td>College Enquiry Chatbot using Rasa Framework (Meshram et al., 2021)</td>
<td>Provides response to students’ queries</td>
<td>Rasa Framework</td>
<td>Website</td>
</tr>
<tr>
<td>Preliminary Findings of using Chat-bots as a Course FAQ Tool (Ch’ng et al., 2019)</td>
<td>Handle students’ queries for a compulsory internship course</td>
<td>DialogFlow</td>
<td>Telegram</td>
</tr>
<tr>
<td>Building a Chatbot for Supporting the Admission of Universities (Nguyen et al., 2021)</td>
<td>Support the admission process by automatically answering questions</td>
<td>Rasa Framework</td>
<td>Facebook Messenger</td>
</tr>
<tr>
<td>Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services (Agus Santoso et al., 2018)</td>
<td>Respond to possible university applicants’ concerns prior to admission</td>
<td>DialogFlow</td>
<td>Website</td>
</tr>
<tr>
<td>A TA-Like Chatbot Application: ATOB (Chuaphan et al., 2021)</td>
<td>Helps students with technical issues they encounter in courses</td>
<td>DialogFlow</td>
<td>Website</td>
</tr>
</tbody>
</table>
2.1 Chatbot development platforms

In the following, some of the most popular frameworks to build chatbots are revised. Each framework is built on a separate set of programming languages, dialogue corpses, data models, and training methodologies. They all serve the same objective: to accurately receive messages from users and provide proper responses in a timely manner.

The Microsoft Chatbot (Microsoft Bot Framework, n.d.) enables the creation and deployment of chatbots on websites and social networks. The channel connectors, which link chatbots to message channels, and the BotBuilder SDK, which implements business logic and integrates NL understanding services, are vital components. It provides advanced cognitive services such as image-processing algorithms and service recommendations.

Rasa (Rasa, n.d.) is an open-source framework with two main components: Natural Language Understanding (NLU) and dialogue management. Rasa's open-source nature allows users to tailor it to their own needs and connect to various data sources simultaneously (Nguyen et al., 2021).

The IBM virtual assistant (IBM Watson Assistant, n.d.) enables the creation of conversational interfaces with intents and entities and may be used to train a machine learning model that understands similar NL requests from users. It provides a service for developing apps based on chatbots, although integrating chatbots into social networks is more complicated than with DialogFlow (Pérez-Soler et al., 2019).

In this research, we use the Google DialogFlow chatbot generation platform to synthesise our chatbot. Our choice is prompted by its popularity, high degree of customizability, support for NL processing, and the ability to interface the chatbot with external services (in our case, a website) through a REST API. DialogFlow (Boonstra, 2021) enables uploading JSON chatbot descriptions or csv files in addition to a cloud-based chatbot editor.
3. Methodology

3.1 DialogFlow Framework

Fundamentally, a chatbot is created of two components; User message analysis (NLU) and Response generation (NLG) (Manaswi, 2018). According to Boonstra (2021), when a user submits a query to a chatbot via an intermediary channel like Facebook Messenger, Telegram, or website, the message is routed to the DialogFlow server, where the inquiry is transformed into an object form. It is then sent to an external web server to process the user request and respond to the question in text format. DialogFlow is based on “intents,” which categorises an end user’s intention for one conversation turn (Boonstra 2021) (See figure 7). Each intent contains training phrases, contexts, and responses. Dialogflow will perform intent classification when a user communicates with the chatbot via written text or spoken voice (user utterances). The NLP engine can recognize user utterances even if they are worded differently or have spelling/grammar errors. It will acknowledge the question and match it by verifying all intents added to the DialogFlow agent. When an intent match is found, it will return the intent fulfilment/response. DialogFlow has two default intents: “Fallback,” which asks for clarification when user input does not match pre-defined interns, and “Welcome,” which greets users.
3.2 Prototype Implementation

