Conversational AI – Virtual Assistant & Chatbot at Sika Ltd.: A Case Study from the Chemical Industry

C. Marioni, M. Soriano Ramirez, M. Gaemperli, A. Kenel, and M. Krey*

***Abstract*—The advances in Artificial Intelligence (AI) and Conversational Agents in recent years have opened possibilities for companies and software developers using chatbots. Several frameworks have been developed to help in the development process of chatbots. One important representative of these frameworks is the Watson™ Toolset created by IBM. In this paper, we present a use case of a chatbot that assists users in creating electronic educational material as part of the internal training platform of Sika Ltd. Through this use case, we present some of the technologies available in this space including a conversational agent that can be programmed through a graphical interface, a language tone analyzer and automated translation mechanisms. Furthermore, a summary on why and how to embed the Watson Discovery services into a chatbot will be given. We show, how these technologies can be created to develop a useful assistant, show experimental results based on interactions of educators, and discuss possibilities for further development.**

***Keywords* –** case study, chatbot, chemical industry, IBM Watson.

I. Introduction

The advances in technology are transforming our world. Businesses must adapt to the new trends and possibilities that these advancements offer. One technology with the potential to disrupt and permanently change the way that we do business are chatbots. With the help of chatbots, already today, a fully automated customer service is possible [1].

An advanced and well implemented chatbot can offer various advantages for the company as well as the user – e.g. service, sales and support costs can be reduced. Likewise, efficiency gains for companies and users can be observed. This is especially beneficial for companies that deal with an increased workload in contact centers and support [2]. Another big advantage of chatbots is the availability [3]. Customers and users can communicate with a chatbot 24/7 without being restricted to the opening hours of the business or the availability of a knowledgeable person that can answer inquiries. Additionally, chatbots can interact and answer questions to numerous clients at the same time [4]. Therefore, an initial investment in a functioning chatbot can be very lucrative for companies that plan to scale up and grow bigger in the future. Moreover, a chatbot is consistent in the way it deals with information. If the answer to a question is implemented correctly, a chatbot always gives the correct answer to the user. Another advantage is that a chatbot creates new user touch points [3]. These reasons make chatbots popular and make them been employed in fields and industries such as healthcare, supporting systems, marketing, entertainment or education [4].

With the performance improvement of chatbots, the user acceptance is likewise increasing [5]. Therefore, it is important that users do not interact with undeveloped chatbots [2].

When we talk about chatbots we can distinguish between different types of chatbots. One important distinction is the knowledge domain. A chatbot can either be an open domain or closed domain chatbot. An open domain chatbot is capable to answer questions about general topics in an appropriate manner. Closed domain chatbots focus on a certain topic or domain. These chatbots are not able to answer a range of questions outside of their domain [4].

Another way to distinguish chatbots is by their main goal. There are conversational chatbots, which react similar to a human and answer questions in a natural way. Informative chatbots provide users with information from a fixed source like FAQ's. These chatbots often give concise answers and it's more apparent that a user is not interacting with another human being. Task-based chatbots assist humans in a range of tasks like reserving restaurants or booking flights [4].

Another way to differentiate chatbots is by their framework. There are open-source frameworks, as well as closed platforms like IBM's Watson Toolset [4].

A. Problem Statement

Sika Ltd. is a multinational specialty chemical business operating out of Switzerland. The company develops and produces systems and products for bonding, sealing, damping, reinforcing, and protecting. The company employs around 25'000 people worldwide with an annual turnover of approximately 8 billion Swiss Francs [6].

Like any other company, employee training is a crucial part for the success of the enterprise. To constantly improve and maintain the knowledge base of the workforce, Sika is using the "Rise Up" learning platform. Rise Up enables Sika employees to widen their knowledge base with the help of e-learnings and online courses. Rise Up wants to provide an augmented learning experience to its customers. Therefore, there is a wide range of different features and tools to create a variety of learnings and courses.

The respective courses are often created by Sika's employees themselves. The creators of the courses are experts in their domain, but they might not be too familiar with the "Rise Up" platform. Questions on how trainings must be created may arise. The vast variety of features to create different types of e-learnings and courses makes it difficult for the training creators to keep a good overview.

Currently, training creators must look for answers in the FAQ section of Rise Up. The articles about how to use the

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features and create trainings are long and time-consuming to read. This makes it bothersome for the training creators to search for an answer for their problem. Furthermore, the training designers are often not able to find an answer for their question in the FAQ section. In that case, they address a Sika employee that is more familiar with the Rise Up platform to ask for support.

