

Callbar Simulator Frontend

Diogo Pedro Barreira Lopes
diogo.barreira.lopes@tecnico.ulisboa.pt

Instituto Superior Técnico, Lisboa, Portugal

October 2019

Abstract

This thesis is inserted in the context of the IST-SCOPE project for the Master Thesis in Information Systems and Computer Engineering. It is a partnership between IST, FBA and Talkdesk where we develop a product for the company in a team. Our group project consists in a real case simulation of Talkdesk's product (Callbar version) through a visual and interactive interface taking into account several concepts that are analysed in the real world like concurrency, scalability and simulate behaviour when possible. My personal main contribute and responsibility was the development of the front-end of the interface.

This document covers the IST-SCOPE project as well as the entities involved (IST, FBA, Talkdesk), the team and the phases of development of the group project but explaining in more detail my personal contribute – front-end development.

Keywords: Callbar Simulator, Project, User Interface, Team, Research.

1. Introduction

The evolution of education in engineering schools has sought to bring the experience of students closer to the needs and challenges of the labor market. There are two main concepts that contribute for this new academic approach and this kind of projects – the interdisciplinary approach to solve even more complex problems and the approach to highly competitive global markets. These needs in the current days of academic research especially in engineering schools directly link to the main scope and goal of the developed project described in this thesis document.

My contribution was part of a team work and the result was a product – Callbar Simulator. The project is a Capstone Project inserted in IST-SCOPE.

The developed work is an automated simulator that offers a visual and interactive interface that we consider as a product and we intended to simulate the use of a target company's product – Callbar new version – from the company Talkdesk through a visual and interactive interface. My main personal contribute was the development of the front-end of the simulator.

IST-SCOPE is a project included in an innovative pedagogical new project taking place at IST's master projects. The project is developed by a group of students from different courses making it a multidisciplinary team. This innovative project aims to approach student experiences and studies to the enterprise world and to fulfill companies

needs. This way the companies get actual real complex engineering problems solved by interdisciplinary teams of students who acquire business competences as well as soft skills and increased tech stack. The main goal of this new academic model is to provide to the students ways and real tools to interact with the professional market and to give them options to do the thesis besides the traditional method.

The work is developed through an academic group (team) of dissertation and project students further discussed in this thesis in order to achieve a common goal satisfying both worlds – academic and enterprise – solving real problems posed by companies in a practical way. With this approach, not only I was able to work with my other three colleagues but also with the target company – Talkdesk – making sure that the academic side and research of the project fulfils the thesis requirements for this innovative academic project thesis.

IST-SCOPE follows the model of a Capstone project.

One aspect of this project is that when it started, it was a completely blank page. Initially we were just a group of four students supervised by some professors with a target company – Talkdesk. No project, no specific goal, nothing more as opposed to the traditional thesis model which usually has an objective and detailed description of the dissertation project, study and its goals.

In order to build up the project bases and the scope of the project and to come up with an ob-

jective description of the project, we (team) had to meet with the target company to meet each other, understand its values, strengths and weaknesses so we could propose to develop or improve a project, product or service and then establish a bridge with the academic world to make the thesis. The project description was a work in progress and therefore the scope of the project suffered some changes throughout the time due to company requirements, academic expectations and external constraints and limitations.

The entities that were considered in this project were the ones with human assets directly related to the project – IST (Instituto Superior Técnico) with both students and professors, FBA (Faculdade de Belas Artes) also with a student and professors, Talkdesk that was the target company and had target employees too.

2. Motivation

Unlike the traditional thesis model and common dissertation researches, this capstone model incentives a more practical research in close relation with the various entities, especially the targeted company through meetings and other procedures.

Talkdesk was created in 2011 by Tiago Paiva (current CEO) and Cristina Fonseca. It is a cloud-based contact center software provider in the digital industry of SaaS. Its headquarters are based in San Francisco and there are offices in the cities of London, Lisbon, Porto, Coimbra, Aveiro, Madrid and South Lake City. Lisbon office was our main meeting point both with Talkdesk staff and for the product development as well.

Both Tiago Paiva and Cristina Fonseca are alumni of IST and they realized that the paradigm of contact centers was outdated and Talkdesk emerged from a contest hosted by a company named Twilio in which they created a first version of Talkdesk using Twilio API in ten days. Then the startup was created and since those days, Talkdesk has been increasing its visibility, dimension and profit at an impressive rate.