Our chatbot is trained based on the information provided by the staff on the doctoral program’s official website. The author shaped the data as a question-and-answer dataset to feed the conversational agent. We estimated a total of 57 queries that are most likely to be asked by prospective students regarding the doctoral program. These questions are categorised into 13 segments (e.g., requirements, contact, duration) based on the areas to be addressed by the chatbot (See Appendix, Table 8). Each of these categories forms the “intents” or the purpose of the student’s questions, while all related questions shape the “training phrases” for the chatbot (Figure 8). The answers for each query are provided based on the official website information, which is matched to the intents. In DialogFlow, these responses are inputted as “Text response” values.
3.3 Assessment of the prototype

After preparing the prototype, we implemented it through a web demo and Telegram channel. The web demo can only be accessed through a desktop computer, and the Telegram bot can be connected via the app. An example of the interface of the web demo can be seen in Figure 9.
To assess the chatbot, a survey was conducted to collect feedback on master’s and PhD students’ perceptions of using it. The survey was reviewed for validation by the supervisors. The framework of this approach is adapted from the TAM proposed by Davis (1985). Among models to examine users’ attitudes towards technology acceptance, TAM is the most widely used theoretical framework in the literature (Li et al., 2022). This hypothesis investigates the impact of contemporary technological advancements and their impact on user behaviours and attitudes (Pookulangara et al., 2021). TAM considers Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) as two critical factors regarding users’ acceptance of new technology. PEOU is the degree to which a person feels that using a specific system would be easy. PU is the extent to which users perceive that technology would improve their job performance. In our case, the two other factors were also applied in the survey as Perceived Enjoyment (PEnj) and at last the Intention to use (ITU).

3.3.1 Experiment and Testing

When the supervisors approved the assessment model, the author provided participants with a short description of the chatbot product and usage instructions. Next, participants were invited to interact with the bot and fill out an online survey through Google form. The survey scheme is provided in the Appendix. The survey consists of ten questions based on the TAM model and general impressions (Table 5). The responses were measured on a seven Likert
scale rate from 1 = strongly agree to 7 = strongly disagree. The questionnaire was provided for the PhD and master’s students in UPC to collect feedback. The instruction to complete the survey was provided at the beginning. After reading the instructions, participants were asked to chat with the bot and complete the questionnaire.

Table 5
Constructs and questions in the survey

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
<td>My interaction with this chatbot is clear &amp; understandable.</td>
</tr>
<tr>
<td></td>
<td>Learning to use this chatbot is easy for me.</td>
</tr>
<tr>
<td></td>
<td>I find this chatbot easy to use.</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>Using this chatbot would enable me to find information more quickly.</td>
</tr>
<tr>
<td></td>
<td>Using this chatbot would improve my search performance.</td>
</tr>
<tr>
<td></td>
<td>I find this chatbot useful to answer my queries.</td>
</tr>
<tr>
<td>Perceived Enjoyment (PEnj)</td>
<td>I like to use this system to get my answers.</td>
</tr>
<tr>
<td>Intention to use (ITU)</td>
<td>I intend to use this chatbot to get my answers.</td>
</tr>
<tr>
<td>General Open Ended</td>
<td>According to your knowledge, did the bot seem adequate to you and correct about facts?</td>
</tr>
<tr>
<td></td>
<td>Please, describe your overall impression from talking to the bot.</td>
</tr>
</tbody>
</table>

Note. Adapted from (Shrestha et al., 2019)
4. Result

In this part, we present the collected data with a brief analysis. There were 19 participants who contacted the chatbot and completed the survey. Among them, there were eight PhD and eleven master’s students. The conversation logs had more than 230 entries, showing that each participant had asked more than ten questions on average to interact with the bot. In total, 14 conversations were through the web demo, and 5 participants chose the Telegram channel.

