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Standardization of ESM Chatbot Development

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The purpose of this study was to help the case company to improve its delivering capability and readiness in chatbot projects. The main aim was to build a proposal that would standardize the development activities in chatbot projects for HR, Finance and IT enterprise functions.

This study is based on data collected from interviews, internal documentation and theory. The interviews divide in two categories by their purpose: a round with chatbot substance experts followed by a round with HR, Finance and IT enterprise function experts. Experts from each enterprise function were interviewed to discover the most common use cases and their content. The literature review focused on the technical aspects of developing a pre-configured chatbot application.

The thesis proposal consisted of three deliverables and was based on the expert interview data and the literature review. The proposal consisted of descriptions of the most common use cases in HR, Finance and IT enterprise services, conversation path illustrations associated with the use cases and a pre-configured chatbot application.

The proposal deliverables introduced standardization in two facets of chatbot development. The use case descriptions and conversation path illustrations were centralized, providing content to be used as-is and as templates for different use cases. The pre-configured chatbot application will be used in the development activities, reducing the time spent in development. The pre-configured chatbots will also be used in customer meetings to demonstrate the case company's capabilities as a chatbot solution provider.

Keywords	Chatbots, ServiceNow VA, ESM, Business Automation

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List of Abbreviations

AI	Artificial Intelligence. A field of information technology that studies software and systems programmed to mimic natural intelligence and organic learning used by humans
API	Application Programming Interface. A term describing the definition of interaction that programs adhere to upon interaction
CI	Configuration Item. A component or asset of a service that requires management to deliver an IT service.
ESM	Enterprise Service Management. A governance model applying ITSM concepts and frameworks in the context of all enterprise services.
ITSM	IT Service Management. The governance model for planning, delivering, executing and controlling IT services.
ML	Machine Learning. Systems that improve their performance in a given task with data or experience.
NLP	Natural Language Processing. A subfield of NLP that studies how humans comprehend and use language.
NLU	Natural Language Understanding. A subfield of artificial intelligence that studies how computers can understand natural language used by humans
REST	Representational State Transfer. An interface architecture model used to transfer data between systems.
RITM	Requested Item. A catalog item request submitted through a service portal.
VA	Virtual Agent. A chat-based service platform provided by ServiceNow.

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1 Introduction

The subject of this thesis is the standardization of Sofigate's chatbot development. Currently, the chatbots are developed on a case-by-case basis regardless of the recurrence of similar use cases and the associated development activities.

1.1 Business Context

Sofigate is a Finnish business technology management company founded in 2003. In addition to Finland, the company operates in Sweden and Denmark, employing 550 people. In 2018 the company's revenue was 80 million euros, marking a 20 percent growth from the year 2019. (Sofigate, 2019)

Sofigate differentiates itself from its competitors with a comprehensive product portfolio of technology solutions, management consultancy and strategic transformation. The portfolio consists of offerings from two business lines: Management Services and Technology Solutions. Management Services focus on enterprise-level transformation with solutions for redefining business and operating models. Technology Solutions focus on redesigning and implementing modern business and service processes for customers. Therefore, Sofigate's focus is on providing a combination of guidance, tools and support to enable businesses to take charge of their own digital transformation to derive sustainable, long-term business value. (Sofigate, 2019)

Sofigate's offering is founded on and evolves with the Business Technology Standard (BT Standard), an open source framework for enterprise-wide organization and coordination of technology management. An essential concept of the framework is the Business Technology mindset model consisting of three dimensions: Business Transformation, Digital Frontline and Technology Backbone. (Business Technolgy Standard, 2019) The model is displayed in Figure 1 below.

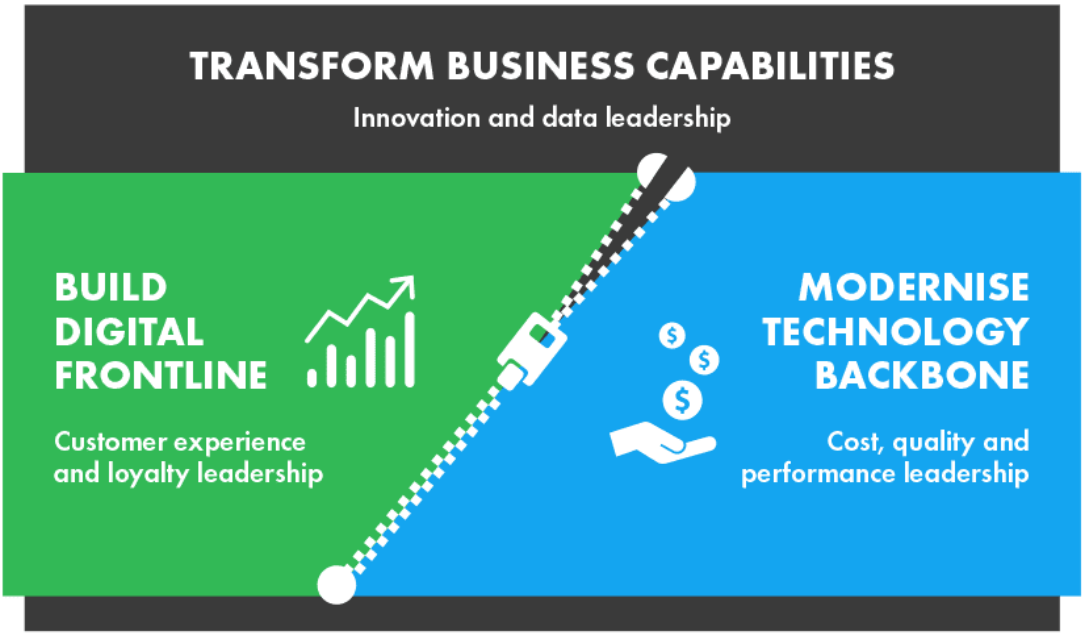

Figure 1: Business Technology Mindset Model with Three Dimensions. (Business Technolgy Standard, 2019)

Sofigate's business model epitomizes the three-dimensional mindset, as it focuses on developing customer's businesses as an ecosystem, providing expertise in business development, digitalization, and Information Technology. As the company's mission states, they "Turn digital innovations into well managed business technology" (Sofigate, 2019).

Sofigate has invested in establishing strong partnerships with industry leading cloud-based platform and system suppliers. Among these suppliers is ServiceNow, who's web-based service management platform enables companies to establish and extend their service management throughout the enterprise. The platform is based on the idea of applying IT Service Management (ITSM) frameworks and practices to all enterprise functions, a concept that is usually referred to as Enterprise Service Management (ESM). The platform centralizes information exchange and facilitates effective service requesting and delivery, as opposed to traditional service delivery channels e.g. stand-alone email.

ESM platforms provide a service portal for the end-users (i.e. employees) to access applications such as service request forms. However, these portals do not facilitate efficient information exchange, as the applications consist of forms and static pages. This poses a challenge to scaling the volume and ensuring the quality of service delivery. These challenges are now combated by utilizing Artificial Intelligence (AI) and Robotic Process Automation (RPA) to introduce intelligence and automation to service delivery through chatbots.

In the context of HR, requests such as updating an employee's address can be fully automated with a chatbot. This results in the HR personnel having more time for demanding tasks, which increases the level of motivation and subsequently, the overall quality of HR service delivery. This works both ways, as chatbots can fulfil simple requests much faster than humans, provide detailed guidance to the user, yet still being able to transfer the request to a human if need be. These factors lead to improved user-experience and service delivery

1.2 Business Challenge, Objective and Outcome

Sofigate has identified substantial progress in the maturity of the chatbot market. Companies have started to embrace the idea of using chatbots throughout the enterprise to improve the quality and automate the delivery of enterprise services. This has led to an increase in the demand for chatbots, which is why Sofigate has decided to take proactive measures to improve their readiness and capability of delivering chatbot solutions.

As enterprise function services are similar across industries, the needs that internal chatbots respond to are of recurring nature. Therefore, the possibilities regarding the standardization of chatbot development activities are vast. Establishing standardization in the development would streamline the chatbot delivery projects, as the focus could be more on service design and cooperation with the customer and the end-users. Currently, Sofigate conducts chatbot projects on a case-by-case basis, effectively starting over every time a new project is initiated.

HR, Finance and IT functions hold the most relevancy in the context of standardization, as they have clearly defined and established services and are of the highest demand in

Sofigate's projects. **Therefore, the objective of this study is to standardize the development of chatbots for HR, Finance and IT enterprise functions.** The outcome of this study is a more standardized way of delivering chatbots.

1.3 Thesis Outline

This thesis is written in seven sections. Section one contains the introduction, business challenge, objective and outcome of the project. Section two discusses the research design, methods and materials used in this thesis. Section three contains the current state analysis. In sections four and five, the relevant theory and existing best practices are studied with the literature review and expert insights running in parallel. Section six discusses the proposal, and section seven presents the results of the proposal validation. Section eight concludes this thesis with a summary and an evaluation of the result.

1.4 Key Concepts

The key concepts are presented in Table 1.

ServiceNow	A cloud-based service management system provider
Chatbot	An application or a set of software that mimic human conversation to automate tasks
Now Platform	An Enterprise Service Management platform
ServiceNow Virtual Agent	Sub-platform for developing, deploying and maintaining chatbots on the Now Platform
ServiceNow Studio	An application development environment in the Now Platform. Used in chatbot solution development to centralize all the components into a single application.
Chat client	An interface facilitating the conversation between two parties (i.e. end-user and chatbot)
Configuration Item	A property or a component of a service that affects the delivery of that service. Can be tangible or intangible, and has relationships to other configuration items

Table 1: Key Concepts

2 Methods and material

This chapter describes the research design, schedule of the thesis and data collection and analysis.

2.1 Research Design

This thesis consists of six phases, each having a definitive goal and an outcome. Figure 2 illustrates the data, goals and outcomes of each phase in a research design diagram.

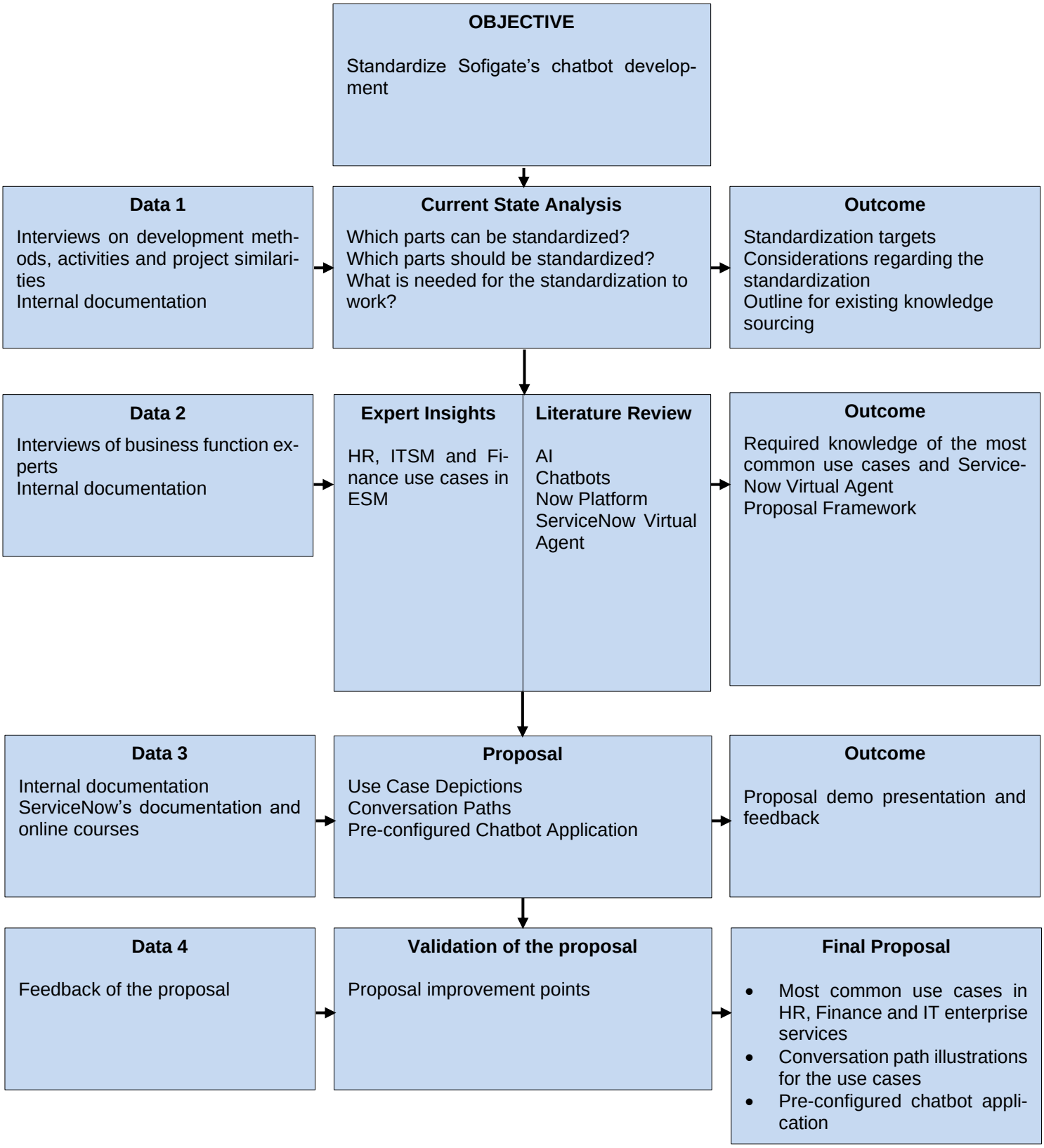

Figure 2: Research Design Diagram

As seen in Figure 2, the first research stage is to define the objective of this thesis. The objective of this thesis is to standardize the development of chatbots for ITSM, HR and Finance functions' service delivery.

The second stage analyses the current state of how the chatbots are developed to discover the areas of standardization that are possible to carry out and would yield maximal value. The data for this stage is gathered by interviewing the chatbot developers, the CTO and by studying internal documentation. The results of this stage are the standardization targets, considerations associated with them and an outlining that justifies the sourcing of knowledge from theory and expert insights.

