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Commercial ERP Chatbots : Conversational Intelligence Agents' Performance Analysis, User experience Benchmarks, and Quality Standards

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ABSTRACT

A key goal of this paper is to investigate commercial applications for chatbots and propose several evaluation metrics for evaluating an embodied conversational agent's performance, usability, and overall quality. Our assessment is based on metrics that include a) size of market share & reach, b) range of users and c) likelihood of being the most advanced commercial chatbot created by their creators. Our study examines several aspects of the function of embodied conversational agents, including their visual appearance, implementation of web sites, speech synthesis unit, built-in knowledge base (with general and specialized information), presentation of knowledge and additional functionality, emergency responses in unexpected situations, and user ratings. An evaluation of any commercial chatbot deployment requires a multidimensional assessment and the current state of Conversational Intelligence in the commercial virtual assistant market.

Keywords : ERP Technologies, Commercial Applications For Chatbots, Measurement Metrics For Evaluating An Embodied Conversational Agent's Performance, Advanced Commercial Chatbots, Embodied Conversational Agents, Speech Synthesis Unit, Built-In Knowledge Base, General And Specialized Knowledge Base, Emergency Responses, Commercial Chatbot Deployment, Commercial Virtual Assistant Market.

I. INTRODUCTION

The first commercial East-European chatbot was released in 2003. It was only static photography of a smiling man. His communication skills were limited to silent, textual correspondence. In the end, his knowledge was limited, imprecise, and somewhat vague. Virtual assistants that resemble human beings have been growing rapidly for more than 10 years. New technology-based platforms were implemented, along with innovative knowledge base designs, and a great deal of new functionality was added. The number of companies producing virtual assistants, also known as chatbots, has exploded. Several of these companies have already fallen, while others have refocused on another business field or merged with bigger foreign companies. Some created conversational artificial intelligence, however, with success. How is the market for conversational assistants currently doing? Customers expect quick,

pleasant, and professional service from virtual agents. How do virtual agents meet these expectations? To evaluate the performance, user experience, and overall quality of commercial chatbots, several measurement metrics are applied in this paper. The paper follows the following structure. As part of our analysis, we examined a number of chatbots, several measurement metrics were introduced and a variety of aspects of the virtual assistant are examined. We discuss our findings in Section 4 and provide a summary of the obtained results. The conclusion of this paper is discussed in Section 5.

II. EXISTING COMMERCIAL CHATBOTS

We identified all commercially available, publicly available digital chatbots that were actively tested on the Internet in the first step. For a chatbot to function on a website, its fixed period is usually subject to expiration. It is not surprising that some companies have only one virtual assistant that can be considered a representative implementation at the moment (Artificial Solutions, Fido intelligence). Other companies (Denise Systems, InteliWISE, Onlinetools.pl, Stanusch Technologies) also have more than one currently working representative implementation. All identified commercial chatbots have been analyzed and reviewed.

Virtual assistants produced by these companies are used in several industries and business fields. Since the nature of the companies mentioned above prevents them from being lumped into one industry, there can be no comparison between their commercial chatbot deployments. Due to the limitations of being able to compare all solutions in one field, we took a representative commercial virtual assistant deployment from every company and displayed it for comparison.

Chatbot developer	Chatbot name	Works on behalf of	Website
Artificial Solutions	Ania	IKEA	http://www.ikea.com/pl/pl/
Denise Systems	Zosia	Villa Pan Tadeusz	http://www.villapantadeusz.pl/
Fido intelligence	Karen	WSHiFM	http://www.wshifm.edu.pl/
InteliWISE	Wirtualny Doradca	PayU	http://www.payu.pl/pomoc
Onlinetools.pl	Ewa/Adam	Kredytum.pl	http://kredytum.pl
Stanusch Technologies	Ewa	Orange	http://www.orange.pl/obsluga_klienta_indywidualnego.phtml

Table 1. List of examined virtual assistants

Secondly, we restricted the list of representative solutions to virtual assistants who worked in B2C environments. Consequently, we rejected chatbots from virtual offices of nonprofit organizations and virtual experts representing government agencies. Using this methodology, the premise was that private entities (companies and universities) are most concerned with maximizing profits, operational efficiencies, and minimizing costs when deploying virtual assistants.