As the first eight answers were measured on a seven Likert scale, we tabulated each response based on the constructs (See Table 6). Then, we categorized them into percentage values to assess the score for each construct. Figure 7 shows the percentage value of each construct on the seven levels. According to the result, most of the factors show a positive impact of the chatbot prototype. We see that the PEOU factor has a high rate regarding the ease of use of this bot. In terms of PU and PEnj, it is clear that the majority of participants found the system helpful and enjoyed their interaction with the chatbot. It is notable that more than 50 percent of the respondents mentioned that they intend to use this system to get their answers.

Table 6
Result of the questionnaire responses

<table>
<thead>
<tr>
<th>Response</th>
<th>PEOU</th>
<th>PU</th>
<th>PEnj</th>
<th>ITU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>25</td>
<td>15</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Agree</td>
<td>20</td>
<td>19</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Slightly agree</td>
<td>6</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Neutral</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Slightly disagree</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>57</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>
4.1 Discussion of findings

This experiment aimed to understand students’ capability and intention to use a chatbot using an adapted TAM approach. We received interesting ideas from the two open-ended questions at the end of the survey. Most of the participants found the bot adequate and enjoyed the idea and the technology behind this prototype. They also provided notable suggestions to improve the bot for the future. For instance, one of the participants mentioned that “The bot is quite accurate. It gave me the information I was looking for, and the response was super fast. I think implementing this chatbot would save time for professionals because they don’t need to answer emails/requests from candidates and it would give support to PhD candidates. It would also push candidates to apply because they would be impressed by chatbots’ efficiency.”

Some others noted usable features for improving the user experience. There were ideas about changing the bot’s name, implementing an entire registration process through the chatbot, connecting to a database for updated information, or adding clickable links. In Figure 11 a word cloud is made based on the answers provided for the last two questions. This figure visualises the 150 most used words, showing their frequency with font size.
All of these suggestions are a starting point for developing and extending the chatbot for future uses. In general, the results suggest that the system's usefulness will influence users’ perception of the chatbot as new technology. The findings support earlier research that evaluated technology adoption and stated that PEOU and PU had a favourable impact on the intention to use technology such as online sizing technology (Pookulangara et al., 2021), VR technology (Li et al., 2022), and chatbot-based consumer service (Ashfaq et al., 2020).
Part III

Lessons learned from this study
1. Conclusions & Discussion

The increasing demand for efficiency in companies and modern digital technologies are glowing in a new era of recruitment. Digital recruitment is continuously evolving; thus, hiring professionals need to modify their approaches and learn how to utilise modern tools (Allal-Chérif et al., 2021). AI-enabled recruitment tools can go beyond the traditional processes and understand possible behaviours regarding job fit and soft skills while being more objective and less biased than humans (Vrontis et al., 2021).

Therefore, organisations are expected to deploy AI (Chatbot) increasingly to make evidence-based decisions in their recruitment processes. In all these processes recruitment chatbot will act as an assistant who is responsive 24/7, takes care of most repetitive tasks, and offers an exciting experience. This technology provides a positive, dynamic and innovative picture of the company. However, there are arguments about acquiring and proceeding with candidates' data that raise issues of privacy and ethical challenges.

According to our findings, the technologies used to implement chatbots are becoming more accessible to all organisations. This makes it possible for the HR departments to consider a larger pool of candidates because each individual becomes a potential recruit, even without actively searching for new roles. In the post-Covid era, companies have the ability to use this technology to interact more easily with the candidates and bring a remote engagement which would be beneficial for both parties. While companies can improve hiring diversity, increase candidates' retention rate and make the recruitment process more enjoyable, there are some challenges to consider when implementing a chatbot. We can advise organisations to bear in mind that chatbots' technical requirements and social communication come as critical points. Their chatbot needs to be trained on extensive data to have the ability to answer a wide range of questions. Having the ability to adapt and learn from past conversations is one of the most remarkable capabilities of chatbots. On the other hand, since interviews can be stressful for candidates, chatbots ought to provide empathy and support through this process.