Stages three and four are conducted in parallel, consisting of the literature review and expert insights. The literature review first addresses Artificial Intelligence and Chatbots, before moving to the focal point of the literature review, the ServiceNow Virtual Agent. In expert insights, HR, IT and Finance functions' experts are consulted to gain insight to each functions' service delivery. The outcome of this stage is the required knowledge regarding the use cases, a theoretical framework and a framework for the proposal.

The fifth stage covers the proposal, during which the use cases are formulated and transformed into conversational paths and finally, implemented in the Virtual Agent environment. The outcome of this stage is the proposal and the subsequent feedback on it.

The sixth stage implements the feedback's improvement propositions, resulting in the final proposal.

2.2 Thesis Plan

This thesis will follow the schedule presented in Table 2 below. The first stage (week 1) focuses on understanding and formulating the objectives of the thesis. The second stage (week 2) concentrates on planning the structure of the thesis and its research. During the third stage (week 3), data collection, centralization and analysis are carried out. Fourth stage (week 4) consists of the current state analysis. Stages five and six (weeks

5-7) focuses on gathering available knowledge from literature and internal experts. The seventh stage (weeks 8-10) focuses on building the solution proposal. The eighth stage (weeks 11-12) begins with the validation of the proposal and concludes the thesis with the hand-over of the final solution.

Week Number	Content
Week 1	Business challenge, objective and outcome
Week 2	Research design, thesis plan
Week 3	Data collection and analysis
Week 4	Current state analysis
Week 5	Literature Review
Week 6	Literature Review / Expert Insights
Week 7	Literature Review / Expert insights
Week 8	Building the proposal
Week 9	Building the proposal
Week 10	Building the proposal
Week 11	Validating the proposal
Week 12	Final proposal

Table 2: Thesis Schedule

This thesis is a real- life project mandated by the case company Sofigate. Therefore, the thesis is based on data of various forms and sources, which are further described in the following chapter.

2.3 Data Collection and Analysis

Data of various forms and extensive volume was mandatory for the completion of this thesis due to the breadth and width of the solution. The data is divided in three sections and presented in Table 3.

Participants/role		Data type	Topic, description	Date	Documented as
Data 1, for the Current State Analysis					
1	Chatbot team	Skype meeting	Ongoing chatbot projects, Virtual Agent solution	3.12.2019	Field Notes
2	Chatbot expert	Face-to-Face meeting	Past projects	10.12.2019	Field Notes
3	CTO	Face-to-Face meeting	Current development environments, past projects	10.1.2020	Field Notes
4	Chatbot team	Skype meeting	Current activities, projects, development and collaboration methods	15.1.2020	Field Notes
Data 2, for the Expert Insights and Proposal building					
5	Finance expert	Teams meeting	Finance use cases	3.2.2020	Field Notes
6	ITSM expert	Teams meeting	ITSM use cases	13.2.2020	Field Notes
7	ITSM experts	Teams meeting	ITSM use cases and the related process flows	19.2.2020	Field Notes
8	HR expert	Face-to-Face meeting	HR use cases	25.2.2020	Field Notes
9	Finance expert	Face-to-Face meeting	Finance use cases	27.2.2020	Field Notes
10	HR Service Delivery Team	Questionnaire	HR use cases	27.2.2020	Questionnaire Data
Data 3, from validation					
11	Chatbot team, Business Automation Executive	Teams meeting	Solution proposal demo presentation	25.3.2020	Field Notes

Table 3: Thesis Data

As seen in Table 3 above, the data for this thesis was collected in three rounds. The first round (Data 1), is used to conduct an analysis on the current state of the development activities and methods to recognize the most valuable targets of standardization. The information is gathered through meetings with individuals and groups, and documentation from previous and ongoing projects.

The second round (Data 2), focuses on the use cases related to the three enterprise functions and is used to construct the expert insights and the proposal building. This round is the most imperative one, as the solution proposal of this thesis relies on and consists of the use cases. The methods of data collection is individual for each function, as the characteristics of the services and their delivery vary substantially between HR, Finance and IT functions.

The final round (Data 3) is acquired from the proposal validation. It consists of feedback on the proposal, provided by the chatbot team and the business automation executive.

Table 4 shows the internal company documents analyzed in this study. Due to its confidentiality, the content of the documents is for company use only.

Name of the document		Number of Pages / Slides	Description
1	Internal Document 1	X	X
2	Internal Document 2	X	X
3	Internal Document 3	X	X
4	Internal Document 4	X	X
5	Internal Document 5	X	X
6	Internal Document 6	X	X
7	Internal Document 7	X	X

Table 4: Internal Documents

The documents were utilized in the current state analysis to gain understanding of the development activities and methods in customer projects, and to discover reusable content for the proposal building.

3 Current State Analysis

This section addresses the current state of chatbot solution development in the case company. The current state analysis is based on data gathered from interviews and meetings with internal chatbot experts, existing ServiceNow instances and documentation of previous projects.

3.1 Overview of Current State Analysis Stage

The current state of chatbot development in the case company is analyzed in two steps. First, chatbot developers are interviewed to gain understanding of the development methods, to inquire which areas of the development are feasible and would yield most value if standardized. Also, documentation from previous chatbot projects are studied to discover any further relevant information. Then, conclusions drawn from the current state analysis are presented as a summary of key findings.

3.2 Chatbot Solution Overview

Based on the interview data and project documentation, there are three separate segments in the development of a chatbot in the context of ServiceNow. The conversation interface in the service portal (chat client), the chatbot (Virtual Agent) and the back-end service management system (Now Platform), which are presented in Figure 3.

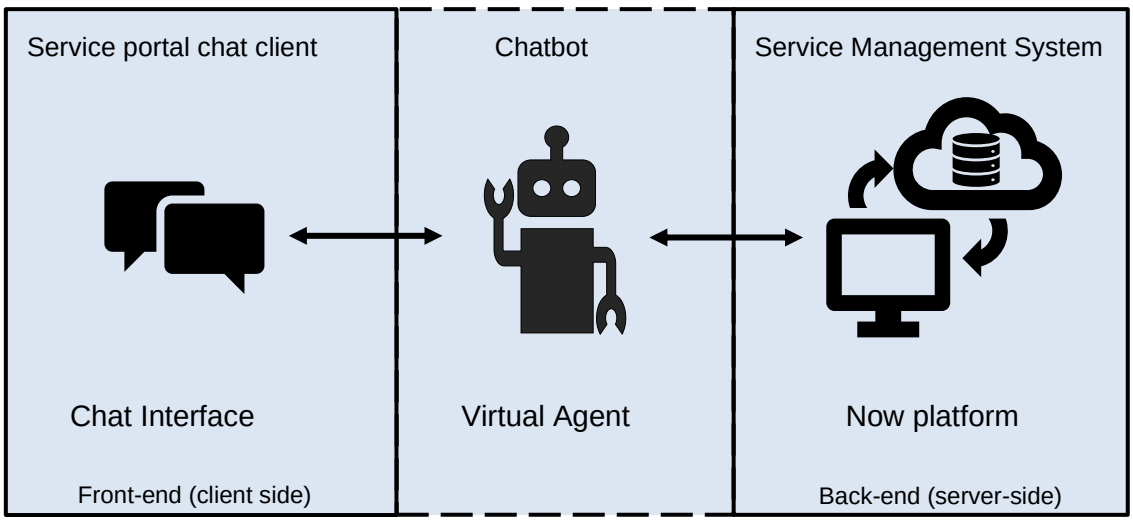

Figure 3: Chatbot Solution Components. (Internal Document)

The functionality of a chatbot solution relies on the interaction between the three components and therefore, integrations are also a part of chatbot solution development. According to the interviewees, the configuration of the chat client varies between customers (e.g. visual appearance) and therefore, would not be feasible to standardize. The configuration of the actual chatbot i.e. virtual agent is the most laborious area but also holds the most potential for standardization. The chatbot is configured in and according to the service management system, hence there is little to standardize regarding the system itself. Therefore, the configuration of the virtual agent and its interaction with other elements is a valuable and feasible target of standardization.

3.3 Chatbot Development

The development of a chatbot consists of two categories, the general settings and the dialogues. General settings cover the conversation facilitating properties and do not directly relate to service fulfilment. A list of common general settings based on the interview data and project documentation is presented in Table 5.

Property	Explanation	Examples
Chatbot Persona	An array of properties personalizing the chatbot to improve user experience	Name, use of language (formal/informal)
Languages	Languages the chatbot must be able to understand	Finnish, English
Live Agent	Whether or not the chatbot can transfer the conversation to a live agent	No
Availability	Accessibility definitions of the chatbot	Service portal main page in browser and mobile
Setup Topics	Common elements in all conversations	Greeting Topic, Closing Topic
Small talk topics	Conversational elements facilitating human-like conversation	Chatbot capabilities topic

Table 5: Common General Settings Based on Interviews and Project Documentation. (Internal Document)

General settings are case specific, as they depend entirely on the project scope, use cases and other aspects that must be individually defined in every project. Their definition is based on workshops where at first the customer's stakeholders are familiarized with chatbots and their capabilities. The following workshops focus on defining the chatbot's properties and functional features through collaboration. Due to their subjective nature and the importance of establishing a mutual understanding of the chatbot's requirements and capabilities, general settings are not a feasible target of standardization.

Dialogues cover the conversations facilitating the service fulfilment and delivery derived from the use cases. Dialogues are based on the use case and consist of the conversation states, their function and the outcomes of each state. Before developing a functional dialog to be implemented in a chatbot, the dialog flow must be defined on a conceptual level. According to the interview data, opening an IT ticket is one of the most common use cases in chatbot projects. It is simple to transform into a dialog, as the high-level process flow and related variables are well-established. An example of the dialogue components and progression for opening an IT ticket (from the development perspective) is described in Table 6.

Dialogue: Report an IT issue		Description: User creates a ticket for IT Support
State	**Function**	**Outcome**
Search for application	Ask user for the application that they are having problems with, search for the correct Configuration Item	Search has results: output a list of the results and ask the user to choose the correct CI. Proceed to the next step
		Search has no results: ask if user wants to search again or skip the CI selection. Proceed to the next step
Search for Knowledge	Search for Knowledge Base articles containing information on how to fix the issue	Search has results: output a list of ways to fix the issue and ask if the issue is corrected. If corrected, end the dialogue. If not corrected, proceed to the next step
		Search has no results: proceed to the next step
Create Incident	Create an Incident on behalf of the user	Incident information retrieved automatically: User, Application, Date and Time
		Incident information prompted from the user: short description, urgency

Table 6: Dialogue flow Definition for Opening an IT Ticket. (Internal Document)

The flow definition appears simple, yet it provides all the necessary information for developing a chatbot topic flow in ServiceNow. Enterprise function services (i.e. use cases) are similar between companies and therefore, so are the dialogue flow definitions derived from them. This implies potential for standardization, as use cases and their corresponding dialogue flow definitions could be pre-defined, centralized and utilized based on the well-established processes that hold little variance across industries and companies.

The dialogue flow definitions act as blueprints for the configuration of the chatbots, which are at simplest an application consisting of a collection of dialogues. The simplicity is enabled by the possibility of embedding scripts within the dialogue to perform database operations such as create, read, update, delete (CRUD). In the context of opening an IT ticket, the chatbot first tries to search (i.e. read) configuration items, then knowledge base articles and finally it creates a record (incident).

According to the interviewees, the construction of these scripts is arduous and would be of immense value if standardized. The dialogues are configured in ServiceNow Studio, a development environment dedicated for custom application development. The development environment enables the centralization of application files and therefore, all topics, integrations and other configuration files can be accessed and stored in the same location. However, for the application to be maintainable and accessible to others than the devoted developer, it should be linked to a Git source control repository.

3.4 Summary of Key Findings

This section concludes the current state analysis by presenting a summary of key findings regarding the most promising areas of standardization of chatbot development in Sofigate's chatbot projects. The summary is based on data that was collected for the current state analysis (Data 1) and consists of the standardization targets with their associated requirements, which are presented in Table 7.

Target	Description	Requirements
Use Cases	Depictions of the most common use cases in HR, Finance and IT functions' services	Knowledge of the use cases and their frequency
Dialogue illustrations	Illustrations of the conversational paths associated with the Use Cases	Knowledge of the processes related to the use cases
Pre-configured ESM chatbot application	A chatbot application to be used in the now platform, containing pre-defined dialogues for HR, Finance and IT use cases	ServiceNow Instance, Knowledge and understanding of ServiceNow's Virtual Agent Solution, ServiceNow Studio, NLP

Table 7: Targets of Standardization

As seen in Table 7, the standardization targets are the use cases, the conversation flows and a pre-configured ESM chatbot application. These three targets will be standardized based on available knowledge from theory and expert insights. Table 8 presents the targets of standardization with their respective knowledge sources and reasoning for the sourcing decision.

Target	Knowledge source	Required knowledge	Reasoning
Use Cases	Expert insights from HR, Finance and IT Service Management or Delivery experts.	Most common use cases • Content • Frequency	Same use cases apply in the context of all mediums of service delivery (e.g. chatbots, forms). Experts are interviewed to ask about previous projects.
Dialogue illustrations	Expert insights from HR, Finance and IT Service Management or Delivery experts	Process flows • Event sequences • Variables • Roles	Expert have deep insight into the processes i.e. the responsibilities, access rules in different use cases, etc.
Pre-configured ESM chatbot application	Theory / Online Documentation	ServiceNow • Virtual Agent • Studio Relevant Conceptual Theory • Chatbots • NLU	Absence of in-house expertise on Virtual Agent. Documentation required for the development of the application.

Table 8: Motivation for the Knowledge Sourcing

The Current State Analysis conducted in this chapter identified the targets of standardization and presented the motivation for the knowledge sourcing. The following chapter studies the use cases and the associated process flows per each enterprise function through expert insights.