Since the beginning of this project (September 2018) Talkdesk became a Unicorn and expanded its resources and investment. Its products and services have nowadays acknowledged quality and not only the company is the youngest CCaaS to be included in the Gartner MQ report but it also has at the moment one of the highest customer satisfaction scores according to G2 Grid.

The main goal of the capstone project is to increase value and improve some needs of the company and improving the quality of its products and services is the right way to achieve success. Therefore our attention focused on the company's products and services since the beginning of the

project.

There are many features in Talkdesk's online contact center such as AI, automation, digital channels, reporting, analytics, management, integrations, voice, text and user experience. All these services get frequent changes and new versions come up regularly so the overall product is up-to-date with real-world requirements and customer expectations – so new versions of each service, product or feature require testing and analysis which is very useful and one focus of capstone projects which got our team's attention.

In Talkdesk, new features, services and products are developed and new versions created in a fast pace and at the date of our research and beginning of our project the main platform services we choose to work on, focus and propose value are described below:

Real-Time Events - Automated processes by subscribing to real-time contact center events. Our project must fulfil these requirements and allow messages and events to flow in real-time to the interface simulator enabling visualization also in real-time.

Call Activity - All activity regarding agents and customers calls – very suited to test scalability and concurrency.

Agent Activity - Each agent (mostly human) has a presence tag according to his availability (occupied, available, after task work, temporarily unavailable, etc). A presence system is very important in a real time service and in our project we consider this agent abstraction in the notion of device which has a unique state. So we considered each device to behave as an agent.

Callbar - Callbar is the main product of Talkdesk that we studied and it was the main focus of our project. It is the application that allows to receive and make calls to anywhere in the desktop and mobile phones increasing agent efficiency with web-based agent experience without even having the browser open. It requires no configuration thus it is easy and simple to use and to deploy on big companies with several workstations. One of the features that make a huge advantage is the fact that it integrates with several CRM's and external applications. This feature allows to access information that is stored in those CRM and add it to the Callbar to ease the process of searching for that information. Some of the features present in this application are: inbound and outbound calls, transferring calls between

agents, record the call and see contact information beforehand.

At the beginning of our project research, after meeting with Talkdesk employees our capstone goal and scope was to test a new version of Callbar with some more features and changes that should have been finished in the meantime.

Talkdesk aims to empower companies continuously improving their customer experience and satisfaction with quality, reliability and security providing a cloud based contact center with enterprise-class performance and consumer-like experience allowing the service to adapt to the customers' expectations and team work flows increasing customer satisfaction, productivity and therefore profit.

"In addition to features and scalability, Talkdesk provides solid security and customer support." – Talkdesk team.

Talkdesk's customers are the product consumers and as it is a contact center they expect quick and personalized service constantly. Whether serving patients, policyholders, students or shoppers, it is essential a comprehensive and fully integrated contact center solution. This solution helps clients accelerate business processes, increasing performance and customer experience through a cloud-based AI driven compilation of applications. Their customers have different needs and scales from a small company or team with just a few employees to a colossal multi-national enterprise with tens of thousands of professionals with different devices all accessing Talkdesk's product at the same time and interchanging messages being voice or text.

Besides the common needs all companies have, especially tech companies, some aspects that Talkdesk tries to improve are: Global Communications Network (GCN); Global Low Latency (GLL); Browser Communications Backup Plan (BCBP); Service Level Agreement (SLA); Enterprise-Class Security; Trust and Reliability; Real-Time Updates.

Capstone projects are usually a two semester project at the end of the course and before entering the market place where students must work in group and independently research a topic. These assignments take significant planning to complete and the main objective is to challenge students to carry out a research and develop a project over a continued period of time for the students not only acquire knowledge but in the case of IST-SCOPE also assist a real company in some matter to be

decided. These paradigm of projects encourage students to develop their hard skills in their specialization field but also their soft skills like critical thinking, problem-solving engineering challenges, research, presentations and oral communication, document writing, teamwork and connecting students, academy and companies as well.