To automate, simplify and accelerate the response time, we are implementing an IBM Watson™ Assistant for this use case. Our ambition is to create a chatbot that enables training creators to type their questions and receive an immediate accurate answer. The IBM Watson Chatbot employs state-of-the-art artificial intelligence to learn and pick up new words and phrases – all while being used and employed by real users.

B. Methodology

This case study provides applied research on how to develop a chatbot with help of the Watson™ Toolset created by IBM. It gives its readers an overview of the implementation process of the chatbot into an existing platform and explains its functionalities and the technology being used. The study is based on primary data (i.e., interviews with Sika and IBM employees on the prototypes requirements and evaluation of data gathered from system logs). The study further relies on qualitative methods such as literature research in scientific publications and specialist literature.

II. Use of AI Framework

Like mentioned in the introduction, today the training creators must either figure out the functionality of the Rise Up platform by themselves, or they directly contact a knowledgeable person for questions. This process is time consuming, and it can be frustrating for the training creators. The training creators might not receive an immediate answer for their problem, and they must wait for an email response. This can disrupt the workflow and diminish the motivation of the training creators. An AI powered chatbot could help to improve the situation. Other than a real person, the chatbot is available around the clock and it always answers questions immediately.

To better understand the need of the training creators, we created an empathy map (Fig. 10). The empathy map guided and helped us during the creation process of the chatbot.

Another aid for us was the creation of a simple user persona. Some of the key characteristics of our user persona is of course, that a training creator is a very skilled and experienced employee. Additionally, they bring a lot of knowledge for their domain. In terms of technical and IT skills, we classified them as heterogeneous. Some of them are very tech-savvy and they navigate with ease through a platform like Rise Up. Others might not be too familiar with the usage of such platforms. In the creation process of our bot, we had to consider this premise. For a tech-savvy person, too many details and text can be irritating and too time-consuming to read. On the other hand, that extra information might just be necessary for another person to be able to resolve a problem. Our goal was to find the sweet spot and give sufficient information in our responses, without going too much into details that might be perceived as unnecessary.

III. System Design and Development

This chapter describes the System Design and Development of the Sika chatbot.

A. Intents

The intents represent the base of a Watson Assistant chatbot. An intent basically summarizes "what a user wants".

In the example, (Fig. 11, Appendix) the name of the intent is #add_trainer. The intent name always starts with a hash mark, but the name can be selected freely. The only restriction is that intent names must be unique. Nonetheless, it is recommendable to choose an intent name that gives an idea for what the user wants. In the example above the intent name makes it clear, that the intention is to add a trainer to a course.

It is important for each intent to write down various user examples on how the question could be phrased. Also, the usage of some synonyms helps the chatbot to recognize intents better. With help of machine learning, the chatbot constantly improves its capabilities to recognize intents. A question does not need to be phrased the same as a user example for the chatbot to recognize it. Our Watson Assistant has a total of 54 intents. Therefore, it should recognize 54 different user needs.

B. Dialog Nodes

Another important aspect of the Watson Chatbot are the dialog nodes. The dialog nodes define the reaction of the chatbot to a user input.

In Fig. 12 in the appendix, we specified the reaction of the chatbot if the intent #add_trainer is recognized. The dialog node responds first with a text answer with some information on how to add a trainer. Afterwards, an image response is specified and finally another text response. The example demonstrates that there are different response types and even a combination of them is possible. Also, the jumping to another dialog node is an important feature of the Watson Assistant. Our chatbot always jumps to the "Anything Else" node to ask a user if he might need assistance with another issue. In total we have 87 dialog nodes created for our chatbot.

C. IBM Cloud Object Storage (COS)

We mentioned before that the Watson Assistant can also give an image response for example with a screenshot of a user interface to highlight where a user must click, etc. These images need to be stored somewhere.

To solve this problem, we implemented IBM's Cloud Object Storage (COS). COS is a cloud solution from IBM, similar to Dropbox. To save and store files a bucket can be created. We created a total of two buckets: One for the image material and another one for the PDF files that we use for the Search Skill. Both repositories need to be publicly accessible. Only that way the chatbot can access the images and files. We configured and created the service according to our needs. To answer with an image one can simply copy paste the displayed URL that accesses the resource.

D. Discovery, Web Crawler and Search Skill

In the following section we will explain how we used the Watson Discovery, Web Crawler and Search Skill functionalities from IBM to find the correct answer to questions which are not covered directly in the Watson Assistant.

Watson Discovery. IBM Watson Discovery makes it possible to rapidly build cognitive, cloud-based exploration applications that unlock actionable insights hidden in unstructured data — including your own proprietary data, as well as public and third-party data (Fig. 1).

Fig. 1. General flow of watson discovery.