4 Expert Insights

This chapter covers the expert insights regarding common use cases in HR, Finance and IT enterprise functions. The insights were gathered from internal employees with experience in implementing use cases in customer projects and concretizing their delivery in service request fulfillment. The objective of this chapter is to discover the most common use cases in HR, Finance and IT enterprise functions.

4.1 HR

The HR insights were gathered from the experts through interviews and a questionnaire form distributed to the HR Business Partners and Administrators. Prior to contacting the experts, initial use cases were sourced from previous customer project documentation. The use cases are presented in Table 9.

Use Case
Add new Employee
Payroll Inquiry
Pay Discrepancy
Manage Working Hours
Notification of Sickness
Update Emergency Contact
Add Emergency Contact
Update Home Address
Update Email Address
Update Phone Number
Request for Leave

Table 9: Initial HR Use Cases. (Internal Document)

The interviews confirmed the validity of the sourced use cases and resulted in the discovery of new use cases. However, instead of producing a short list of the most common ones, the interviews resulted in an aggregate of generally occurring use cases.

Upon addressing the aforementioned concern, the second interviewee proposed that a questionnaire could be effective in gathering data about the frequency of the use cases. Therefore, a questionnaire was formulated as a web-form containing use cases and prompting the user to rate the corresponding rate of frequency. The web-form was distributed to experts handling service requests on a regular basis, as well as manager level

experts possessing deep and broad knowledge. The form structure and content are presented in Table 10.

<table>
<tr><th colspan="3">Section 1</th></tr>
<tr><th>Category</th><th>Use Case</th><th>Choice options</th></tr>
<tr><td>Employee profile information</td><td>- Update contact details (phone, email, home address)
- Update emergency contact
- Delete emergency contact
- Who is my supervisor?</td><td rowspan="7">1) Very rarely
2) Rarely
3) Sometimes
4) Often
5) Very Often</td></tr>
<tr><td>Traveling regulations</td><td>- Travel reservations inquiry
- Travel expenses inquiry
- Travel insurance inquiry</td></tr>
<tr><td>Occupational Health care</td><td>- Booking an appointment
- Available health care services inquiry
- Clinic location inquiry</td></tr>
<tr><td>Sick Leave</td><td>- How to report sick leave
- What are the regulations (e.g. number of days without a medical certificate)</td></tr>
<tr><td>Holidays</td><td>- Holiday balance inquiry
- How to report holidays</td></tr>
<tr><td>Payroll / Salary</td><td>- Payroll discrepancy
- Current salary inquiry
- Salary raise inquiry</td></tr>
<tr><th colspan="3">Section 2</th></tr>
<tr><td colspan="3">Common use cases not included above</td></tr>
<tr><td colspan="3">Free text field</td></tr>
<tr><th colspan="3">Section 3</th></tr>
<tr><td colspan="3">Additional comments</td></tr>
<tr><td colspan="3">Free Text Field</td></tr>
</table>

Table 10: The Questionnaire Form

The form was divided in three sections, first asking the experts to rate the frequency of each request (use case) based on their personal experience. To make the form's structure more coherent and to invoke interest in specific request topics, the first section was further separated by the category in which the request belonged to. Albeit the focus on discovering the most common use cases, the form was supplemented with two additional

segments: one inquiring of any common use cases not included in the list, and the other providing an opportunity to submit additional comments. This was done to enable the users to comment on the use cases e.g. request sentence formulation.

The questionnaire data revealed a distinct set of the most commonly occurring use cases, which are displayed in Table 11.

Use Case
How to report sick leave
Holiday balance inquiry
How to report holidays
Payroll discrepancy
Current salary inquiry

Table 11: Most Common Use Cases in HR

Use cases represent service requests, and therefore a use case named “How to report holidays” describes a service request where the user (employee) asks the service fulfiller (HR user) about the holiday reporting process by submitting a form in the service portal or through an email. Both ways render the request into a ticket that is assigned to the HR user team.

4.2 Finance

For the finance use cases, two finance service experts were interviewed, and relevant project documentation were studied. The first interviewee was experienced in finance implementation projects and therefore, had knowledge of the frequently occurring use cases. A list of finance use cases was drafted to ease the discovery of the most common use cases, and its contents are presented in Table 12.

Use Case
General inquiry
Opening and changing fixed assets
Invoice inquiry (Accounts Payable)
New Vendor
Vendor data change
Expense claims
Invoice inquiry (Accounts Receivable)
New customer
Billing request
Customer data change
Incoming payment
Outgoing payment
Credit information inquiry
Bankruptcy control

Table 12: Finance Use Cases. (Internal Document)

The list was presented to the interviewee to inquire the frequency of each use case and to discover any common use cases not included in the list. After this, the interviewee was asked to describe the processes associated with the use cases that they had deemed most common. The most common use cases were discovered but according to the interviewee, the process flows are defined on an ad-hoc basis and dictated by the requirements related to the service request forms and are therefore infeasible to define on a general level.

However, financial services are bound to legal regulations and well-established transaction processes and therefore, the processes relating to these services are similar across different companies and industries. The second interviewee was experienced in finance request fulfillment and therefore, the interview focused on discovering recurring elements that are inherent to the services, such as mandatory information and tasks related to the services. The interviewee provided differing opinions regarding the definition of processes and advised to inspect Sofigate's internal finance service portal and its forms. According to the interviewee, the configuration of a service request form defines the required variables and the associated workflow. The interviewee also stated that chatbots hold immense potential in finance service management, as the users are often oblivious of the processes behind the service requests. A chatbot could reduce redundancy by guiding the users in the service request process and by providing access to knowledge and therefore, would improve the user experience, the quality of the service delivery and enable the finance request fulfillers to focus on demanding tasks.

Based on the two interviews discussed in this chapter, a list of the most common finance use cases was formed and is displayed in Table 13.

Use Case
Project initiation
New Vendor
Vendor data change
New Supplier
Supplier data change

Table 13: Most Common Use Cases in Finance

The project initiation use case describes a service request where the user wants to initiate a new project in the service management system. The request is submitted through a service portal form where the project information is declared. After submission, a ticket is created and assigned to the finance user team for validation of the information and approval of the project initiation in the system.

4.3 IT

Due to ITSM frameworks and practices, IT use cases and their associated processes are exceptionally well-established. Therefore, the interviews of IT enterprise service experts focused on displaying a list of use cases to discover the most common service requests and their associated fulfillment process. The list constructed prior to the interviews is presented in Table 14.

Use Case
Open IT Ticket
Check IT Ticket Status
Escalate IT Ticket
Broken Device
Access Control Inquiry
Assigned Equipment Inquiry
Device Order
Accessories Order
Get Password Reset Link
Create Change Request

Table 14: IT Use Cases. (Internal Document)

The first interview was attended by an ITSM expert experienced in implementation projects and consisted of identifying the most common use cases from the list constructed prior to the interview. According to the interviewee, the most common use cases are ordering a device, getting a password reset link and opening an IT ticket.

The first interview was followed by a meeting attended by four ITSM experts where the initial list of all sourced use cases was displayed against the list of the most common use cases drafted after the first interview. The experts agreed that the use cases presented were among the most common ones but proposed the addition of the use case check IT ticket status. After discussing the use cases, the experts were asked about the associated process flows and possible existing depictions of these process flows. The experts provided documentation from previous projects that included process depictions related to the use cases *open IT ticket* and *check IT ticket status*.

Based on the interview data and internal documentation, a list of the most common IT use cases was defined as is presented in Table 15.

Use Case
Device Order
Open IT Ticket
Check IT ticket status
Get Password Reset Link

Table 15: Most Common Use Cases in IT

The Device Order use case represents a request where the user places an order for an item in the service portal. The request is submitted through the service catalogue by locating the desired device, defining the order details and placing the order. After the item request is submitted, it is approved, ordered, configured and delivered.

The analysis conducted in this chapter identified the most common use cases, the associated process flows and presented one example of these for each enterprise function. The following chapter studies the relevant theory regarding the construction of a preconfigured chatbot application in the Now Platform.

5 Literature Review

This section discusses the theory behind chatbots, and the available knowledge related to building a pre-configured ESM chatbot application in the Now Platform. This section first aims to gain knowledge of the underlying theoretical concepts constituting chatbots. Then, the ServiceNow Virtual Agent is addressed extensively, as it covers all the specific technical knowledge required in the development of a pre-configured ESM chatbot application. The reasoning behind the topic selection is further presented in Table 16.

Topic (Including subtopics)	Motive
Artificial Intelligence	Gain general knowledge of the theoretical concepts behind chatbots
Chatbots	Gain general knowledge of chatbots
ServiceNow Virtual Agent	Gain specific knowledge of how chatbots are developed in the Now Platform

Table 16: Literature Review Topics

5.1 Artificial Intelligence

Artificial Intelligence (AI) is a field of information technology that studies software and systems programmed to mimic Natural Intelligence (NI) and Organic Learning (OL) used by humans. Albeit being used for various purposes through different methodologies, all AI systems share two characteristics that correspond to NI and OL: the ability to operate in complex environments autonomously and the ability to improve performance by learning from prior experience. (Siukonen & Neittaanmäki, 2019)

5.1.1 Machine Learning

Machine Learning (ML) studies statistical models and algorithms in the context of AI. The fundamental idea of ML is to develop systems that can become better at certain tasks by processing data relating to that task. The data can be in various forms e.g. files, user

inputs or perceptions of the system of its environment. (Frankenfield, Machine Learning, 2018)

5.1.2 Natural Language Processing

Natural Language Processing (NLP) is a subfield of artificial intelligence that studies how computers can understand natural language used by humans. The core idea of NLP is to read a text input, process and transform the text to a computationally efficient form, derive valuable meaning of it through statistical methods and finally determine an action that is most appropriate. (Singh A. , Karthik, Shivam, & Shrey, 2019)

5.1.3 Natural Language Understanding

Natural Language Understanding (NLU) is a subfield of NLP that focuses on comprehending language in the sense that humans do. NLU can perceive unstructured (i.e. natural) language and transform it into a structured format, enabling the computer program to read it. The focal point of NLU is tackling the complexity and inconsistency of natural language such as misspelling or the use of idioms. (Singh A. , Karthik, Shivam, & Shrey, 2019)

5.2 Chatbots

The term chatbot refers to a computer software that simulates human conversation on a chat platform. The idea behind this simulation is to automate tasks and operate based on the three following steps:

1. Input processing – The bot receives a user input and processes it

2. Understanding – The bot understands the data at hand according to and within the limits of the algorithms constituting its level of understanding

3. Output – The bot responds to the user with an output determined by its model of understanding and the space of possible outputs

Albeit following the same high-level step-cycle, chatbots are generally divided in two categories: scripted and intelligent chatbots. (Botpress, 2019)

Scripted chatbots are only able to interact according to a limited set of paths that are predefined within them. Scripted chatbots are not able to apply free form user inputs and therefore, usually present the array of input options available at that state of the path. With careful and novel design, scripted chatbots can mimic conversation well enough to fulfill a need associated with a certain task. (Botpress, 2019)

Intelligent chatbots use NLP models to increase the level of understanding regarding user inputs. Therefore, they can handle free form text as inputs, enabling the chatbot to facilitate a more genuine conversation. The use of NLP also introduces a new facet to the functionality of the chatbot: it can be trained with embedded machine learning models to improve its performance. (Botpress, 2019)

5.3 ServiceNow Virtual Agent

ServiceNow is an American enterprise software company founded in 2004. (ServiceNow, 2019) The company's annual revenue for 2019 was 3.255 billion dollars, marking a 34 percent year-over-year growth. (ServiceNow, 2019). In 2018, Forbes ranked ServiceNow as the world's most innovative company. (Forbes, 2018)

5.3.1 Now Platform

ServiceNow's Now Platform is a cloud-based system for managing enterprise services. The company has expanded the platform from an IT service Management system to cover all enterprise services, driven by the vision of making IT omnipresent in the enterprise. By merging IT as an element of all enterprise services, business processes are automated and standardized, evoking enterprise transformation inherently due to the reformation. (ServiceNow Inc, 2019)

ServiceNow provides a free developer instance to consumers with access to most of the functionalities, thorough documentation and access to the ServiceNow Community page and knowledge articles. The user community around the Now Platform is substantial in

its size and level of engagement, generating user feedback data, visibility and enhanced user experience through extensive access to information. (ServiceNow Community, 2020)

ServiceNow's Virtual Agent is a chat-based service platform integrated with the Now Platform. It was implemented to introduce a consistent and scalable self-service option for information retrieval and workflow initiation across the enterprise. The Virtual Agent platform consists of three components: Virtual Agent conversational interface, Virtual Agent Designer and Live Agent Support. (ServiceNow, 2019)

5.3.2 Virtual Agent Terminology

Table 17 explains the relevant terminology related to the Now Platform and the Virtual Agent.

Term	Explanation	Example
Utterance	Written or spoken user input that the virtual agent tries to understand. Comprises the different ways users may ask for something.	"I want to open a ticket"
Intent	Describes the user's intention behind the utterance.	Open a ticket
Entity	An object relevant to the intent. Entities add context to user utterances, enabling improved NLU model understanding.	INC10010005
Named Entity	A specific type of entity or object configured within the NLU model.	Time
NLU Model	A collection of utterance examples, associated intents and entities that the system uses as a reference to infer intents and entities upon a new utterance.	-

Table 17: Virtual Agent Terminology. (ServiceNow, 2019)

Table 17 explains the terminology in the context of opening an IT ticket. Utterances, intents and entities correspond to the variables and events presented in the Expert Insights.