Also, in the higher education sector, the use of chatbots can significantly facilitate recruitment processes in order to attract the best-fitting candidates for all post-secondary education stages. Educators can benefit from enabling a chatbot in their recruitment process by considering candidates' needs. A chatbot can serve candidates with updated data regarding the application process, support them in gathering their documents and show their results customised to professors' perspectives. From the literature and our case, we clearly observe that an innovative service like a chatbot would bring enjoyment to the new generation of prospective students. Therefore, academia can use these AI-enabled tools to provide a modern and different experience to attract candidates.

In the second part of this thesis, we successfully presented the design and creation of a chatbot prototype to address prospective PhD students' queries. The chatbot was built on the Google DialogFlow platform and was deployed on a web demo and Telegram with instructions on how to use it. A survey based on the TAM framework was conducted to understand the users' intention to use this new technology. The responses were analysed, and they can be a good starting point for further development of the chatbot. Results of the questionnaire proved that a chatbot has the potential to be a viable tool to provide information for the students and save educators the time to answer repeated questions. A
chatbot can enable professors to implement an interactive mechanism and react to frequently asked questions in a modern form.

Considering the gathered information, we evidently noticed that this type of service has the potential to become mainstream in the near future for all businesses who need recruitment. The AI is going towards anticipating the human need and developing a system of proactive outreach.
2. Future Work and Limitations

This thesis covered various aspects of state-of-the-art technologies utilised in the recruitment and selection sector. The main focus was on why and how to use AI applications to facilitate the recruitment process for both HR professionals and candidates. We provided a foundation study for research directions of AI chatbots in recruitment and higher education institutions.

While this study delivered meaningful insights, it reflects possible limitations. First, since this thesis primarily focused on using chatbots in recruiting, literature on in-depth HR professions was excluded. When integrating technology with business sectors, both areas must be comprehensively evaluated. Hence, the findings need to be validated for future research involving hiring experts in order to get a complete view of chatbot utilisation. Secondly, because the emphasis of this study was on texting chatbots, the literature on voice-based conversational agents was excluded. Further study is necessary to focus on limitations to improve the resilience of chatbots to meet organisational demands.

Regarding the chatbot development for any organisation, the challenges would be related to training the bot and continuous refinement. New data for training the chatbot will enhance the quality of NLU and dialogue management. Chatbots can provide responses exclusively if the data is already available. The lack of historical data leads to the limitation of proper answers and the performance of chatbots. Therefore, the dataset (intents) should be refined based on candidates’ questions. This ongoing review and optimisation would be a drawback for recruitment chatbots at the early stages of implementation. Another point to consider for future work is to make a multi-lingual bot that is able to interact in many languages. It can also recognise the users’ voices and respond with text-to-speech capabilities.

In our case, with four universities and multiple professors involved in a program, the chatbot can go further to guide students with personalised responses to help them find the proper educators in their field of interest. Professors can benefit from this type of interaction to create criteria to attract suitable candidates for their open positions. The chatbot can act as a recommender system for research areas and professors based on the criteria and students’ profiles.

It is notable to conclude that chatbots are not intended to be a solitary channel for communication. Instead, they should be employed as a support method to deal with a large number of candidates with 24/7 accessibility, mainly when there is a lack of human resources. While chatbots need low maintenance, they still require monitoring, training, and support. Our prototype demonstrates some potential uses for chatbots in this era, as well as opportunities for both academics and developers to conduct more profound research in this area.
3. Budget summary

The final total hours to complete this thesis was 1540 hours and the total budget was 20265 Euro. The detailed information is located in the budget summary document.
4. Analysis and assessment of environmental and social implications

This master thesis was conducted based on software use and the internet. The only environmental implication would be related to the use of electricity for a computer which is not significant. Social implications are also not related to the thesis, since the study is focused on specific processes in recruitment and selection for businesses and higher education institutions.
5. References