IBM Watson Discovery brings together a functionally rich set of integrated, automated Watson APIs to:

- Crawl, convert, enrich, and normalize data.
- Securely explore your proprietary content as well as free and licensed public content.
- Apply additional enrichments such as concepts, relations, and sentiment through Natural Language Understanding (NLU).
- Simplify development while still providing direct access to APIs.

Web Crawler. You configure crawlers for different types of data that you want to include in a collection. A single collection can contain any number of crawlers.

A crawler has two primary functions. When you configure a crawler, the Discovery processes determine which sources are available in a data source. After you start a crawler, the crawler copies data from the data sources to a converter pipeline.

Search Skill. The Search Skill in the Watson Assistant is the connection between the chatbot, and the external information gathered by the IBM Watson Discovery (cf. Fig. 2). When a Search Skill is added, your assistant can route complex customer inquiries to the IBM Watson Discovery service. Discovery treats the user input as a search query. It finds information that is relevant to the query from an external data source and returns it to the assistant. [7]

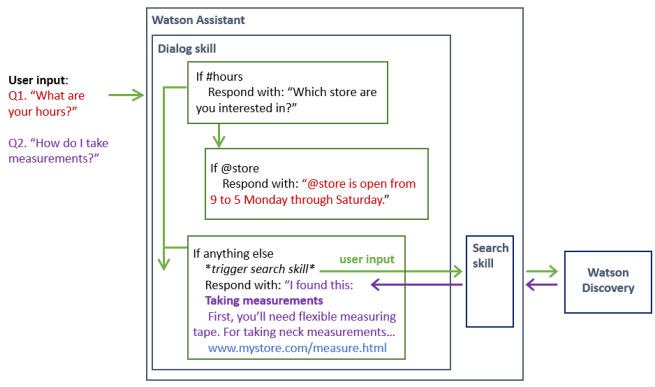

Fig. 2. Example flow to trigger search skill.

Use of Watson Discovery. In our case we configured the web crawling to two different websites. On one hand, we are connected to the Rise Up Help center directly to ensure that we always have access to the latest training material of them. On the other hand, we were forced to build our own repository on GitHub, with the .html files from the Rise Up Help center, as initially, the web crawling to them directly was not working (Fig. 3).

Since we cannot guarantee that Rise Up will not change their security settings in the future, which might break the direct integration again, we decided to keep the connection to both websites.

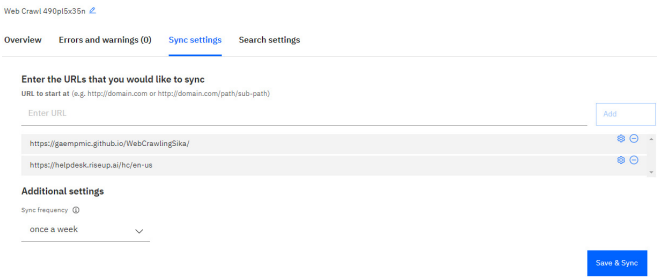

Fig. 3. Web crawling integration settings.

The source web pages are synchronized on a weekly basis to check if there is any updated content which might be helpful for the chatbot to answer the questions of the user.

The main reason of using an integration to an external source is that the business is changing. In our case, Rise Up might implement new features on their applications, which are not covered with the already trained intents by the chatbot. To always have access to the latest information, and to try to help the end user to find an answer to his question, it makes sense to extend the knowledge of a chatbot with an external source.

E. Conversational Design, Prototype & Flows

A collaborative, user-centered, iterative design process was the guide to this project from the kickoff, through development and launch. Team collaboration and collaborative design thinking were critical for the idea generation and facilitation of core team alignment and decision making. User data as general training material from Sika Ltd., research of how to design a chatbot conversation as well as interviews provided invaluable input and ongoing feedback.

Desk Research. Everything started with desk research [7] of how to build a chatbot and what are the best practices as [1]

- Clearly define your objectives and your chatbot's role(s)
- Endow your chatbot with a personality
- Pay particular attention to the first messages
- Keep it simple and user-friendly
- Use quick replies wisely
- Make sure to use fallbacks
- Always reengage user interaction
- Use analytics and keep improving your chatbot
- Take diligent care of your chatbot's aesthetic

What type of chatbot should we build. Since the purpose of this chatbot is to help the trainers to build a valuable and helpful training for the users on the Rise Up

platform, the chatbot must act like a superuser. This led us to the fact, that the chatbot must answer the questions of the training creators and does not have to lead them through the full application of Rise Up.