5.3.3 Conversational Interface

The Virtual Agent can serve internal employees, external users and consumers through a conversational interface (i.e. chat client) with extensive integration possibilities. This allows access to the virtual agent through third-party and consumer messenger applications, ServiceNow's service portals and on external web pages as an embeddable web client. Figure 4 presents the conversation interface in the context of checking an IT ticket status. (ServiceNow, 2019)

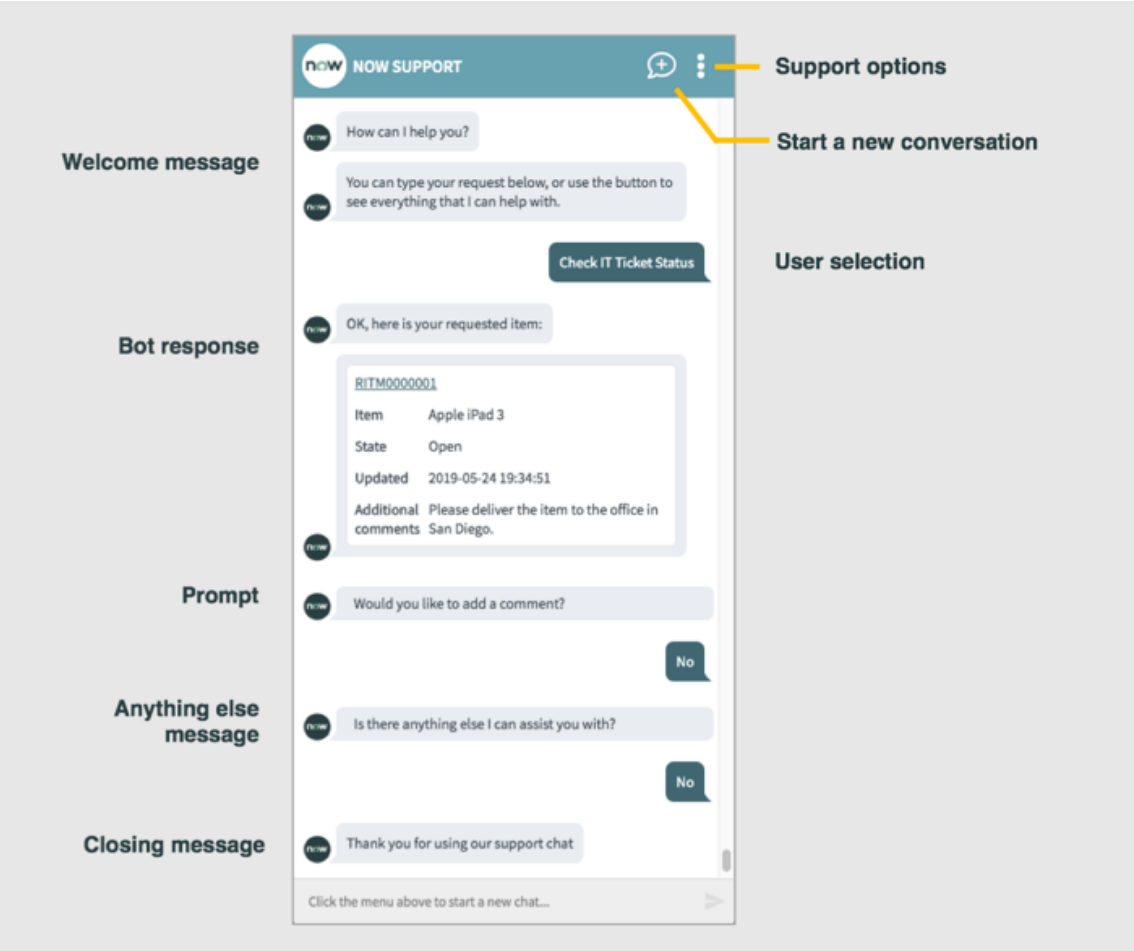

Figure 4: The Conversational Interface: Simple conversation example. (ServiceNow, 2019)

The Virtual Agent includes setup topics, which are standard conversational elements independent of the use cases. The setup topics are divided in three subcategories: conversation beginning, conversation body and conversation ending. In the beginning of the conversation, the virtual agent greets and prompts the user to input their intent via the text input field or through a list of all available topics. Upon recognizing the user intent, the virtual agent switches to the topic related to the intent. Once the topic reaches its end, the virtual agent switches to the *anything else* topic, asking if it can assist with another topic. If the user inputs no, the virtual agent runs the closing topic and ends the conversation. (ServiceNow, 2019)

5.3.4 ServiceNow Studio

Applications used in the Now Platform are built in ServiceNow Studio, which is an application tool for custom application development in the Now Platform. It is designed to mimic modern integrated development environments (IDEs) with its interface and functionality. ServiceNow Studio enables centralized access to the application files, integration with source control (i.e. GitHub) and code searching. (ServiceNow, 2019)

5.3.5 Virtual Agent Topic Builder

The service specific use cases appearing in the conversation body are created and configured in the Virtual Agent Topic Builder. The topics and conversations corresponding to use cases are created with a four-step process: Plan, Build, Test, Publish.

The first step covers the conversation design, determining the structure and variables of the topic. This is achieved by defining the topic scope, intended audience, intermediate accomplishments (i.e. creating a new ticket) and the required information from the users during the conversation. The topic building starts with defining the topic properties, which are presented in Table 18.

Property	Description	Example
Name	Topic Name	Open IT Ticket
Description	Brief description of what the topic is built for	ITSM conversation for creating incidents
NLU Model	The NLU Model used in the topic	ITSM NLU for Virtual Agent
Associated Intent	The intent within the NLU Model that was built for the topic	OpenITTicket
Category	A dropdown list assisting with the sorting of the topics in the main view	ITSM Self Service

Condition	The expression that must return true or false to display the topic to the user when searching from the client	(function execute() {
		var gr = new GlideRecord('incident');
		return gr.canCreate(); })()

Roles	Roles that a user must satisfy to view and run the topic	snc_internal
Live Agent Variables	Variables defined in the chat setup form to send dynamic context to a live agent if the conversation is transferred from a chatbot to a live agent	

Table 18: Dialogue Topic Properties. (ServiceNow, 2020)

After the properties are defined, the conversation is built with the topic flow editor. The topic flow editor is a graphic, low-code tool for building the conversations and is presented in Figure 5.

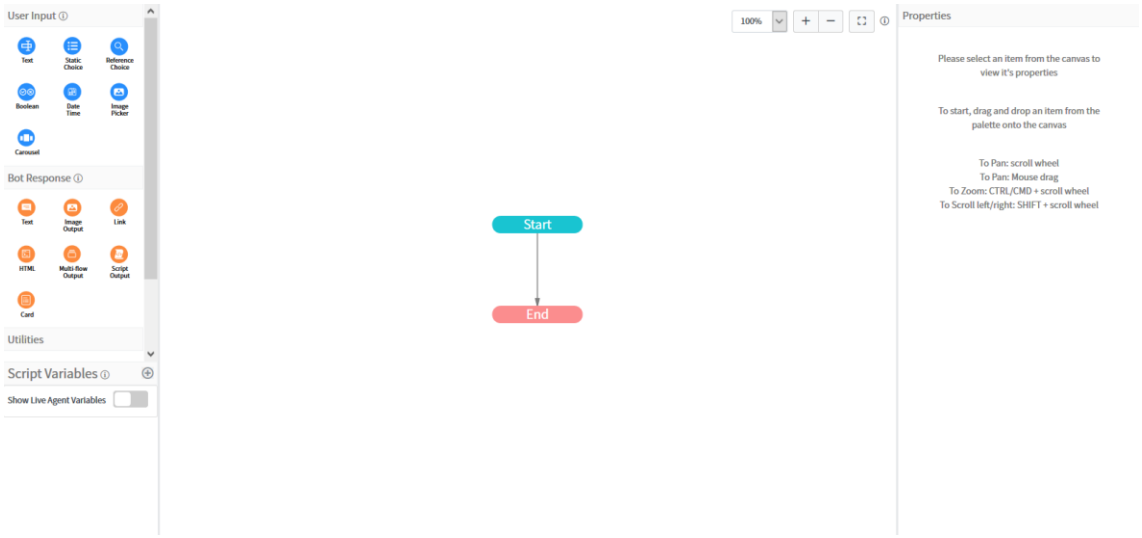

Figure 5: Topic Flow Editor. Source: (ServiceNow, 2020)

The specific functions to be carried out in different states of the conversation consist of user inputs, bot responses and utilities.

5.3.6 ServiceNow Natural Language Understanding

ServiceNow's NLU functionality is based on a system hierarchy with three components: The Virtual Agent, an NLU inference Service and the NLU model. The high-level hierarchy is illustrated in Figure 6.

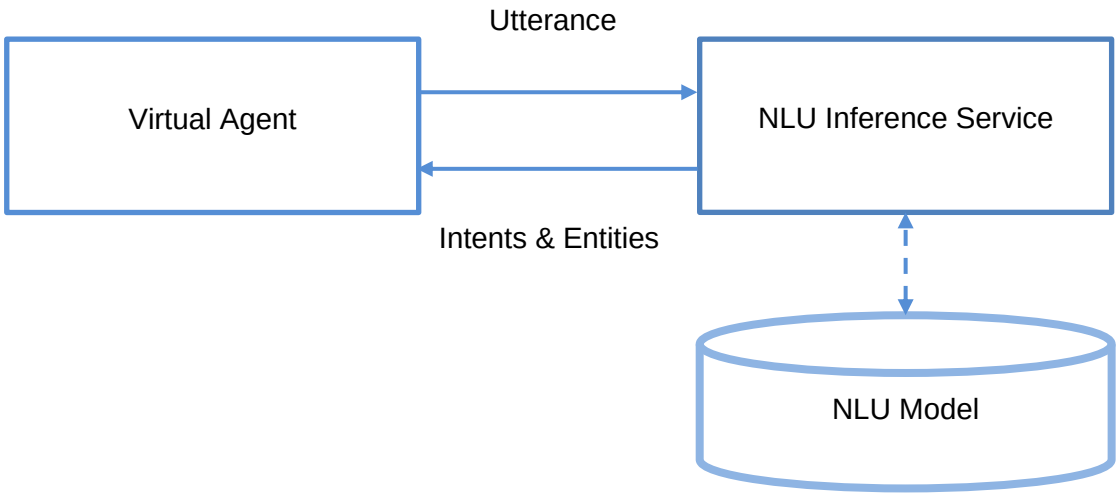

Figure 6: High-Level Hierarchy. Source: By "Natural Language Understanding Consumption" (ServiceNow, 2019)

As seen in Figure 6 above, the virtual agent forwards the utterance (user input) to the inference service. The service predicts intents and entities from the utterance according to the NLU model.

5.3.7 Building a Natural Language Understanding Model

ServiceNow Studio includes an empty NLU Model file to be used as a template for the model building. Once the NLU model file has been created in the application environment, the basic properties (Model name, description, confidence threshold) are defined. (ServiceNow, 2019) Figure 7 presents the view of an empty NLU model in ServiceNow Studio.

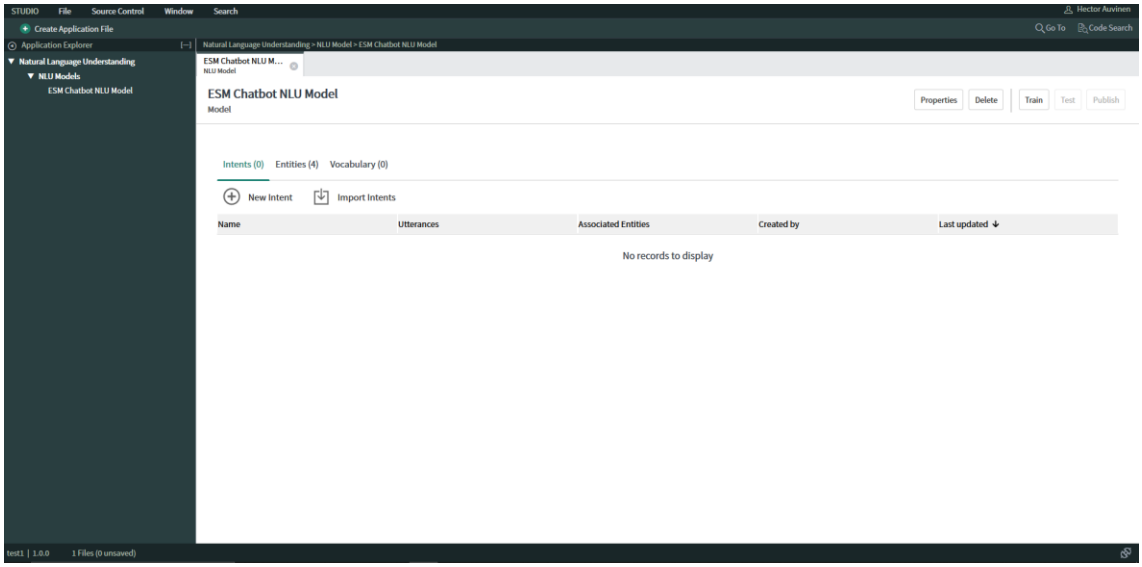

Figure 7: Empty NLU Model in ServiceNow Studio. (ServiceNow, 2020)

As seen in Figure 7, the NLU model development consists of three parts, intents, entities and vocabulary. These are accessible through tabs in the model file. Intents, entities and vocabulary are configured according to the use cases that the NLU model serves. Empty NLU models contain four system defined entities by default: Date, time, duration and location. These are universally useful and applicable across use cases and if desired, can be disabled. Once the desired intents, their associated entities and the vocabulary are defined, the model is trained based on these parameters. The training is initiated through the “Train” button, and once trained, the model can be tested in the development environment before publishing it. Model testing is done through the “Test” button, which

opens a pane with a text input field. After submitting the test statement, the system returns three highest scored intents that exceed the confidence threshold. This functionality enables rapid and iterative development, as the model can be tested within the development environment without publishing it. (ServiceNow, 2020)

5.4 Theoretical Framework

ServiceNow Virtual Agent is the only topic that is directly utilized in the development of the pre-configured ESM chatbot application. Table 19 presents the subtopics that are directly used in the solution building and specifies how they are used in the application building.

Topic	Utilization
Virtual Agent Terminology	Understanding the concepts behind topic and NLU model building
Topic Builder	Transform the processes corresponding to the use cases into conversations, including the logical continuum and actions (e.g. database actions)
Building a Natural Language Understanding Model	Build an NLU model to facilitate natural language interaction
ServiceNow Studio	Combine the topics and the NLU model into a functional application
Conversational Interface	Deploy the application in a portal

Table 19: Theoretical Framework

5.5 Framework for the Proposal

The expert insights and the theoretical framework form the conceptual framework of this study, which is presented in Figure 8.