A generic guideline for a Capstone project model (especially following IST-SCOPE) is:

1. Choose a target company and supervisor professor;
2. Meet the team – other group colleagues for the same capstone project;
3. Get to know the company – values, product, service, philosophy, needs, strengths and weaknesses;
4. Formulate a topic and a project proposal;
5. Build the foundations of the project – related work, investigation and research over theoretical and practical aspects;
6. Present the research findings and formulate a scope for practical development (or even dissertation) project;
7. Work in close relation between school and company.
8. Finally deliver and present the product or documents (project, code, reports, videos, presentations, papers, websites, etc) to the target company and to school.

The project was developed in group and all the four members contributed equally in terms of time and effort to the project work. All of us tried to be part of every stage of the project giving our personal input and learning things that may be off of our specific scope, for example me giving my opinion on design subjects and conducting user research interviews with users. Nevertheless, each member adjusted its efforts and responsibilities according to the personal interests, expertise and academic field. In general, the software developers were responsible for the development of front-end and back-end of the application, the designer member was responsible for the creation and visualization aspects of the user interface and the project manager had the responsibility of the team's planning and results analysis resulting from the application project. My personal contribution towards this project was weighed in both time and effort invested both in the project research and development.

The front-end development of the Callbar Simulator was my main contribution for the project

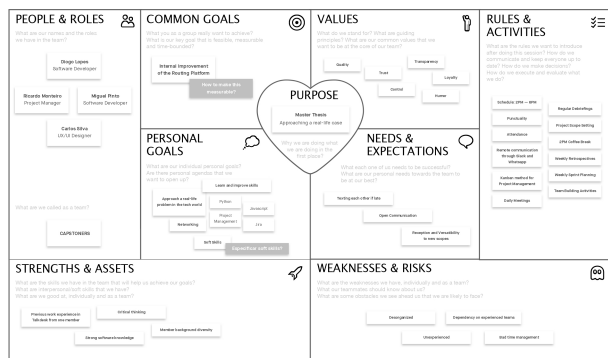


Figure 1: Team Model Canvas Diagram.

but I also provide considerable contribution towards: user research, theoretical concepts research, meetings, reports, documents, development of integration with back-end, protocols, interface visualization and presentation materials development (presentations, videos, thesis document, information website).

3. Research

Team Model Canvas (TMC) is a Business Model Canvas (BMC) for teamwork in a form of a diagram that was built in group by the four members of the team with the goal of improving team work, resolve conflicts, bring members to the same page and therefore improve project development.

As may be seen in figure 1 (and in our website) the team converged to the following sectors: People and Roles; Common Goals; Personal Goals; Values; Rules and Activities; Needs and Expectations; Strengths and Assets; Weaknesses and Risks; Purpose.

User Research is the investigation of some user characteristics to collect useful information. This information could be results of user testing, retrieving their behaviours, etc. It is used in many steps of product development and design and is easily used in continuous development and testing as well as agile methodologies. There are many types of user research being them experimental or observational, qualitative or quantitative and are very well suited for multidisciplinary teams such as ours.

User Experience (UX) is the user's satisfaction, its emotions and attitudes about using a product or service. It combines practical and emotional important singularities and aspects of Human-Computer Interaction (HCI). The main goal of UX is to make a product better. The quality of a product increases when its functionality performs well, is useful, easy to use and makes users happy. UX and User Research include the investigation done by us to the people that actually use the application – Callbar – to understand what is their typical day of work and what are their reactions to certain chains of events. In this user research we intended to do shadow-

ing, to create personas and scenarios. With the shadowing and informal interviews we were able to create more realistic scenarios and adapt the personas to a real-world environment. It also helped us define the different test cases and simulation paths that we needed to cover for our simulator.

In terms of User Research I performed shadowing to sales employees of Talkdesk using Callbar (although just outbound calls), interviews (somehow formal and also informal) and then all team members gathered their annotations and we developed scenarios based in personas in order to simulate the behaviour of the agents.

Shadowing is a qualitative research technique that closely observes and accompany the work of some target user allowing us to understand existing behaviours of agents that use some product or service. An interview is a conversational meeting between two or more people where questions are asked and answers are given. Scenarios could be a specific story within the user research scope that contribute to personas performances or some larger scale story to be integrated in various paths of our simulation that in our case includes different personas. Behaviour is a range of actions and decisions made by individuals. Personas are fictional characters created by us that represent general agents. These personas are created based on user research and represent a group of users (Callbar agents) with similar behaviours and patterns using the product and reacting to some triggers. In our project we considered Profiles as a representation of some user characteristics and is where variability was introduced.