Rapid prototyping of conversation flow. After elaborating the basics of how to create a chatbot on Watson Assistant, we started to reflect the information from Sika, which we gathered during the introduction session as well as an interview with a training creator, in the IBM Watson Chatbot. A basic conversation has been created within a couple of days.

Phased development and iterative testing. After the first version has been developed, we started to share the chatbot with Sika, so they could provide hands on feedback to us. With that approach we implemented several changes during a period of round about 3 months until the result was satisfactory for our customer.

F. Watson Services in Use and Integrations

To better understand the attitude of the users, we created an empathy map canvas [8], based on the information provided by IBM and Sika at the beginning of the project (Fig. 13, Appendix).

The empathy map helps to understand the interactions and expectations of the users in their use of the chatbot.

Based on this analysis and our own observations, we were able to focus on the perceived pains and potential gains originating from the development of this project and guide the decisions about the services and integrations that would be necessary.

We can summarize this as follows: A pain for Sika is that its employees find that the responses of the chatbot are not accurate. This will lead them to frustration and finally a feeling that this channel of information is useless.

On the other hand, the potential gain would be that the chatbot provides its users with a helpful source of information.

From our observations, we could see that the Rise Up Frequently Asked Questions pages are written in different languages, and that they have an international user base. This made us realize the importance of allowing interactions with the chatbot in several languages.

We also realized that the content creators could come from diverse backgrounds, and therefore might benefit from multiple ways of interacting with the system.

To address these observations, we integrated our chatbot with the following resources: Watson Discovery, Language Translator integration using Cloud functions, Tone Analyzer, Phone integration with Text to Speech, Speech to Text and Logging.

Discovery and Watson Assistant have been already discussed; therefore, we are going to explain in detail the rest of the resources and integrations implemented for our specific case.

Language Translator integration using Cloud functions. Watson language translator that is integrated via IBM Cloud Functions. The user's questions are intercepted by the pre-webhook, which uses the Watson Language Translator to determine the language in which it is written and if necessary, to translate it to English, so that the chatbot receives the input in English. Once the chatbot answers the question in English, the post-webhook intercepts the response, and if necessary, translates it back to the original language (Fig. 4).

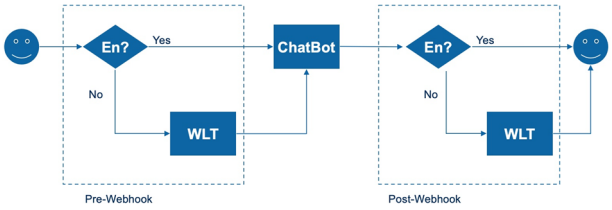

Fig. 4. Watson language translator.

The end user interface allows the user to write questions in different languages at the same time.

Tone Analyzer. As we need to address any sentiments that the users might have, we implemented the Watson Tone Analyzer Cloud Service which works as follows: the user's questions are processed by a webhook which sends the text to the Watson Tone Analyzer to determine the user's sentiment. Using this information, the chatbot can provide responses appropriate to the way the user is feeling (Fig. 5).

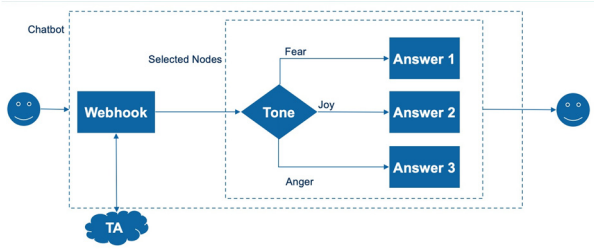

Fig. 5. Architecture tone analyzer.

Thanks to this service, we could also provide a request made by the user to send a message when the chatbot is no longer able to provide more assistance.

Phone integration with Text to Speech and Speech to Text. In the IBM Watson challenge, we are delivering a real tool to a real customer. Some of the users might find it useful to make a phone call to ask for help or get instructions for trainings. For example, Marketing or Sales Managers, which are Subject Matter experts and potential training creators might find it easier to interact with a voice instead of a chatbot (Fig. 6).

Therefore, we implemented a phone integration with two services: IBM Watson Speech to Text and IBM Watson Text to Speech. As a third party for VOIP service, we choose Twilio as this provided us with a free trial subscription and a U.S. phone number. This was enough to create a phone integration.

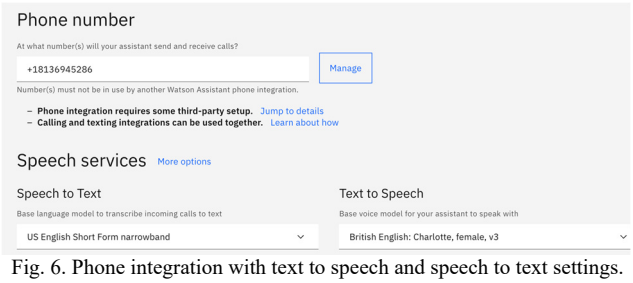

Fig. 6. Phone integration with text to speech and speech to text settings.