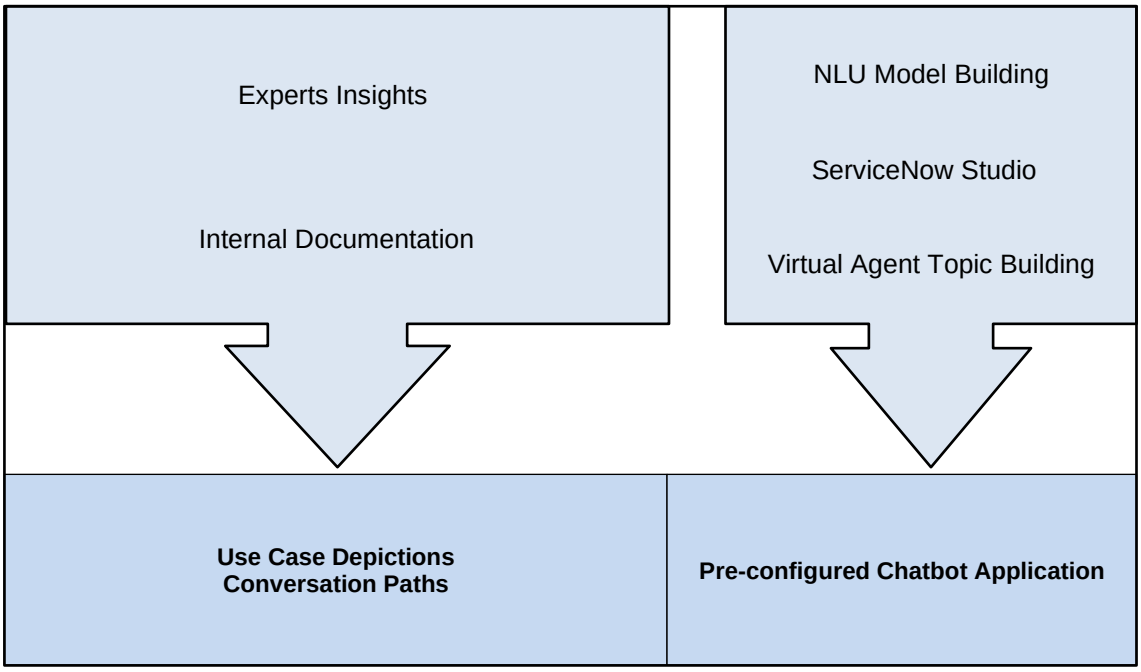

Figure 8: Framework for the Proposal

As shown in Figure 8, the conceptual framework of this thesis uses two main sources. The Expert insights and internal documentation are the source for the use case depictions and the conversation path illustrations. The literature sources from ServiceNow's documentation are used to develop the pre-configured chatbot application.

This chapter studied the relevant literature regarding the construction of a pre-configured chatbot application in the Now Platform, resulting in a theoretical framework. Combining the literature review and the expert insights, it also presented a framework for the proposal. Based on the framework, the proposal is presented in the following chapter, covering the use cases, conversation flows and the pre-configured chatbot application.

6 Proposal

This chapter discusses the solution proposal that is built based on the data from expert insights, internal documentation and literature topics specified in the previous chapter. The proposal consists of slides including the use case depictions and the conversation paths and an application in the Now Platform (Pre-configured chatbot application).

6.1 Overview of the Proposal

The proposal is presented in three segments. The first segment presents the most common use cases and their descriptions for each enterprise function. Then, one conversation path from each function is displayed and discussed. Finally, the pre-configured chatbot application is addressed, covering its development and final form.

6.2 Use Cases

The most common use cases discovered are displayed in Table 20.

Function	Use Case	Description
HR	How to report sick leave	Request for instructions regarding the process of sick leave reporting
	Holiday balance inquiry	Inquiry of the number of available holiday days
	How to report holidays	Request for instructions regarding the process of holiday reporting
	Payroll discrepancy	Report and resolve salary and/or pay related discrepancy
	Current salary inquiry	Inquiry of the amount of the employee's salary
Finance	Open project	Insertion of a new project record into the system
	New vendor	Insertion of a new vendor record into the system
	Vendor data change	Modification of an existing vendor record
	New customer	Insertion of a new customer record into the system
	Customer data change	Modification of an existing customer record
IT	Device order	Request for ordering a new device
	Open IT ticket	Creation of an incident ticket
	Check IT ticket status	Inspection of the status of an incident or item request ticket
	Get password reset link	Request for a password reset link (system credentials)

Table 20: Use Case Depictions

6.3 Conversation Paths

This section presents three conversation paths, one from each enterprise function. The conversation paths consist of three lanes; the upmost lane represents the user and the user inputs, the lane in the middle represents the chatbot's outputs that are visible to the

user and the last lane represents the logic used and actions carried out by the chatbot, which are invisible to the user in the conversation interface.

6.3.1 HR

The HR conversation paths were derived from internal documentation containing process flow depictions from customer projects and information about the case company's internal processes. Figure 9 presents the conversation path associated with the use case "Holiday balance inquiry".

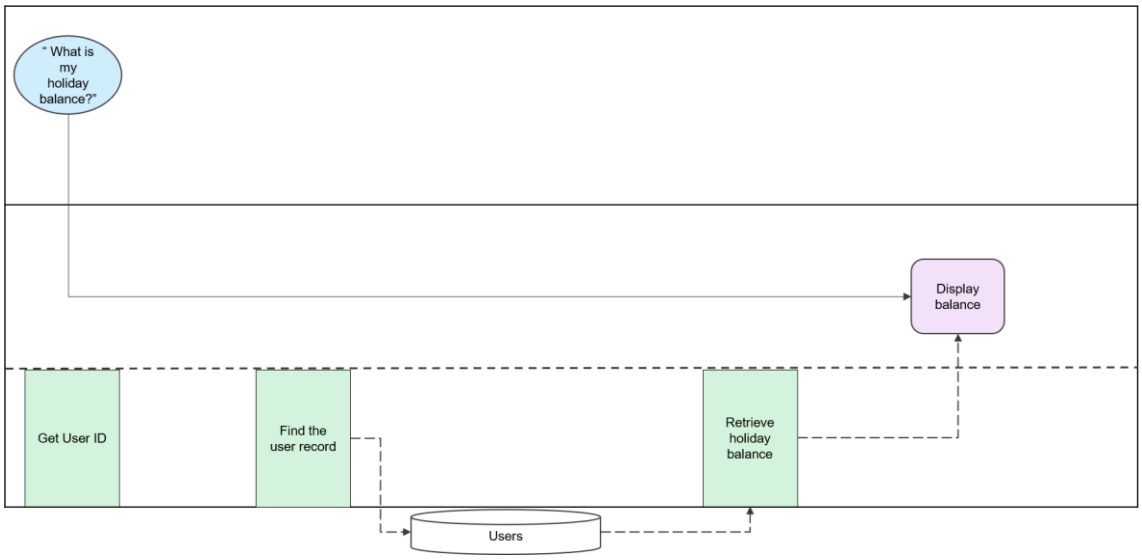

Figure 9: Conversation Path: Holiday Balance Inquiry

The conversation path starts with the user prompt (i.e. utterance that triggers the use case topic). The user's system ID is used to query the system users table and upon finding the matching record, the queried variable (holiday balance) is retrieved. Then, the balance is displayed to the user.

6.3.2 Finance

The finance conversation paths were derived from internal documentation containing process flow depictions from customer projects and from the service portal forms used by the case company. Figure 10 presents the conversation path associated with the use case "Open project".

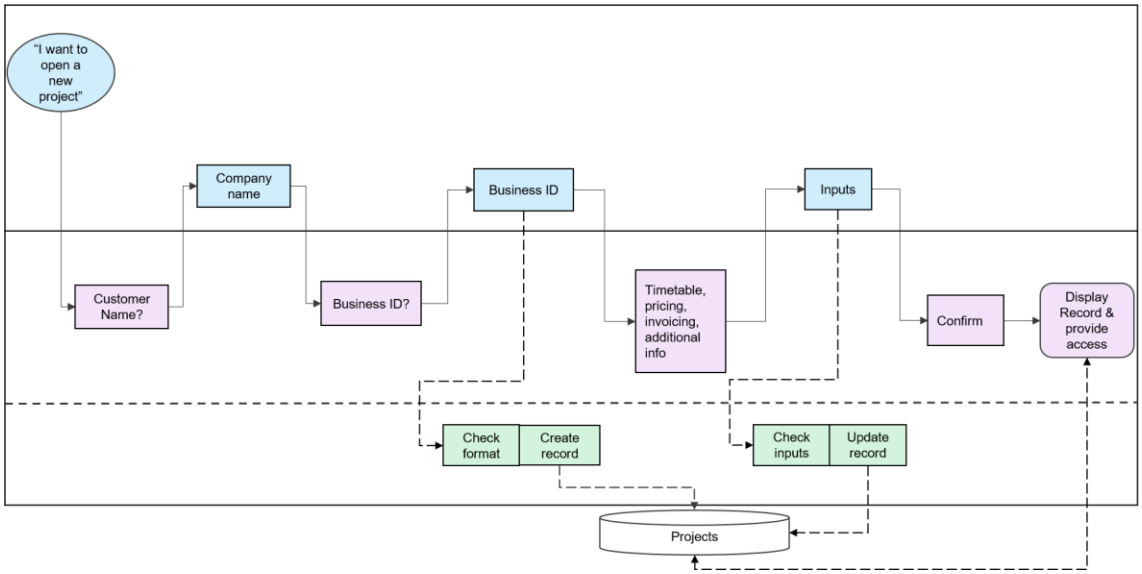

Figure 10: Conversation Path: Open Project

After the user prompt, the conversation path mirrors the contents of submitting a project initiation form in a service portal. However, the advantage of implementing the use case in the context of a chatbot lies in the user guidance and input validation. Upon asking for information about the project, the chatbot can provide proactive guidance and instructions e.g. “Please provide the Business ID. The ID should start with seven digits followed by a dash and finally, one digit.” After the user inputs information, its validity can be confirmed with regex and conditional logic. In the context of providing the business ID, a Regular Expression (Regex) condition can be scripted to process the user input to validate that the input is of the right format. After all required information is provided, the chatbot displays the information inputted by the user, and asks for a confirmation. After the confirmation, the user is provided with a summary of the new project record and access to the record in the system.

6.3.3 IT

The IT conversation paths were derived from internal documentation containing process flow depictions from customer projects and from ServiceNow’s Virtual Agent Documentation. Figure 11 presents the conversation path associated with the use case “Device Order”.

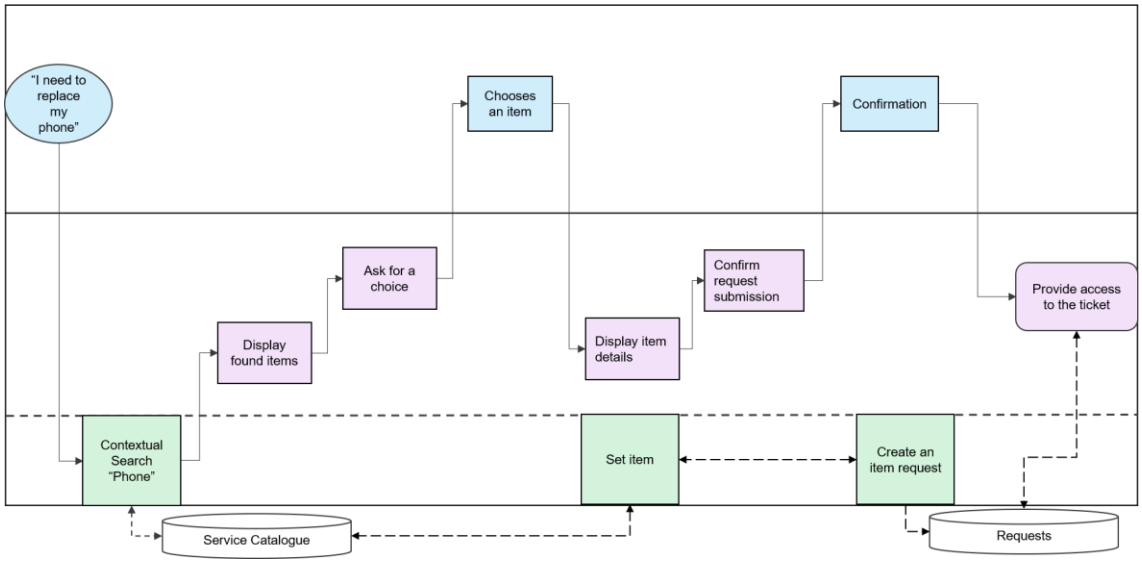

Figure 11: Conversation Path: Device Order

As displayed in Figure 11, the user prompt “I need to replace my phone” initiates a contextual search. The sentence is transformed into words, which are used as search terms to query the service catalogue for relevant items. The query returns all items in the catalog it evaluates relevant, after which the chatbot displays the items to the user and asks for a choice. After the user chooses an item, the chatbot provides further detail of the item and asks for a confirmation. Once confirmed, an item request is created and the chatbot provides the user a link to the item request ticket.

6.4 Pre-Configured ESM Chatbot Application

The pre-configured chatbot application consists of an NLU model and Virtual Agent topics. The NLU model is initiated first, and the use cases are implemented into the NLU model as intents. An intent describes the intention of a user and therefore, it is synonymous to the use cases but formulated differently. After this, a minimum of 10 utterances per intent are formulated, after which the model is trained. Figure 12 presents the use case “Open Project” as an intent, displaying the intents utterances.

Figure 12: NLU Model Intent "Open Project" in ServiceNow Studio

After training the model, new utterances are tested with the NLU model to inspect how well it generalizes i.e. can understand the user's intent even if they formulate their expression in a way differing from the utterances inserted into the model. Figure 13 demonstrates the testing of a new utterance with a trained model.