Many theoretical concepts were studied in order to understand and develop the project. These concepts were: **simulation, automation, testing, metric results and analysis, scalability, reliability, concurrency, user interface, messaging system and presence system.**

Our project is a capstone project that aims to improve a company's product or service. Therefore we had an inevitable dependency on Talkdesk's teams that are responsible for the product development that we wanted to test and simulate.

This product is Callbar and was already being commercialized to company customers so our analysis and simulator output would be much more useful and valuable if applicable to the new (and complete) version of Callbar. It is useful to compare a new version of Callbar to previous ones in terms of times, features, efficiency and efficacy – and we contributed exactly to stressing the system and testing its concurrency potentiality, scalability, efficiency and reliability to analyse if it was possi-

ble to expand the product to other potential bigger clients with different and more demanding requirements always maintaining the product's quality – to understand if there were improvements and in which conditions those occurred.

The new version of Callbar was planned to be finished at the starting time of our project development but unfortunately that didn't happen which delayed our development and to get things worst we had no guarantees of the estimated time delivery of this new version of Callbar (could be a week, two weeks, a month or even a year) and so the capstoners team first decided to wait some time and continuously seek updates of Talkdesk responsible people for the new version and then dynamically decide the next steps and adapt the scope.

Time had run and we still had no final, complete and stable version of the company's product to test and simulate – this matter was something out of our control. Given this issue we started to think about scope alternatives or even project change. After meeting with the company employees we were told that it was possible for them to give us not a complete version of the product Callbar but a simpler (and very important) core module of the product – **the Routing Platform (RP)**.

Instead of Callbar, at this moment our target product to be simulated was the RP which led to a scope update and evolution – testing the product in the terms of a test-harness was no longer relevant but this scope evolved to a more generic simulation of the system and it would still be helpful for concurrency, scalability and reliability analysis.

RP is one of many modules that compose Callbar and it is one of the most important and core ones. It routes communication (calls) between devices through an API with given endpoints and returns a list of devices with their current states and values. It abstracts a representation of calls and device state changes which is a core functionality of a contact center. So testing and stressing it (scalability, reliability, concurrency, etc) according to the company needs would increase this module value and therefore strengthen the future new version of Talkdesk's product Callbar.

The project is a visual and simple web interface to be deployed in the browser with the following features:

Setup Scenarios - The user may choose a scenario for the simulation to run or customize his own.

Graphic Timeline - A real-time graphic that enables the visualization in real-time of calls be-

ing answered and rejected.

Device Activity - A visual block that also may have interaction. It contains all devices that were generated and may be filtered by states.

Test/Simulation View - From the start of the simulation until its end it is possible to see the time elapsed and other useful simulation information.

For the development of this project we followed Kanban which is a branch of Agile methodology. We used Git for source code version control.

Both Schedule and planning suffered some modifications due to the scope evolution but the main aspect remained intact. Our time planning changed mainly because of the team's lack of experience in this kind of projects, knowledge of the company work pace and also to external delays.

The final roadmap we made had the following steps:

1. Familiarization with Talkdesk's APIs.
2. Creation of back-end communication with the RP through API endpoints and make HTTP requests.
3. Create and add mocked Callbar agents (devices).
4. Develop a first simple base version of the front-end of the interface with the main visual blocks and interaction with the user by inserting some input values.
5. Create test cases and different scenarios, personas and behaviours.
6. Integrate back-end and front-end and allow the interchanging of data and information on setup and whenever an event occurs.
7. Run the simulation and watch the real-time responses on the interface.
8. Gather useful metrics from the simulation.
9. Analyse and produce reports with the gathered data from the simulation.
10. Present the DEMO, receive feedback and propose solutions (if possible).
11. Iterate to step 3.

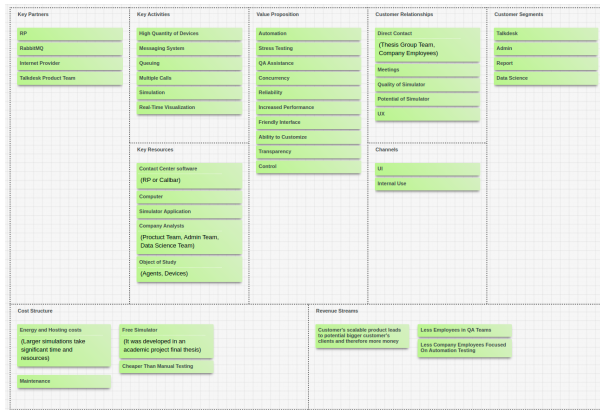


Figure 2: Business Model Canvas.