The voice of the chatbot can be configured thanks to the Watson Text to Speech service. It is possible to call the

number and interact with the chatbot as if the user were calling a person to ask for help related to the Sika information.

Logging. We explored the use of the IBM Log Analysis by using the Ingestion REST API to extract a detailed record of the conversations of the assistant. For example, we checked the existing API, nothing that only version 1 of the API is supported on the Plus plan that we had available. However, at the time that we checked the data, there were not enough records to allow for a meaningful analysis, but it was an exceptionally valuable experience as a proof of concept.

However, once we got the result from the JSON file, we found out that the best solution in this use case, was to use the built-in analytics section of the Watson Assistant user interface because it provides with various analytics capabilities to measure and manage intents and conversation recorded on the chatbot. As an example, it helped us to re-order the nodes on the dialog because it was causing incorrect behavior.

Furthermore, there was a week where Sika users tested the chatbot, so this was a good opportunity for the logs to be recorded for analysis (Fig. 7).

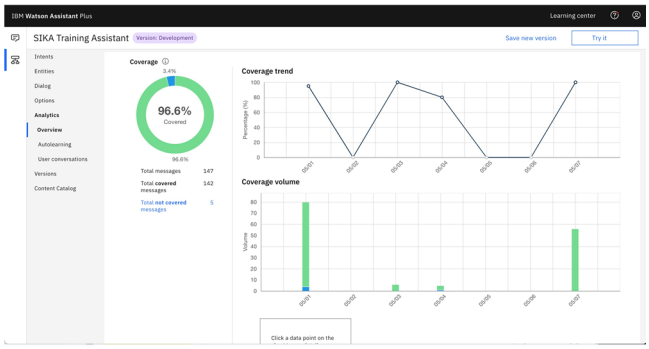

Fig. 7. Graphics of the conversation between 1st and 7th of May.

Fig. 8. Example of Watson language translator.

IV. Result

In this section, we would like to emphasize the functionality of our chatbot. As the dialog has been already discussed, it is fair to show some of the integrations that we already mentioned before.

A. Example of Integrations

This section describes the functionalities of the Watson Language Translator and the Watson Tone Analyzer (Fig. 8).

Watson Language Translator. The intention of the Watson Language Translator integration is to allow the user to interact with the chatbot in multiple languages. The architecture described allows decoupling the chatbot dialog design from the translation functionality.

Example of Tone Analyzer. A good example of how our chatbot reacts to sentiments of the user is shown in Fig. 9. As we can see, the user has expressed that he is not happy with the answer provided by the chatbot. Detecting this, the chatbot reacts by providing extended information for the user. The chatbot reacts not only to the negative feedback from the user, but also to the positive reaction at the end.

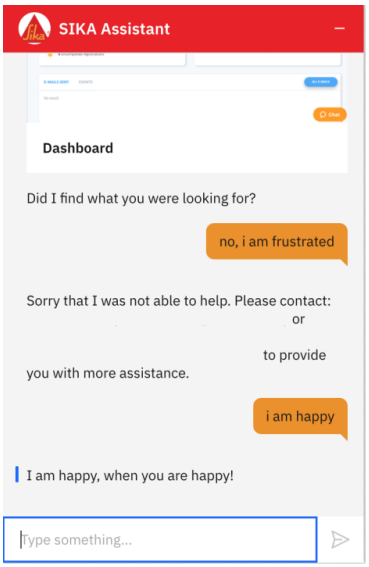

Fig. 9. Example of watson tone analyzer.

B. Usability Improvements

From the beginning some of the answers provided by our chatbot included images. We received feedback from our test group indicating that the images were too small to be readable due to the small width provided by the chatbot interface. To address this shortcoming, we added to each image a link, so the user can click it, to enlarge it to its full size. This improvement was welcomed by the testers.

As a second improvement, we added a reactive feedback node, so the chatbot asks the user after providing an answer whether the information was useful. This gives the user an opportunity to express the feedback and, together with the information from the Tone Analyzer, allows the chatbot to express empathy with the user.