## Appendix

### Table 7

<table>
<thead>
<tr>
<th>ID</th>
<th>Chatbot Name</th>
<th>Company Name</th>
<th>Weblink</th>
<th>Type of Customers</th>
<th>Customers</th>
<th>Stats &amp; Extra</th>
<th>Co. Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Olivia</td>
<td>Paradox</td>
<td><a href="https://www.paradox.ai/">https://www.paradox.ai/</a></td>
<td>large organizations</td>
<td>Mcdonald’s, Unilever, Disney, Nestle, Aramark, CVS Health</td>
<td>Their founding team has been in HRTech forever and has built everything from job boards in the 90s to recruitment marketing software in the 00s and now chatbots.</td>
<td>USA</td>
</tr>
<tr>
<td>2</td>
<td>XOR</td>
<td>XOR</td>
<td><a href="https://www.xor.ai/">https://www.xor.ai/</a></td>
<td>large organizations</td>
<td>ExxonMobil, Ikea, Heineken, Aldi, McDonald’s, Mars, Manpower, Sutter Health, and UC Davis</td>
<td>33% faster time-to-hire 50% lower hiring costs 90% net promoter score from candidates</td>
<td>USA</td>
</tr>
<tr>
<td>3</td>
<td>Mya</td>
<td>Mya System</td>
<td><a href="https://www.myacom">https://www.myacom</a> /</td>
<td>large organizations</td>
<td>L’Oréal, Adecco, Advantage Solutions, Deloitte, HAYS, PepsiCo, Sevenstep, Comfort Keepers</td>
<td>40 clients among the Fortune 500 company list 5x increase in funnel conversion At L’Oréal, they helped reduce the average time spent per applicant by 40 minutes.</td>
<td>USA</td>
</tr>
<tr>
<td>4</td>
<td>AllyO</td>
<td>HireVue</td>
<td><a href="https://www.hirevue.com/">https://www.hirevue.com/</a></td>
<td>large organizations</td>
<td>Intel, Honeywell, Randstad, Boston Red Sox, Unilever, Anixter International, Vodafone, PwC, Oracle</td>
<td>Unilever deployed HireVue AI-driven assessments and achieved £1M annual cost savings, a 90% reduction in hiring time, and a 16% increase in diversity in hiring. Along with voice and facial recognition software, HireVue has a proprietary algorithm to determine which candidates are ideal for a specific job by analyzing their vocabulary, speech patterns, body language, tone, and facial expressions.</td>
<td>USA &amp; Canada</td>
</tr>
<tr>
<td>5</td>
<td>Nuance</td>
<td>Nuance</td>
<td><a href="https://www.nuance.com/">https://www.nuance.com/</a></td>
<td>large organizations</td>
<td>Coca Cola, ING Netherlands, Medical Institutes</td>
<td>Nuance serve Fortune 2500 companies across the globe with a mix of direct and channel partner selling models. Nuance ensures that any virtual assistants and chatbots created in their platform can be deployed to all tracks, including IVR, mobile, web, smart speakers, messaging and social media messaging channels.</td>
<td>USA</td>
</tr>
<tr>
<td></td>
<td>Company Name</td>
<td>Industry</td>
<td>Link</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SmashFlyX Symphony Talent</td>
<td>All sizes</td>
<td><a href="https://www.symphonytalent.com/">https://www.symphonytalent.com/</a></td>
<td>Dick's Sporting Goods, FCA, Rio Tinto, Mars. SmashFly was used by more than 600 customers worldwide. They helped Dick's Sporting Goods achieve an 80% reduction in cost per applicant.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Wade &amp; Wendy</td>
<td>Job seekers, large recruiting teams within companies, and recruitment agencies.</td>