4. Results & discussion

Business Model Canvas (BMC) is a visual strategic management model template that is useful to understand a business (or simply a product) development and its elements described in a visual chart. With this model we can see the Callbar Simulator infrastructure, its value propositions, the customer segment and also the finance value of the product. The Callbar Simulator has the following sectors:

Customer Segments - serves its customer target which is Talkdesk;

Value Proposition - The values we deliver to our customer segments are in accordance to the customer (Talkdesk) needs and they are what differentiates our simulator from already existing smaller processes that the company uses (automation, stress testing, QA assistance, concurrency, reliability, increased performance, friendly interface, ability to customize, transparency and control);

Channels - Channels refer to how the simulator is delivered to Talkdesk and this is simply done by internal direct delivery for the company to use by their teams. They just need to receive the UI and its source code;

Customer Relationships - Callbar Simulator is considered a product that was developed somehow internally and therefore the customer relationship includes direct contact, meetings and is maintained by the quality and potential growth of the application and also from UX;

Revenue Streams - This simulator does not bring customer's direct profit but allows to increase its value and profit in the future mainly by scaling the customer's product to bigger clients and therefore get more money from them. It also allows Talkdesk to save money on employees directly working in QA teams allowing these people to perform other kinds of testing and it helps on the automation testing;

Key Resources - Key resources describe our

most important strategic assets to make the model work;

Key Activities - These are the strategic things that must be performed to make the model work and are directly relatable to the value proposition. Key Activities include simulation, high quantity of devices and calls, real-time visualization and control, message system and queuing;

Key Partners - In this block we describe the partners needed to perform the simulation, besides the direct assets already described.

Cost Structure - In this sector it is mapped the key activities to the inherent costs. One main advantage of Callbar Simulator is that it has very little cost structure being it just energy and hosting costs because larger simulations take significant time and resources to be performed although cheaper than manual testing, maintenance of the simulator software and this is a free simulator as it was developed in an academic project final thesis.

The environment for this project development was divided into physical and digital domains. The physical one is where the team was developing the project and the main local was the team table at the open space of Lisbon's office that Talkdesk kindly provided for the project development. Outside of the company office I developed my portion of this project at home, IST and also at FBA with the rest of the team in the final stage of the work for the website, video and presentation preparation and elaboration. The digital domain includes obviously our own personal computers, the project hosted location and all its digital and source components locations, help tools and communication technologies.

This capstone project had the following stages (from the first to the last ones) also described in Figure 3: **User Research** (with shadowing, interviews and meetings), **Team and Project Management** (with Project and Team), **Design** (with interface architecture, website architecture and wireframes), **Callbar Simulator Software Development** (with front-end, back-end and integrations), **Analysis and Report** and also **Other Project Materials** (such as information website, videos, thesis document and presentations).

Related to the **Software Architecture** (figure 4), the Callbar Simulator has a few layers of abstraction and may simply be described having a front-end application – user interface – that is web based in the browser and it just communicates with the human end user and the back-end of the application through a two-way web socket – *socket.IO* – with endpoints to localhost. The back-end is con-

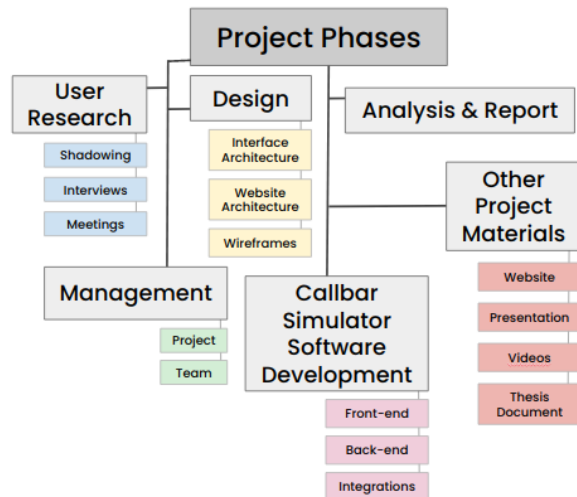


Figure 3: Project Phases.