C. Evaluation

To evaluate the usefulness of the chatbot, we differentiate between five metrics, each of which is evaluated bellow:

Comprehensive capabilities. The understanding of inquiries related to the main content of the chatbot is covered using 87 dialogue nodes that specify the reaction to an input received from a user. A set of predefined example questions in each node, make sure that a variation in phrasing results in the same output. The chatbot further ensures, that typing and spelling mistakes do not mitigate

the overall user experience. While it has a solid text-based understanding, its capability of balanced text use is yet to be improved. Complex sentences containing multiple questions, questions that are formulated unclearly or refer to unrelated topics, trigger the chatbot to make use of the training material at best guess. The comprehensive capability of the chatbot is further enhanced by its ability to recognize different languages and automatically translating the provided answers.

User engagement. To be generally accepted by users, it is crucial for a chatbot to be experienced as useful and pleasurable. Herby must be differentiated between the requirements of a chatbot and the ones of conversational agents [9]. In respect to this, the chatbot covers basic phrases for initiating a conversation, such as greeting and the inquiry about how satisfiable the provided response was. The function of this feedback node has two primary aims; the first one being that chatbot can take a second approach in providing an answer, while the second one being that the collected ratings help to improve the provided answers (Fig. 10).

Fig. 10. Sika Training creator empathy map.

Speed. As a quantitative key performance indicator, the speed of the chatbot summarizes amongst other the activity volume, use rate, session volume, response volume and conversational length and allows evaluating the effectiveness and the way it is used by its target audience. While the performance of these indicators of the chatbot's speed may vary subsequently to its integration and once in real use, the chatbot is expected to be capable of scalable use and able to provide responses in a timely manner.

Functionality. In addition to images and textual responses, the chatbot covers different services to enhance its functionality. As such, the Cloud Object Storage (COS), the Watson Discovery, Web Crawler and Search Skill as well as the Tone Analyzer and Language Translator are essential services that increased the chatbot's overall functionality. The use of these functionalities provided by IBM from the core design of the chatbot. These services provide access to data storage and external information. The phone integration allows to convert text to speech and vice versa. Log analytics provide a further instrument, to constantly supervise and improve the functionality of the chatbot. Yet not covered in the chatbot's functionality, are features for responses including rich media, such as videos, audio files or tools that foster a greater conversational flow.

Interoperability. The chatbots has an extended interoperability allowing the user to access its service over multiple channels (I.e., browser, mobile and phone dial) and can exchange information with other computer systems or applications. This makes it possible for the user to operate the chatbot over voice or textual input.

V. Future Work

In the beginning of the project, we started focusing on a proof of concept, which could provide a working chatbot. As our project concluded, we learned that this technology has a vast range of possibilities, which offer many avenues for potential future work.

Some of the main topics for future work that we have identified include the following:

- **Dialog improvements:** The dialog that we have implemented covers the basic questions that users may ask. In the future, additional effort is needed to increase the number of intents that identify user's questions topics and the corresponding dialog nodes to provide useful responses.
- **Increased crawling functionality:** Provide additional documents that can be used to better train the document analysis facility of Watson Discovery, so that it can provide more accurate responses even for questions that are not coded in the Dialog.
- **Improvements to language translation:** Our prototype only translates the first response provided by the chatbot to the user. Additional response paragraphs should also be translated by implementing this functionality in the corresponding Cloud Functions.
- **Additional applications of Tone Analyzer:** Currently, the Tone Analyzer information is only used in a few nodes within the dialog; more extensive use of this information would allow the chatbot to provide a more personalized interaction.
- **Optimized phone integration:** Phone integration supporting multiple languages would allow international users to interact by voice with the chatbot in their native language. A second improvement possibility would be to implement voice optimized responses that the chatbot can use when interacting with users over the phone.
- **Improved log analytics:** Once we got all the information from logs, we found out that this chatbot needs more testing by the users to get more feedback of problems, or changes to improve the usability of the user interface, position of buttons and hierarchy of menus or better training material.
- **Implementation of actions:** Eventually we would like the chatbot to not only provide information to the users, but also to be able to execute certain actions for them. This would require tighter integration with the Sika Rise Up

platform.

These topics are only the beginning. As the chatbot improves, we expect that it would become a powerful platform for supporting educators in a flexible and scalable manner. Furthermore, an end-to-end onboarding process could be developed, which makes the resources acquisition more effective and cheaper [10]. In addition, in some time, the chatbot knows more about the interests of the trainers then their managers do, which means with a good setup and the needed maintenance, the chatbot can be the knowledge base of the future [11].

VI. Conclusion

In the beginning it was difficult to figure out where to start in the creation process of the chatbot. Our group only had minor experiences with this technology, and it was complex to get a good overview about such a vast topic. Also, there was a lot of events and information especially in the beginning of the project. After watching the recorded introduction classes by IBM, we started to get an understanding on how a chatbot works and how it can be created.