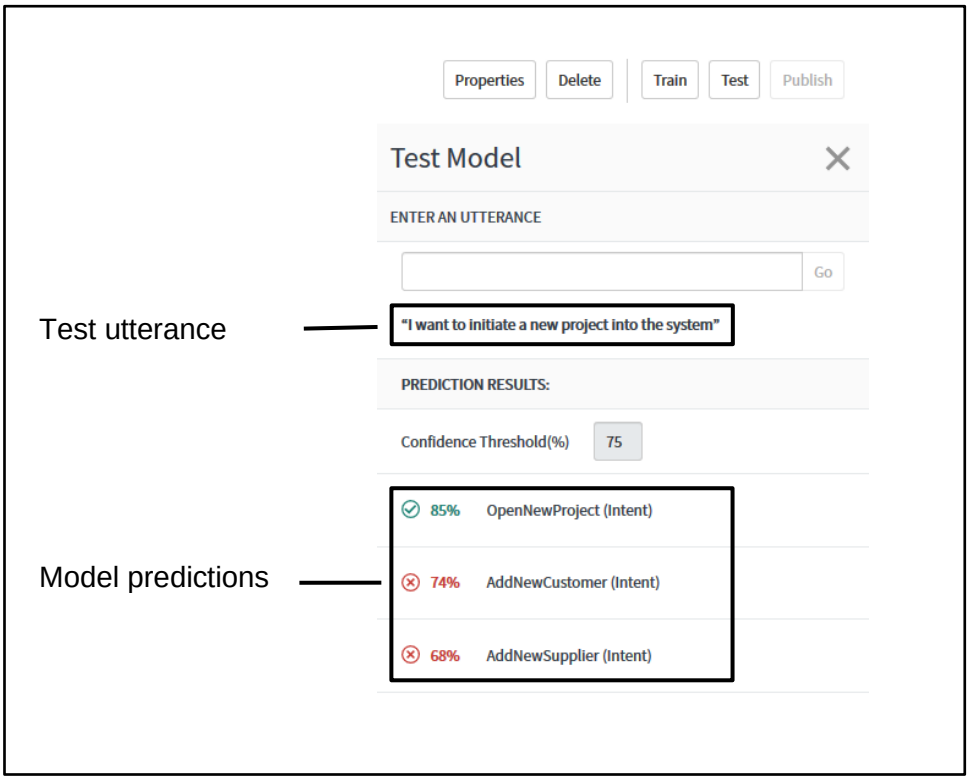

Figure 13: NLU Model Testing

After the NLU model is created, the topics are created in the application builder. Each topic is attached to their corresponding intent, in this case “Open Project”. After initiating the topic, the flow logic is implemented, and the topic is saved and published. After all the topics are created, tested and published, the chatbot is ready for use. The chat client is placed on a portal as a widget and is ready for use. Figure 14 displays the pre-configured chatbot application in the service portal.

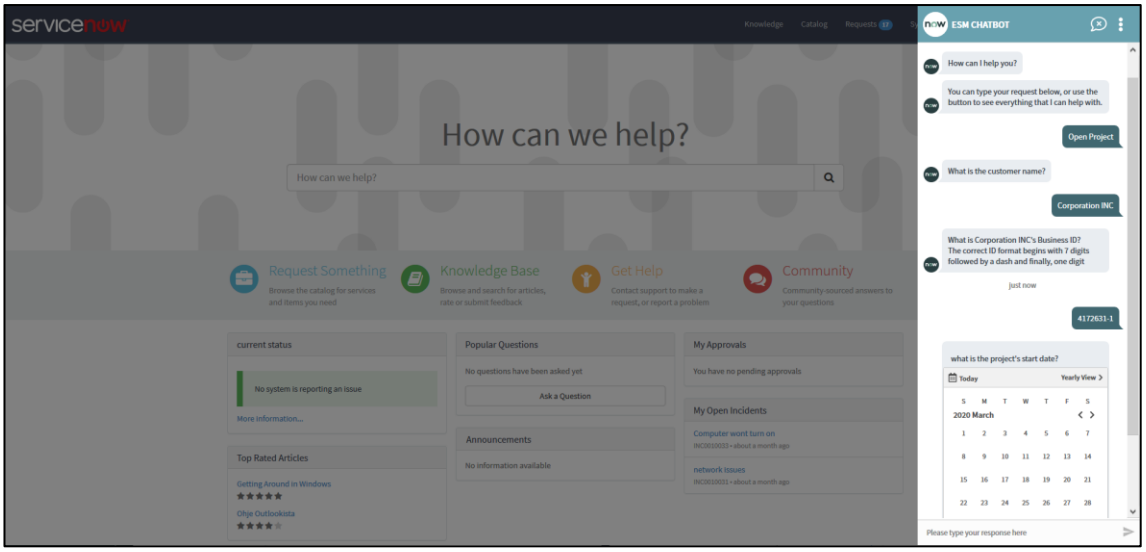

Figure 14: ESM Chatbot in the Service Portal

As this chapter presented only one conversation path illustration per each enterprise function, the remaining illustrations can be found in the Appendices. The pre-configured chatbot application could not be displayed in its full extent, as it included 14 topics constituting of long conversations.

This chapter presented the solution proposal of this thesis, covering the use cases, conversation paths and the pre-configured chatbot application. The following chapter covers the proposal validation, which is based on feedback from internal stakeholders.

7 Proposal Feedback

This section describes the results of the validation of the solution proposal presented in chapter 6. This chapter discusses the validation stages and their respective outcomes.

7.1 Overview of the Feedback Stage

The objective of the proposal validation was to ensure that the solution proposal could be used in chatbot development and customer-facing presentations. This was achieved by compiling a demo bundle, which was a condensed version of the solution proposal. Due to the extensiveness of the solution proposal, this approach was deemed more appropriate and efficient as opposed to presenting the proposal in all its entirety. The continuum of the proposal validation in illustrated in Figure 15.

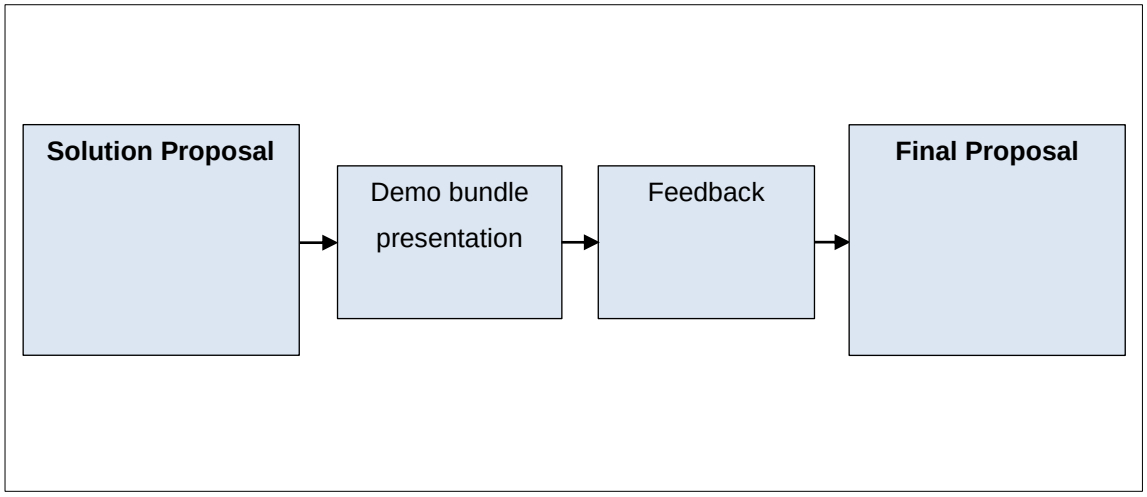

Figure 15: Proposal Validation Stages

The demo bundle was presented to the chatbot substance experts, the Business Automation CTO, and the Business Automation Executive as a set of PowerPoint slides and a live demonstration of the chatbot application. The slides included one use case description and conversation path per each enterprise function, followed by a live demonstration of the pre-configured chatbot application. The contents of the demo bundle are further described in Table 21.

Area	Content
Use Case Descriptions	Open Project Holiday Balance Inquiry Device Order
Conversational Paths	Open Project Holiday Balance Inquiry Device Order
Chatbot Application Demonstration (conversation topics)	Open Project Holiday Balance Inquiry Device Order
Chatbot Application Demonstration (platforms)	Now Platform Service Portal External Website (Private domain)

Table 21: Contents of the Demo Bundle

7.2 Feedback

The demo bundle presentation was concluded with a feedback round where each participant provided their feedback on the solution proposal demo. The participants were pleased with the solution proposal and affirmed that it met the set requirements. According to the participants, the use cases were described well, and the conversation path illustrations were concise, covering the essential elements without going too deep into the specifics. Furthermore, the functionality of the chatbot application was found versatile and good. According to a chatbot substance expert, the proposal will be very beneficial, as customer facing demonstrations and chatbot solution development no longer needs to be started from scratch.

The participants also proposed points of improvement to be implemented regarding the pre-configured chatbot application. The chatbot could be more effective if proactive elements were to be introduced into its behavior i.e. topic configurations. This would mean including informative messages in the topics, for example displaying knowledge base articles to the user to enable self-resolution and therefore, reduce the number of incident tickets created. Another improvement proposition was the use of SharePoint as the external website instead of a private domain, as SharePoint is widely used as an intranet platform, and customer projects often involve the implementation of a chatbot in their intranet instead of a service portal.

8 Summary & Conclusions

This section concludes this thesis by providing an executive summary, recommendations for the next steps and an evaluation of the thesis by reflecting the initial objective against the results.

8.1 Executive Summary

The objective of this thesis was to standardize the development of chatbot solutions in Sofigate. The development model used prior to this project was based on a case-by-case approach and required the chatbot developers to start from scratch upon receiving an assignment.

The thesis started with the current state analysis which was conducted to discover the feasible and most valuable areas of standardization. Furthermore, the analysis studied the prerequisites and other requirements for the standardization to work and yield value.

After the current state analysis, the required knowledge of the most common use cases and the conceptual framework were established by reviewing literature and expert insights to acquire existing knowledge and best practices.

Based on the acquired knowledge and the conceptual framework, an initial solution proposal was built. The proposal consisted of descriptions of the most common use cases in HR, Finance and IT enterprise functions, definitions and illustrations of the corresponding conversation paths, and a pre-configured chatbot application in the Now Platform.

The proposal was validated by presenting a demo bundle covering one use case and conversation path illustration, and a live demonstration of the pre-configured chatbot on the Now Platform and an external website.

Based on the feedback, the solution proposal can already be used in its current form as a template from which to start the development. Furthermore, the proposal sets a baseline for the standardization of chatbot development.

8.2 Proposal Implementation Next Steps

For Sofigate to utilize the proposal in customer projects, it should be accessible to all employees who engage in development and delivery activities in chatbot projects. The pre-configured chatbot application can be centralized by linking it to a source control (GitHub) repository hosted by Sofigate. From there, the application can be fetched and modified according to the case at hand without changing the original application.

The use case descriptions and conversation path illustrations are to be uploaded to the chatbot team's SharePoint channel, from where it is accessible to the team members. Furthermore, the pre-configured chatbot deployed in the team's SharePoint channel should be developed further to cover more use cases.

By centralizing the proposal's deliverables to a repository and a SharePoint site hosted by a group instead of an individual, they will be robust to changes in personnel and remain accessible in the future to all Sofigate employees who hold a stake in chatbot projects.

8.3 Thesis Evaluation: Objective vs. Results

The objective of this study was to standardize the development of chatbots for HR, Finance and IT enterprise functions.

The final proposal included the discovery and definition of the most common use cases and the corresponding conversational paths. This part of the proposal was based on data from internal documentation and interviews with experts possessing deep knowledge of their respective enterprise functions. The most common use cases were identified by interviewing experts with a background in customer project implementations. The in-depth, use-case specific information (e.g. processes) was acquired through interviews with operational experts and internal documentation. The inclusion of operational experts turned out to be of great importance, as the existing processes could be transformed into conversation paths based on the roles, events and actions defined in the process depictions. The existence of pre-defined use case descriptions and conversation paths streamlines and standardizes the chatbot development, as they can be used as-is in the

design phase of the chatbot development. The pre-configured chatbot application was developed according to the best practices sourced from Sofigate's internal chatbot experts and ServiceNow's documentation and the development community dedicated to the ServiceNow Virtual Agent. The application is extensive enough to be used in development as a template or a point of reference, and in customer meetings to demonstrate the opportunities and benefits of chatbots in ESM. Furthermore, it displays the elevated readiness and capability of Sofigate as a chatbot solution provider.

In conclusion, this thesis reached its objectives and standardized Sofigate's chatbot development in HR, Finance and IT functions. It also laid a foundation from which to build on and expand to other enterprise functions (e.g. facilities)

8.4 Final Words

This thesis taught me a great deal about enterprise service management, both in the context of soft and hard skills. Interacting with people from different departments, it was crucial to understand the business context in which they work to establish a rapport in order to extract information efficiently. Furthermore, the construction of the conversation path illustrations turned out to be more difficult than expected. The initial assumption of constructing everything with a development-first mindset was not supporting the fundamental purpose that the illustrations served, which is to display the automatization of enterprise services in a way that is easy to understand regardless of the observer's background. By abstaining from the use of technical vocabulary and simplifying the conversation continuums, the conversation paths cover enough of the technical aspects without diving too deep into the specifics.

The hard skills acquired during this thesis are of immense value for me, as my programming background consisted of languages used for data analysis and engineering, and the corresponding methods and frameworks. As data analytics relies on applying mathematical concepts, the prevailing paradigm in ESM using low-code or no-code solutions was completely new to me. However, the low-code and no-code approach applies to the end-users and therefore, I had to familiarize myself with a new language, JavaScript. I am grateful to the developers who guided and assisted me in the process of learning this

language and recognize how privileged I am to have learned JavaScript, which is arguably the predominant language in web-based development.