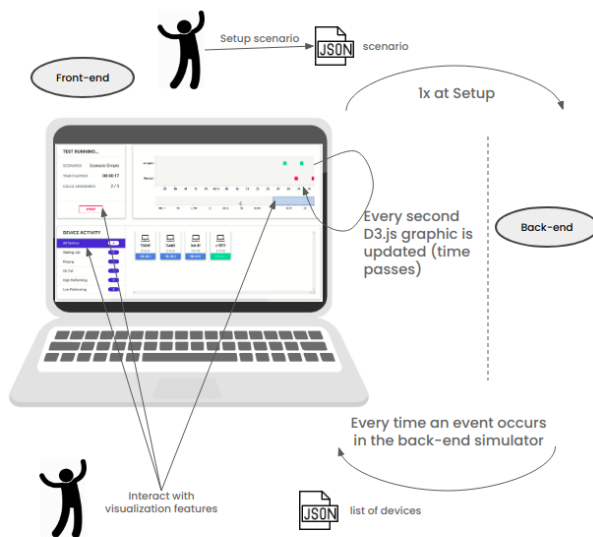


Figure 4: Front-end architecture.

nected with Talkdesk's API of RP, uses *queuing* and messaging system with *RabbitMQ* over AMQP protocol.

Some files are accessed locally present in our machines and are just access files, credentials and also JSON files we created for the front-end to load default scenarios and profiles.

Back-end is the data access and manipulation layer of a software project. In our project the back-end is considered the brain of the operation and is responsible for providing the correct functionalities to Callbar Simulator and interacting with almost every component and external modules present in the software architecture.

The presence system we developed was a simple Finite State Machine with the states; "Waiting

Call", "Ringing" and "On Call".

As there is no information about clients and users (meaning that the RP has no information about the device or agent that should get a specific call for a customer) we had to develop a simple assignment system and choose some device to have the initiative of picking up (or rejecting) some call because this is an automated simulation. The decision of a device to accept or reject the call is done in real time by the device's call pickup probability (inherent from the profile defined in the setup stage of the simulation). Each profile has a probability of picking up a call (0 to 1) which contributes to variability, randomness, entropy and complexity of the simulation. This device pickup call probability is an attribute of each device deriving from its profile. Each profile represents a persona and we created four different personas after the user research previously done. The profile name is descriptive but it links to a defined float value (0 to 1).

Integrations for front and back-end are important because data should flow between the presentation layer (front-end) and the data access layer (back-end). This interchanging of data was performed using webSockets with *socket.IO*. The data format we choose to flow were JSON files because they are easily manipulated both by Python in back-end and JavaScript in front-end and it's a technology very used nowadays in tech companies. The front-end of the application had to integrate the stream of information with back-end and the usage of *d3.js* as a JavaScript library for the real-time interactive timeline graphic. These integrations were: Talkdesk API, Protocols and Sata Strucures.

Front-end was my main contribution and is the presentation layer of the application – usually deployed in the client side – and the direct connection between the user interface (simulator) and the user, providing a user-friendly interface focused in accessibility and performance. It is the responsibility of the front-end to enable interaction, visualization, creativity and user experience of the application. It makes the bridge between the team members of design and back-end and therefore their contributions and development.

It receives input from the user at the beginning setup of the simulation being it just the selection of a predefined scenario, profile and environment or the customization of the scenario by the user.

While the simulation is running the user may observe in real-time what is happening and interact through a list of devices with their activity (that may be filtered by device status) and a graphic timeline

flowing in time.

The front-end development of the Callbar Simulator may be divided into four subsets:

Loading Page - Just an initial loading page before the real beginning of the application.

Initial Screen - Just a simple and clean visualization of the main features and a clickable block for the user to setup the scenario to be simulated.

Setup - In the "Setup" step (prior to the simulation beginning) the user needed to click on the "Run" button to start the simulation. If no other action was performed by the user, then a default scenario is loaded from a JSON file list of predefined scenarios. Instead of just running the simulation, the user may see the details and select a predefined scenario from a list of scenarios (loaded from an external JSON file that may be created by the user, or not – see figure or customize his own scenario by filling the variables input boxes and selecting the desired persona profiles. In any case the output of this simulation setup phase is a JSON file to be sent to back-end with the variables:

- Number of devices
- Number of calls
- Duration of each call
- Delay for each device to pickup the call
- Each call ringing time (standby)
- Four persona profiles (may be repeated)
 - "Champion", "Shy", "Sleepy", "Normal".