After this first block of theory, we wanted to get our "hands dirty" and decided to create a prototype version of a chatbot. We created some simple intents and dialog nodes to get a feel on how an IBM Watson Assistant works. We quickly recognized that there are many different features and options that are possible to implement, but that the core of a chatbot is relatively simple to understand. We took an explorative and playful approach and started to try out different tools and services to see how the results change. Also, IBM was of immense help and always at our service whenever we had questions on how to implement a technology or improve our bot. They gave us valuable tips and feedback to our work.

Due to this experimental and playful approach we constantly improved and further developed our Sika bot. We took a keen interest in the different IBM products and constantly presented better solutions to solve problems. In conclusion we think it is fair to say that our chatbot makes use of a wide variety of different tools and services like COS, Text to Speech, Tone Analyzer and so on.

Additionally, our Sika contact was extremely helpful and a keen observer of the progress of our chatbot. He avidly tested the chatbot and gave us useful feedback when the behavior of the chatbot was not as expected. We appreciated a lot working with him. He was an extremely helpful and friendly link to the Sika organization during our project.

As explained in the problem formulation, the FAQs are not written in a concise manner. Often there were page-long articles for problems. To find the correct response to questions, we often had to read a lot of text material. This is a good opportunity for future use of Watson Discovery for free test analysis.

Overall, the creation of our Sika chatbot was a very pleasant and insightful experience for our group. We think that this project was an excellent opportunity to get familiar with a crucial technology that is certainly going to reshape aspects on how businesses operate.

Appendix

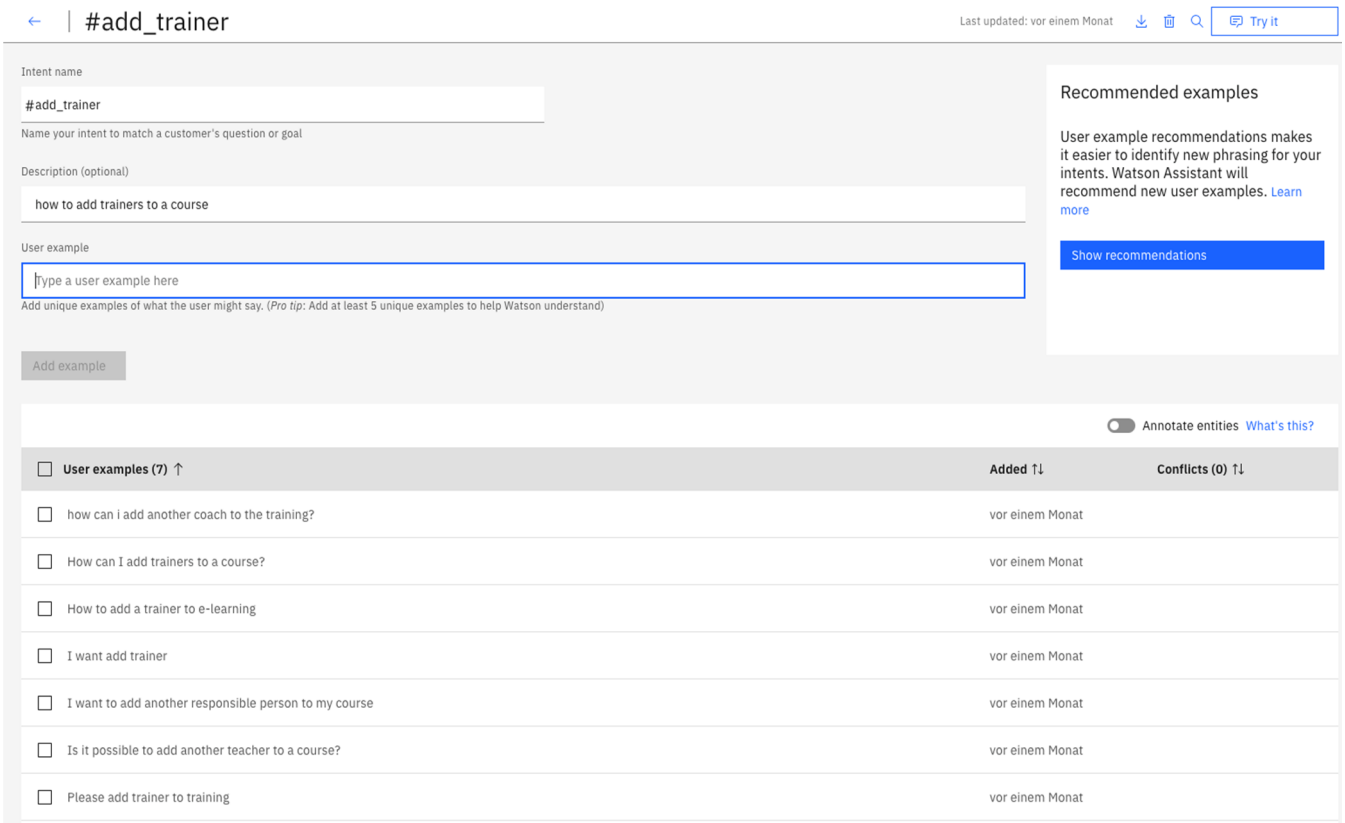

Fig. 11 Intent "#add_trainer"