I am extremely excited about the future and the upcoming projects with chatbots. This thesis has been by far the most educative part of my studies, and I am grateful to Sofigate and Metropolia University of Applied Sciences for the guidance and tools without which I would not have been able to conduct this study. I would also like to thank Nina Hellman for her incomparable skills as the thesis instructor and as a lecturer, and Sofigate's Jussi Vuokko for his guidance throughout this thesis, especially for his assertive attitude during times when my approach was going amiss.

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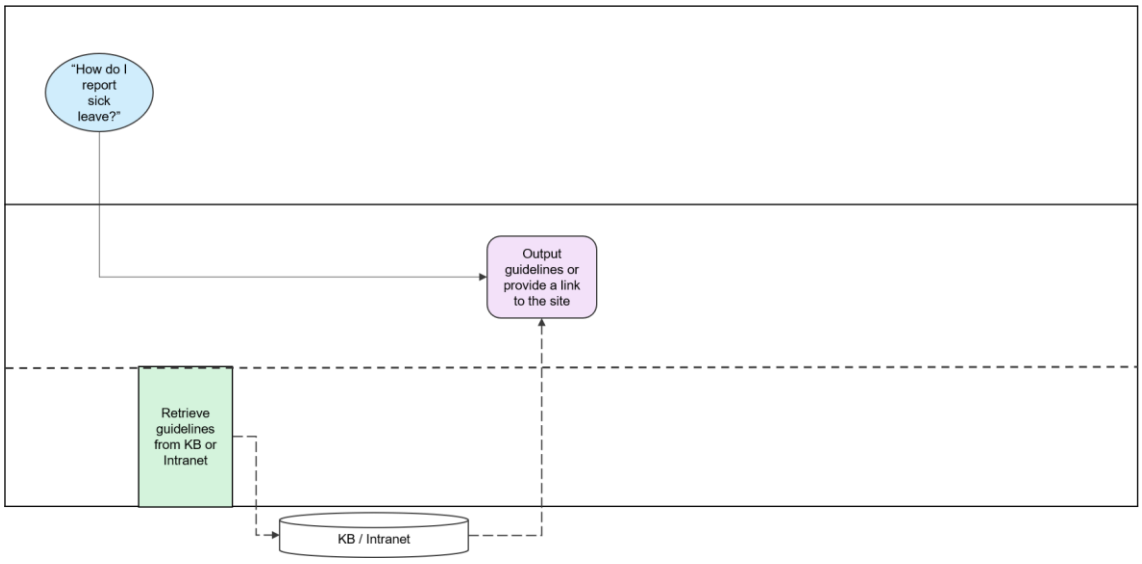
Appendices

How to report sick leave



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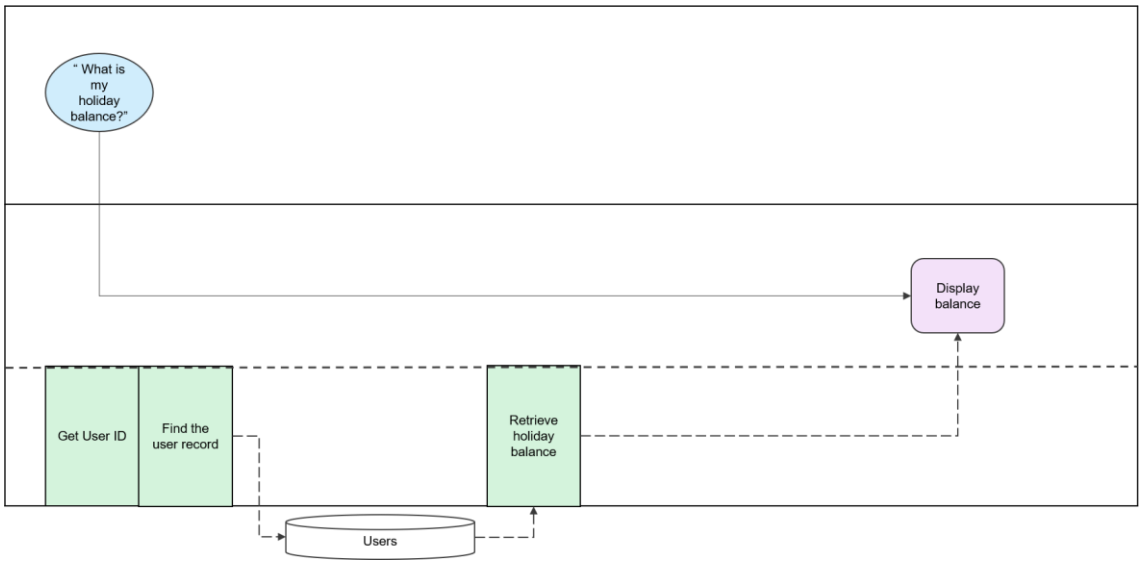

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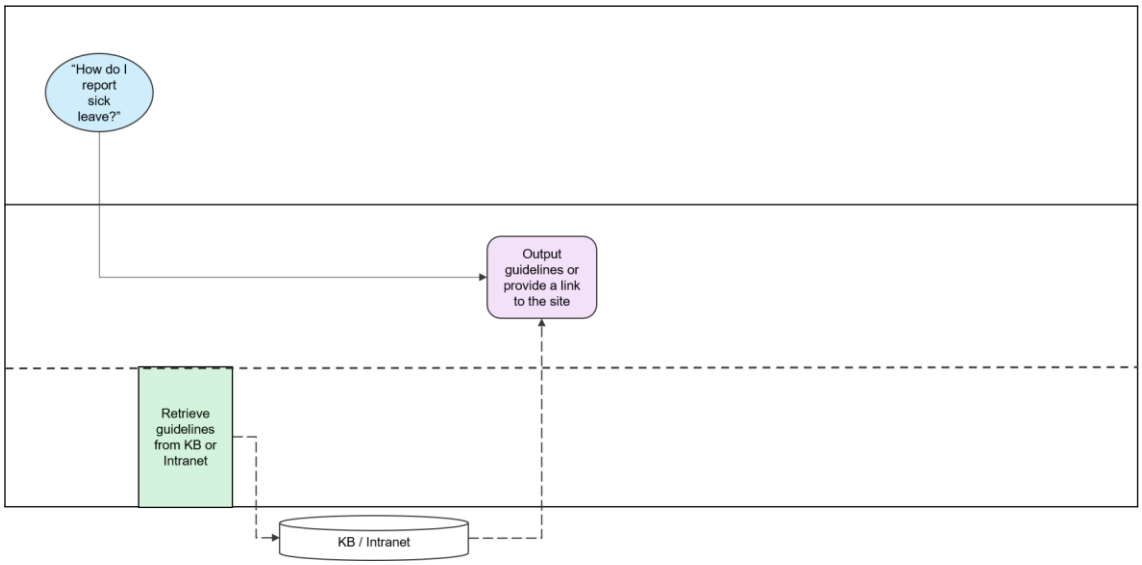

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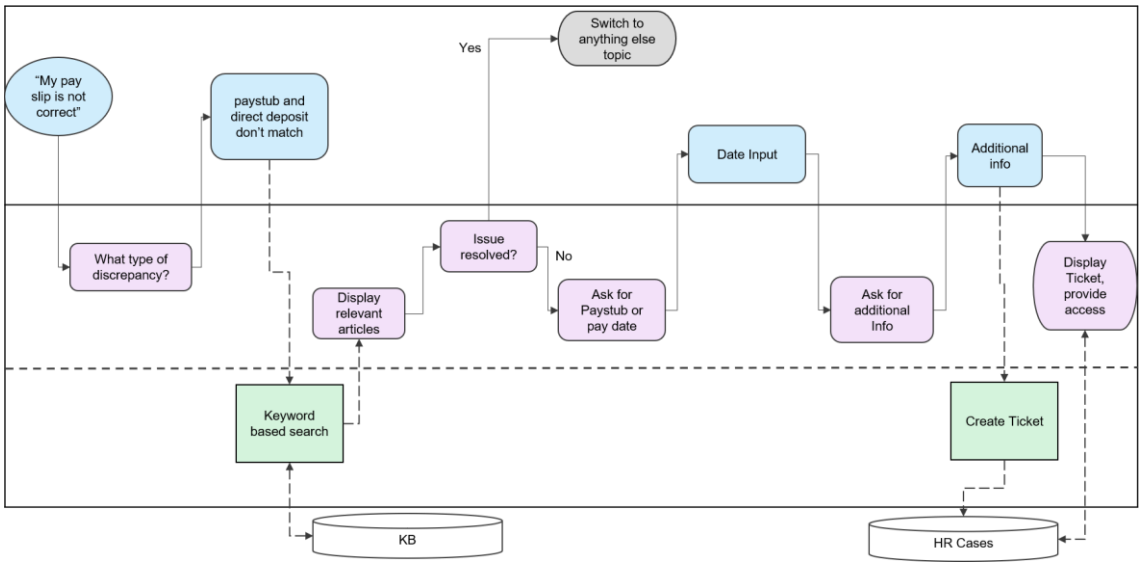

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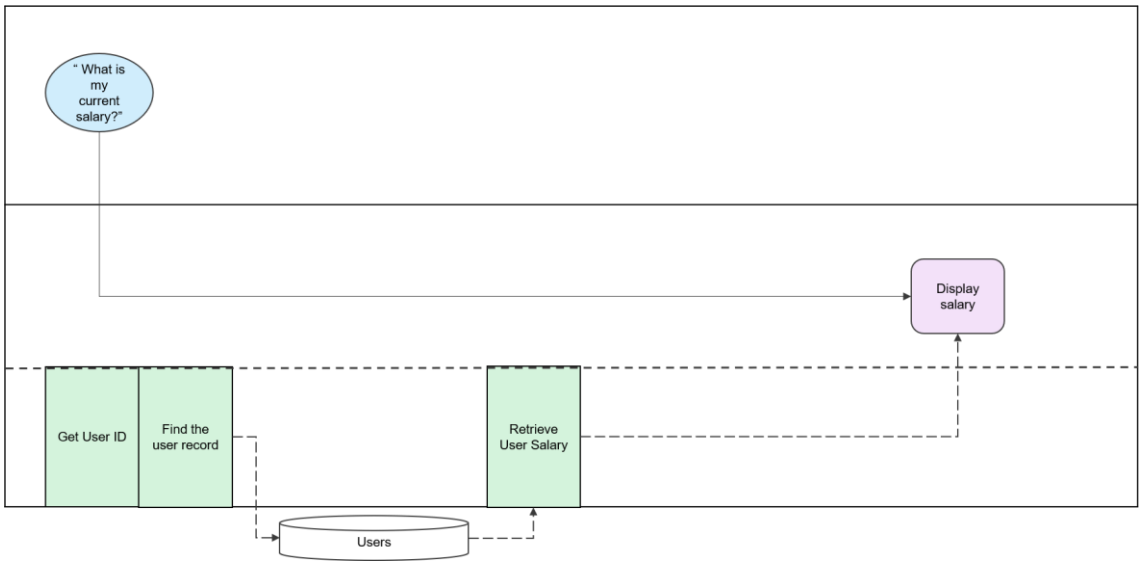

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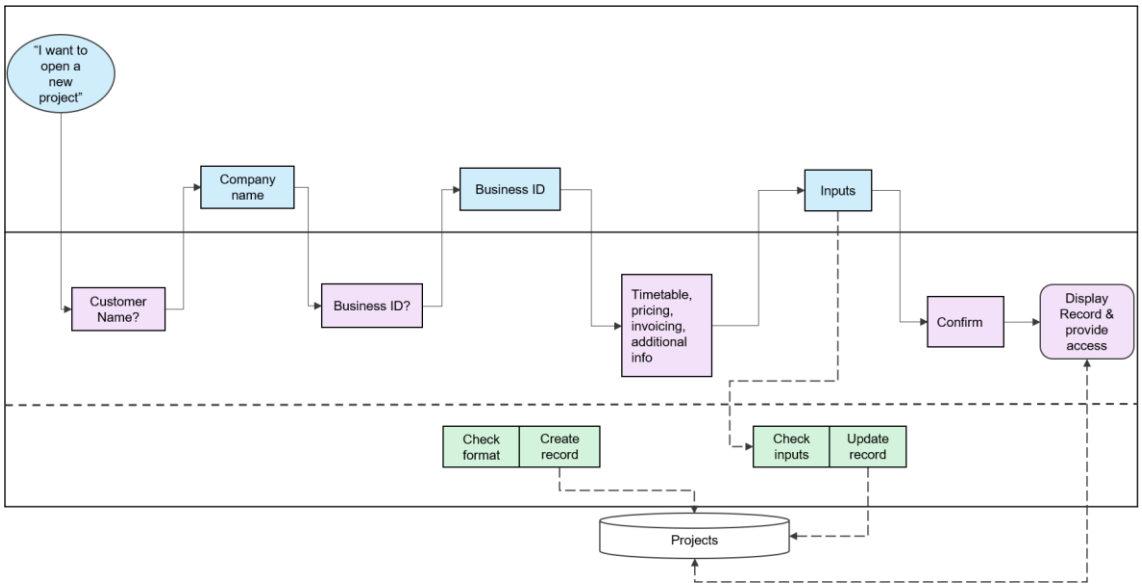