Simulation - This is the main subset of the front-end of the project and has both **automation** and **user interaction**.

- **Automation** - At a specified timeout (every second) of the simulation the HTML components (DOM elements) time elapsed and graphic timeline (with *D3.js* library) are updated both because time passes and therefore the HTML page is rendered even if no (other) alteration happened in the simulator.

The other way that forces the front-end application to update is by receiving an event from the back-end simulator with an updated list of devices and then it updates the device activity component, the devices lists by label and status and also the visualization of a call accepted or rejected (if applicable) in the real-time graphic.

- **User Interaction** - The user may interact with the simulation application in two aspects: either by setting up the scenario or clicking in the visualizing components during the simulation. To setup the simulation the user either chooses a predefined scenario or customize his own. At any time during the simulation, the user may click in some sections and interact with the application:

- **"Stop" button** - Stops the simulation and goes back to the setup step (in order to begin a new simulation).
- **"Reset" button** - Same as the previous button but in the case the simulation had already finished.
- **Graphic Slider** - Change the width and range of the timeline graphic.
- **Device activity labels** - Filter the list of devices by their states ("All Devices", "Waiting Call", "Ringing", "On Call", "High Performing", "Low Performing") by clicking in the respective label.

In this project we refer to **visualization** as data visualization. It is a graphic representation of information to be observed by humans. Data visualization is an art (therefore the design team member input) and also a science (my personal input and contribution). Front-end follows the design work and wireframes previously made in image editors or in plain paper (initially) from the design phase. Visual perception of data is different among the living beings and since our project was made for Talkdesk teams we were only interested in the human perception. Humans can distinguish differences in colors, orientations, shapes and text fonts (among others) and the style choices may significantly increase users familiarity and control of the interface reducing time and effort to perform their desired tasks. Human cognition are people processes like memory, learning, attention, problem-solving, intelligence and perception.

The Callbar Simulator has its own style, defined in the front-end code, represented in CSS files. This overall style was created in the design phases and I tried to replicate it in the interface code.

When the user first opens the Callbar Simulator, a static loading screen appears for a starting approach of the application and to warm up the user. This takes about five seconds and some calls so back-end and then to various APIs may be performed before the simulation really begins.



Figure 5: Callbar Simulator Main Screen.

Then the user needs to specify or choose the simulation environment interacting with the setup box being it predefined scenarios or a custom one. This interaction occurs just by clicking at elements and filling some input boxes the user desires, to customize the simulation with his own delays, times, and number of objects (devices, calls) variable values.

While the simulation is running the user is able to observe real-time events (calls being accepted and rejected) and the activity of its devices and their current state ("On Call", "Ringing", "Waiting Call") but the user is also able to interact with the application customizing the timeline graphic on its time window width and size, and filtering the device activity block by the desired states of the devices.

Objectively the interface is a web interface with only two screens – loading screen which is irrelevant for the simulation operations and the Callbar Simulator screen. This last one has various components and some of them are hidden when others are displayed making the illusion of screen changing for the end user. Besides this adopted approach I consider each visualization block to be a screen as it contains specific information about some aspects and the user attention flows from one block to another and therefore I consider it to be the flowing between screens. So, Callbar Simulator has the following screens: Loading Screen, Simulator First Screen, Test Setup Screen and Simulation Screen (figure 5).

5. Conclusions

There were some limitations and constraints to the project development that we faced and had to deal. First of all this whole capstone project is an innovation at my university in the final thesis of my course so there was no other similar project to compare or guide us – the paradigm has changed and with it some particularities regarding the traditional course evaluation. We suffered an important limitation in terms of time management when

we needed to wait several weeks for the company product new version and then it wasn't ready and deployed yet so we add to deal with a different product – a core module RP new version – and modify the project initial scope adapting our previous user research and previous project bases already prepared. Instead of a test-harness we changed to a simulator. Resuming we had a limitation that was the dependency of other teams, in this case the Talkdesk product team. Also about the RP, this new product had very little documentation since it had just been developed.

Regarding team and project management we had some difficulties learning how to use *JIRA* software since it is a complex tool and none of the team members had experience in that matter.

This capstone project had the duration of a year (two semesters) as it was included in both my Master Project and Master Thesis in Information and Software Engineering. The first one was on the first semester and corresponded to the research of the project while the second one corresponded to the second semester work on the project development.