<td><a href="https://wade-andwendy.ai/">https://wade-andwendy.ai/</a></td>
<td>Randstad, Comcast, E-Trade, Financial Corporation, Equitable. To achieve the best performance for their conversational system, NLP data scientists at Wade &amp; Wendy experimented with cutting-edge models, including BERT and XLNet.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Ideal</td>
<td>high-volume hiring in any industry</td>
<td><a href="https://ideal.com/">https://ideal.com/</a></td>
<td>Bell, Dish, Staples, Novant Health, Purolator, S&amp;P data, Indigo. Increased retention rates by 20%.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Inbenta</td>
<td>all company sizes</td>
<td><a href="https://www.inbenta.com">https://www.inbenta.com</a></td>
<td>Groupon, DocuSign, Skyscanner, BBVA, Sabadell Bank, El corte Inglés. 200+ customers. 1 million user questions answered everyday. 8 offices around the world.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Brazen</td>
<td>large organizations</td>
<td><a href="https://www.brazen.com/">https://www.brazen.com/</a></td>
<td>CVS Health, Amazon, KPMG, Deloitte, UPS, American Airlines, Google. Their bot engages 40% more career site visitors than just asking candidates to apply. Founded in 2007. $13.4 million in funding.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Arya Leoforce</td>
<td>all company sizes</td>
<td><a href="https://goarya.com">https://goarya.com</a></td>
<td>Lenovo, American Century Investments, PeopleScout, Ecotalent, Polaris Alpha. 10,000+ clients. 40 million candidates sourced. Over 50 professional social channels for sourcing. Championed by 6,000 recruiters globally.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Humanly</td>
<td>mid-market companies</td>
<td><a href="https://humanly.io">https://humanly.io</a></td>
<td>Swiss Monkey, Armoire, Tiny Pulse, Oakland Roots, and BPM. 60 hours saved in scheduling and screening for each open job. 95% of references complete background checks within 48 hours.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Eightfold</td>
<td>large organizations</td>
<td><a href="https://eightfold.ai">https://eightfold.ai</a></td>
<td>Air Asia, Capital One, Mercado Libre, Tata Communications, Booking.com, Bayer. Eightfold is currently valued between $500M and $1B. At Ui Path, their product increased the number of positions filled per recruiter every quarter by 50%.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service Provider</td>
<td>URL</td>
<td>Application</td>
<td>Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>-----</td>
<td>-------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>iCIMS Digital Assistant (formerly ARI)</td>
<td>iCIMS</td>
<td>all company sizes</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Mainstay (AdmitHub)</td>
<td>Mainstay (AdmitHub)</td>
<td>Universities &amp; Colleges</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Mongoose Harmony</td>
<td>Drift</td>
<td>Universities &amp; Colleges</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>QnABot</td>
<td>Amazon</td>
<td>Universities &amp; Colleges</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Watson</td>
<td>IBM</td>
<td>All organizations</td>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 8
*FAQ dataset to train the chatbot*