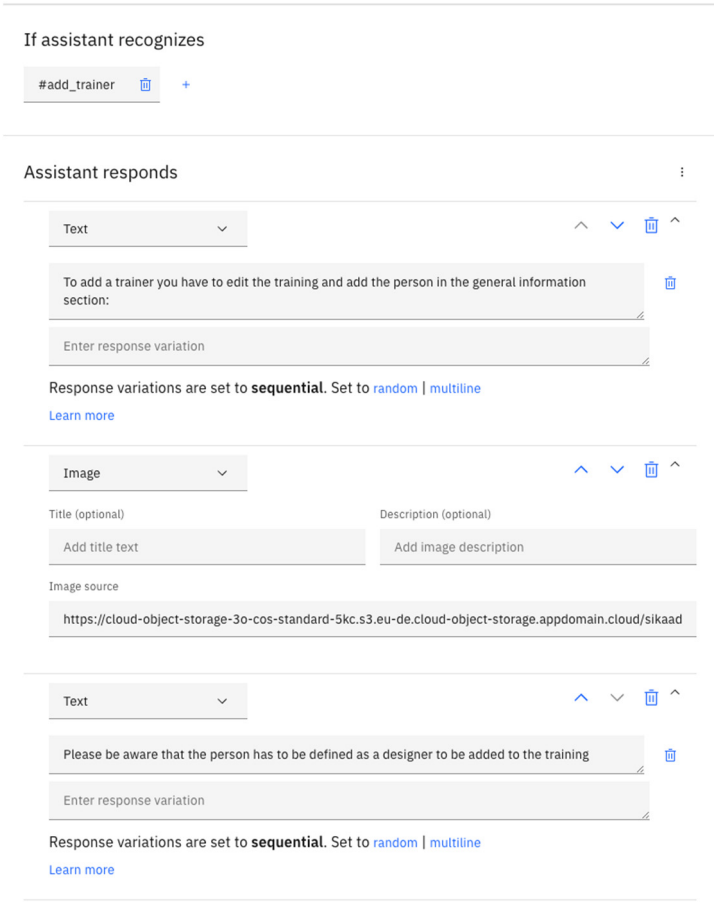

Fig. 12. Node mapping to COS.

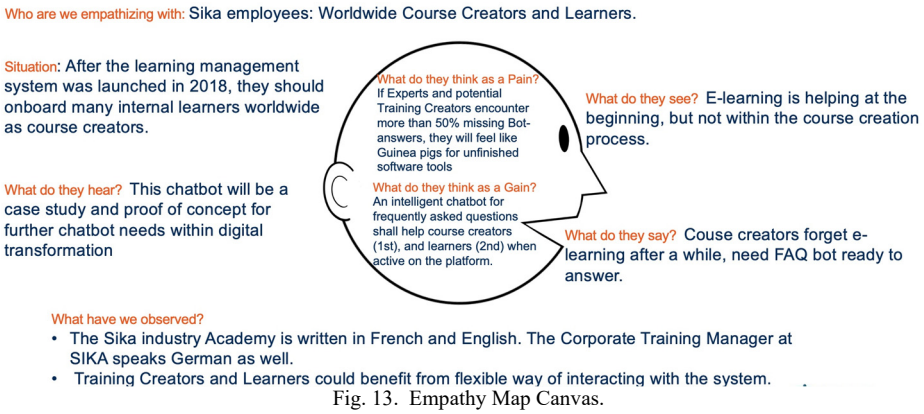

Fig. 13. Empathy Map Canvas.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

C. Marioni contributed to the implementation of intents and dialog nodes for the IBM Watson Assistant. He conducted the research for its documentation and was responsible for the evaluation of the chatbot. M. Soriano Ramirez contributed to the design of the prototype, creation of the artifact, build and implementation of the chatbot. A. Kenel has implemented various intents as well as dialog nodes for the IBM Watson Assistant. Furthermore, he set up the IBM Cloud Object Storage (COS). M. Gämperli and M. Krey supervised the project and reviewed the research.

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