The team project result was a product – Callbar Simulator – to be used by the target company Talkdesk. The project suffered some modification in its scope and changing from an automated test-harness to an automated simulator. Nevertheless the project output is very similar as it may test massively Talkdesk's product being it Callbar or a simpler module component and stressing it to the critical point so Talkdesk can analyse the issues that occurred and then act accordingly in order to increase the scale of its product always testing it and making sure it is reliable.

Project research and development information towards the thesis are described in this document. In this report I intended to describe the progress of the project from its initial research to the final presentations and its various components. Although this was a capstone group project, in this document is my contribution more detailed, the team work developed, concepts described and research performed as well. Also this document thesis has my personal view of the thematic, project analysis and opinions.

This project was a tech demanding one because it required software engineering and development knowledge and a large part of my personal research was directed to this technological path. Not only I had to increase my software development skills I also had to understand the big and complex software architecture of the company and the connection between the various modules Talkdesk has in their products and then understand what is

required and returned of the component RP of the new version that did not have relevant documentation because the product development teams were still developing and finishing that same version.

With this capstone project I personally acquired many skills and improved existing ones that I already had. More specifically I increased my technological stack in terms of programming languages such as Python and its libraries, JavaScript and its libraries, JSON, HTML and CSS. The constant communication and the development methodology adopted – Agile, Kanban – also enabled new knowledge and paradigms to be acquired, for example team work, regular meetings, briefings and debriefings, presentations and networking between the team, the assistant professors and the company employees and their teams too. The connection between the last phase of the academic course (final thesis) and the very first step in the work environment was demanding and interesting because issues came from everywhere the it was our responsibility to overcome them in group using (or creating) our problem-solving skills.

It was possible with this project for me to learn about my field of study (software engineering) and also contents of design, team and project management, user research, communication, critical thinking, problem-solving and other soft skills.

Our main goals with this project were fulfilled as the simulator allows Talkdesk to perform automated testing and therefore test its product – not only RP but it is also extensible to Callbar or other module components as our project is modular and uses the return messages of Talkdesk's API as a product so in order to change the product it is just needed to change the target API. We consider the results positive because Talkdesk representatives (that were our main point of contact inside the company) were happy and gave good reviews when the Callbar Simulator was presented. Our product has potential to grow and increase value on a target company product or service and on top of this it is simple but has quality and gives a good user experience when used, increasing the company employees satisfaction and motivation.

I would also like to discuss the importance of this simulator and its potentiality in terms of features and scale. Some of the future work that may be developed is the following:

- Graphic Timeline improvement.
- Generation of reports at the end of the simulation with the visualized analysis.
- Incorporation of other metrics.

- Test the Callbar Simulator.
- Integration with other company APIs and simulate the whole product (when there is a stable version of the complete product).
- Simulate different versions of the product and compare them.

References

- [1] [Online]. Available: <https://www.bestvalueschools.com/faq/what-is-a-capstone-project/>
- [2] [Online]. Available: <https://www.edglossary.org/capstone-project/>
- [3] [Online]. Available: <https://papersowl.com/blog/what-is-capstone-project>
- [4] [Online]. Available: <http://web.tecnico.ulisboa.pt/ist175564/landerz/>
- [5] [Online]. Available: <https://www.bestvalueschools.com/faq/what-is-a-capstone-project/>
- [6] [Online]. Available: <https://www.edglossary.org/capstone-project/>
- [7] [Online]. Available: <https://docs.talkdesk.com/docs>
- [8] [Online]. Available: <https://www.talkdesk.com/>
- [9] [Online]. Available: <https://academy.talkdesk.com/>
- [10] [Online]. Available: <https://socket.io/>
- [11] [Online]. Available: <https://www.interaction-design.org/literature/topics/user-research>
- [12] Mouhib Alnoukari, Moutasem Shafaamry and Kinaz Aytouni, "Simulation for Computer Sciences Education", Communications of the ACS, Vol. 6, N0.1 (2013)
- [13] [Online]. Available: <https://www.gartner.com/en>
- [14] Rebecca Gill, Joshua Barbour and Marleah Dean, "Shadowing in/as work: ten recommendations for shadowing fieldwork practice", Department of Communication, Texas A&M University, College Station, TX, USA