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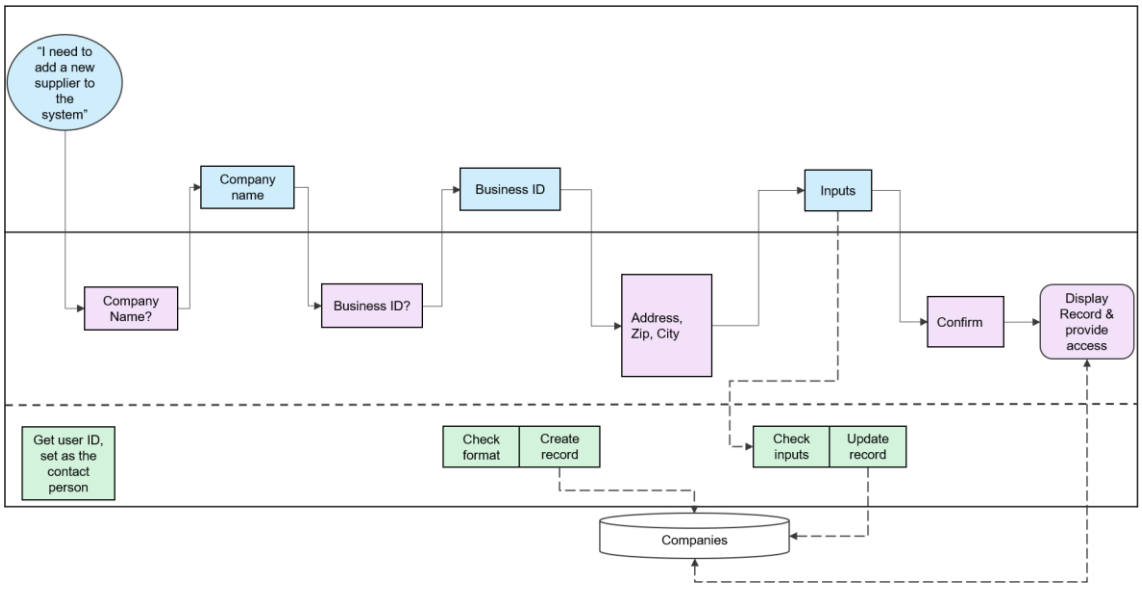

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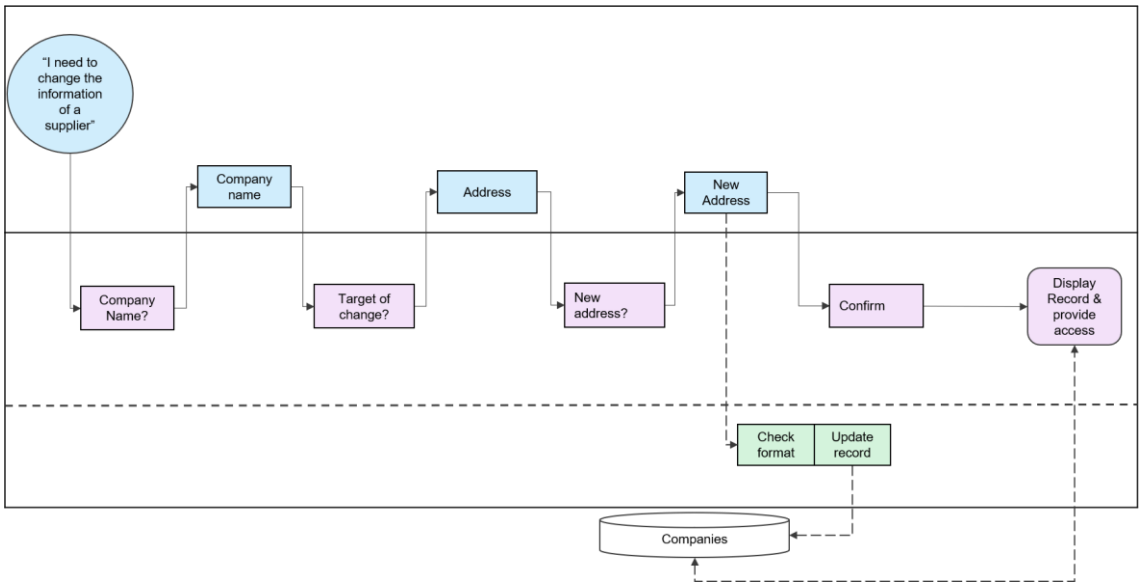

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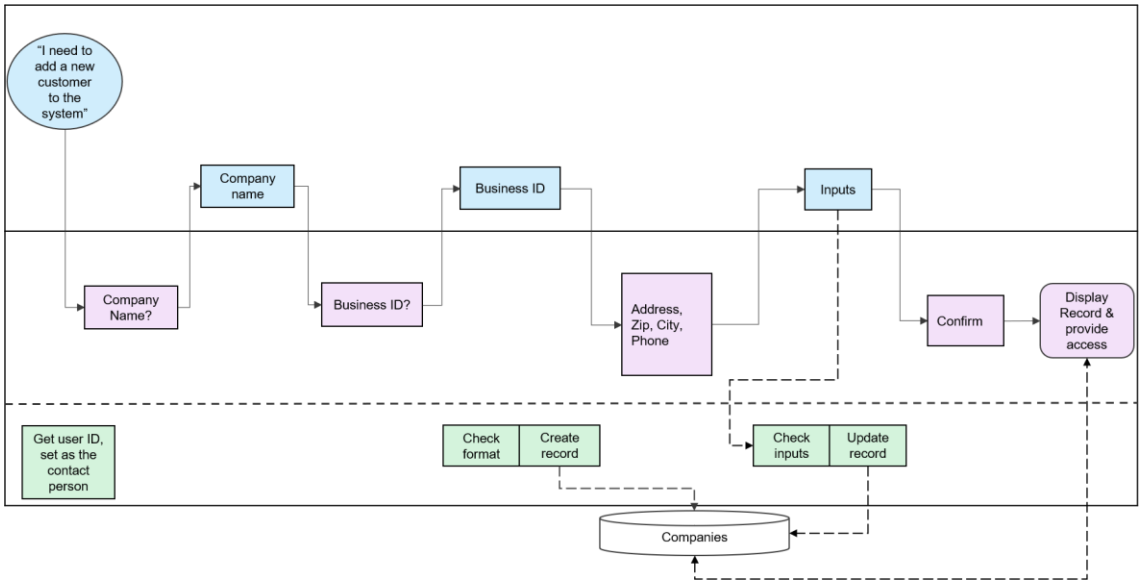

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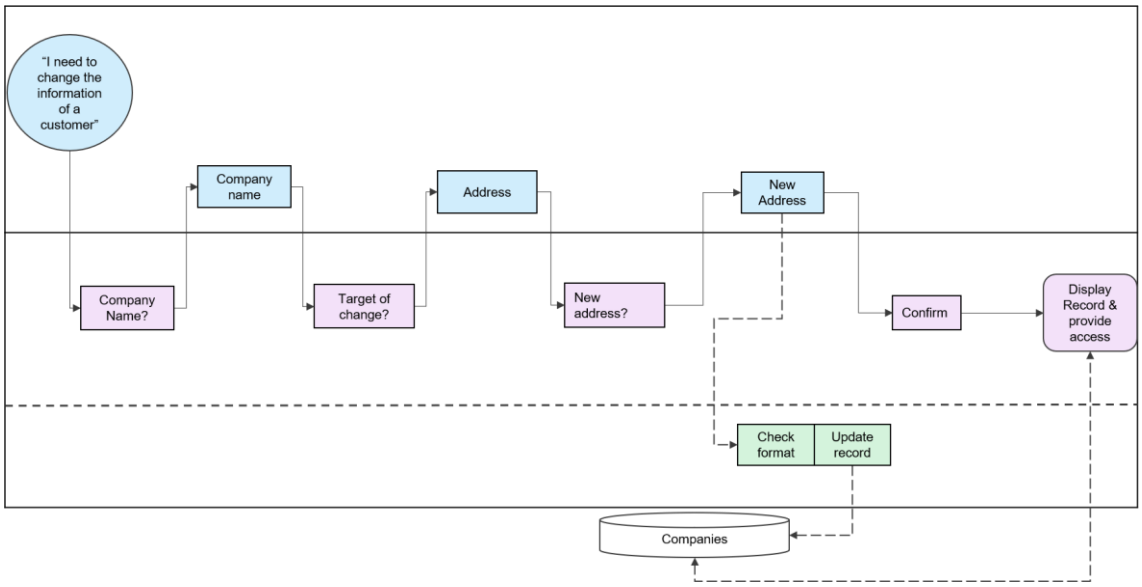

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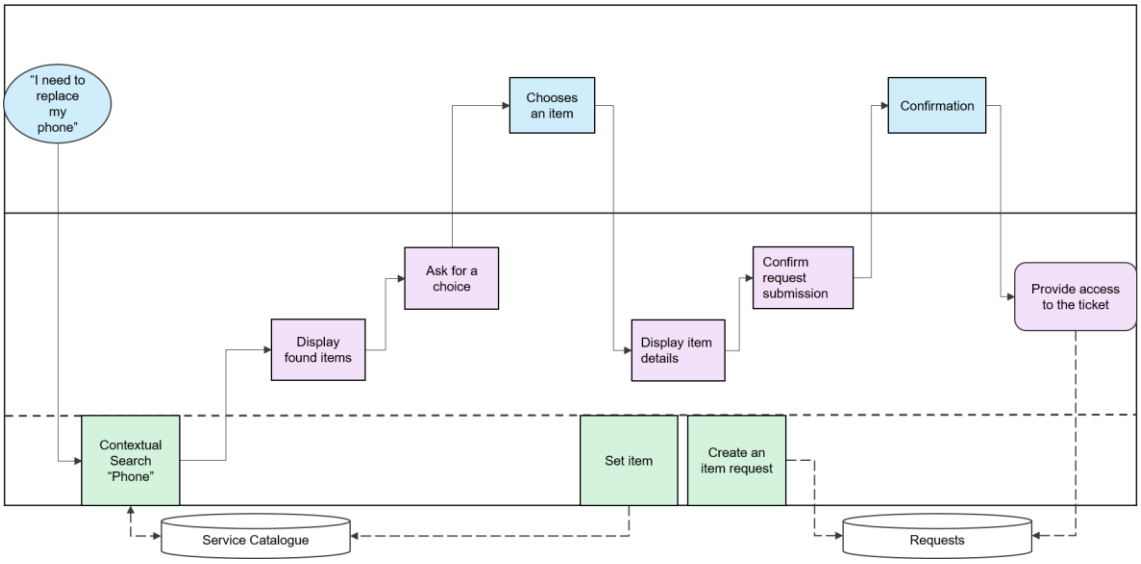
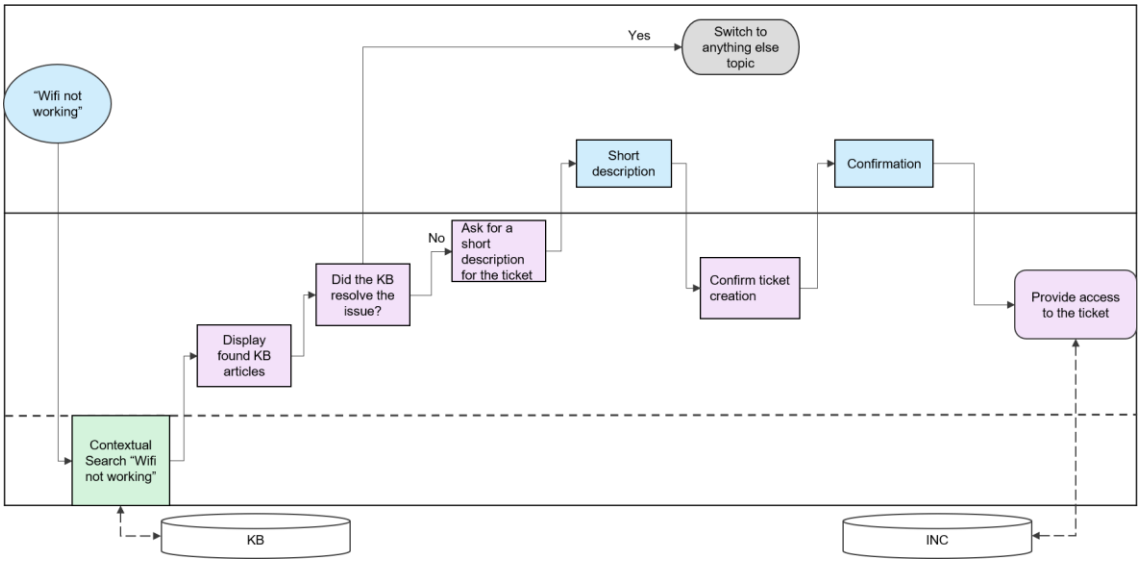
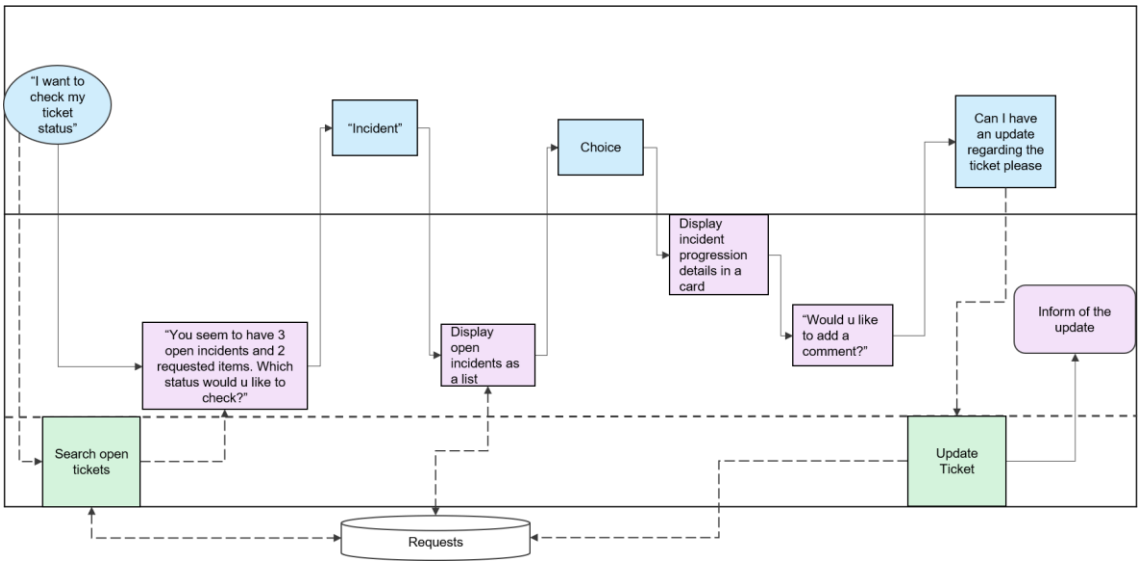


Open IT ticket



Check IT ticket status



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