<table>
<thead>
<tr>
<th>Intent-ID</th>
<th>Intent-Name</th>
<th>Query</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Admitted</td>
<td>What will happen after admission?</td>
<td>Once you are admitted, the Academic Committee will assign you a tutor from the academic staff of the programme. You will register in the university of your tutor.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Which university will I be registered?</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Where can I study the program?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regulations</td>
<td>what are the regulations of doctoral in Spain?</td>
<td>Links to regulations (available in PDF): <a href="https://management-phd.eu/the-phd-in-our-programme/">https://management-phd.eu/the-phd-in-our-programme/</a></td>
</tr>
<tr>
<td>3</td>
<td>Duration</td>
<td>how long is the phd?</td>
<td>The ordinary period to complete the doctoral thesis is three years full-time, or five years part-time. Learn here about the yearly assessment process of PhD candidates on the programme.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>What is the duration of program?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>is the phd full-time or part-time?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Training</td>
<td>does the program need training?</td>
<td>The Academic Committee may establish for some students the obligation to carry out training complements considered appropriate for his/her success in the programme.</td>
</tr>
<tr>
<td>5</td>
<td>Apply</td>
<td>how can I register?</td>
<td>To apply for the programme, the candidate must submit the documentation at <a href="https://management-phd.eu/admission-application/">https://management-phd.eu/admission-application/</a></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>how is the admission process?</td>
<td>Before submitting your application, you are suggested to contact a prospective supervisor aligned with your research interests.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>What do I need to apply?</td>
<td>In the admission application section you can find the documents required for the admission application, and the current calendar for admission applications.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>where can I register?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>How can I apply?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Documents</td>
<td>do I need English certificate?</td>
<td>Candidate must submit the following documentation: 1- Cover letter, 2- CV, 3- English Certification, 4- Academic or research work. More info at <a href="https://management-phd.eu/admission-application/">https://management-phd.eu/admission-application/</a></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>what documents are needed?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>what are the requirements?</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Deadline</td>
<td>when is the deadline to apply?</td>
<td>The application dates for the 2022/2023 course will be announced on December 2021.</td>
</tr>
<tr>
<td>8</td>
<td>Contact</td>
<td>you are not able to help me</td>
<td>You can send us message from <a href="https://management-phd.eu/contact/">https://management-phd.eu/contact/</a></td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>you can’t answer my question</td>
<td>You can get in touch for more information through <a href="https://management-phd.eu/contact/">https://management-phd.eu/contact/</a></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I need human assistant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I’m having trouble to apply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I’m having trouble finding a supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>who can I contact for more information?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>what is the program’s email?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>get_started</td>
<td>what is this program?</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I want to know about phd doctoral</td>
<td>This doctoral is an inter-university programme, four leading Spanish universities join efforts to train researchers in the fields of management and business administration.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I want to know about phd doctoral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>what is this doctoral?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>is this a phd program?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>start</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>how can you help me?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>what is this site?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Supervisors</td>
<td>what are the research areas?</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>in which fields of management and business administration members re-</td>
<td>The faculty of our programme is actively engaged in cutting-edge research on a wide range of fields of management and business administration. You can find information about research activities in this link: <a href="https://management-phd.eu/thesis-supervisors/">https://management-phd.eu/thesis-supervisors/</a></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>search?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>who is the thesis supervisor?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Who are the faculty members?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>which professors participate?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>what are the specialisations of phd?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>what are the fields of phd?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>who is the academic committee?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admin</td>
<td>Coordinator</td>
<td>Funding</td>
</tr>
<tr>
<td>---</td>
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<td>---------</td>
</tr>
<tr>
<td>11</td>
<td>who is the administrative?</td>
<td>The administrative officer of this program is Nuria Góngora Mora</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>who is the coordinator?</td>
<td>The academic coordinator of this program is Jose María Sallán Leyes</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>does the program provide funding?</td>
<td>Regarding the funding options and tuition fee, you can contact the program administrator.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>is it a paid program?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>is funding available?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>how much is the tuition fee?</td>
<td></td>
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</tr>
</tbody>
</table>
Chatbot Prototype Survey

Thank you for taking part in the test of my chatbot for the master thesis!

The survey is about a chatbot which can be a supplementary channel for this website: https://management-phd.eu/. The purpose of this chatbot is to help future PhD candidates to know more about the doctoral program by asking questions about the program, duration, deadlines, documents, applications, supervisors, fundings, admins, research topics, contact details and etc.

Here's the step-by-step procedure:

1) Launch the chatbot on web demo by following this link: https://bot.dialogflow.com/ff52c2dd-76fa-4db4-99d6-a2db729d0a99 or through Telegram: https://t.me/Barc_Tech_bot

Note. Web demo can only accessed through a desktop computer.

Please, find out the following information while casually talking to the bot.

Note. Ask open questions and place all the information in one sentence.

For example:

- registration... Do you know where? I want to apply ✗
- How can I apply? ✓
- So, how's timing? How much left for applying? ✗
- When is the deadline to apply? ✓

Note. You can have small talk with the bot (try it!), just bear in mind that the bot is pretty simple at the moment and is designed to answer general questions.

Note. You may receive paraphrased responses for the same question.

3) Fill in this form with your results.

Note. At the end of the form you will see two questions about your general experience. Please, fill them in, too.