As the third step, we chose automated chatbot deployments that would reach the broadest possible audience - potential clients of the company. We rejected chatbots interacting with a limited number of users on behalf of small local companies. Having selected the most effective or advanced commercial implementations of a given company from the remaining set, we chose implementations from the rest. As a result, the final list of chatbots that were examined in our study is presented in Table 1.

III. QUALITY COMPONENTS AND THEIR EVALUATION

Each virtual assistant was thoroughly analyzed in terms of different aspects. In addition to the design of the chatbot and how it is implemented on the website, we examined the speech synthesis module. We asked the same set of questions to each virtual assistant in order to evaluate the built-in knowledge base (which contains general and specialized information) comprehensively, reliably, and accurately. In other words, we examined how each chatbot presented knowledge and what additional functions it offered.

Our interviews explored a chatbot's conversational capabilities, language abilities, and contextual awareness. Also analyzed were personal characteristics, personalization options, and emergency reactions to unexpected situations.

The final step was to determine whether the website and chatbot could be rated by the user. Each virtual assistant would be evaluated according to its quality component. It is adapted to the commercial chatbot deployment and is expected to reflect user expectations, needs and preferences. Moreover, from a commercial applications evaluation standpoint, a focus must be put not only on the end-user satisfaction but also on the benefit of the website owner on behalf of which the virtual assistant is working.

Using a standard rating scale of 1-5, we rated the quality components as follows: Those with 1 being very poor, 2 being poor, 3 being satisfactory, 4 being good, and 5 being very good. Information from prior research, literature reviews, and best business practices is used to develop the assessment. There were some components divided into five evaluated parts where the rating was based on the sum of the points earned. Measures were very simple and transparent, so advanced statistical analysis of the data was not required. Finally, in part 4, we calculated an overall quality score, which is based on all evaluated points.

IV. VISUAL LOOK OF THE CHATBOT

Many people judge a book by its cover. Thus, the outward appearance of a virtual assistant plays a crucial role in the standard of its implementation. Research on interaction with chatbots emphasizes how important the visual look is [Haake 2009:35-56], and demonstrates the benefit of using faces (human or animated) [Berry et al., 2004:34]. An avatar of a chatbot that looks like a real person increases user engagement and willingness to initiate a conversation [Van Vugt et al., 2010:21-22]. A consistent interaction between verbal and non-verbal behavior is also recommended [Berry et al., 2004:10].

In order to enable rich social interactions, chatbots should make use of natural conversation, expressiveness, and convergent gestures [Kopp et al., 2009:508]. Video sequences seem to be a standard realization for commercial chatbot display, given the available advanced technology. There are however bodiless virtual assistants (PayU) and animated virtual assistants (IKEA) even today. The majority of visualizations, however, consist of high-quality video sequences of a living individual who is speaking, gesturing and behaving in accordance with displayed utterances (Kredytum.pl, Orange, Villa Pan Tadeusz). The video sequences depicting a live person as a chatbot visualization were rated very high. In Table 2, it is shown that cartoon-like animation is still a good appearance, but disembodied chatbots are rated quite poorly.

Chatbot name (works on behalf of)	Visual look of the chatbot	Rating
Ania (IKEA)	cartoon-like animation	4
Zosia (Villa Pan Tadeusz)	video sequences depicting a living person	5
Karen (WSHiFM)	video sequences depicting a living person	5
Wirtualny Doradca (PayU)	disembodied	1
Ewa/Adam (Kredytum.pl)	video sequences depicting a living person	5
Ewa (Orange)	video sequences depicting a living person	5

Table 2. Chatbot visualization and its evaluation

V. FORM OF IMPLEMENTATION ON THE WEBSITE

The visibility of the virtual assistant is one of the most important aspects to consider when embedding one on a website [Gaudiano, Kater, 2000:121] [Hsu 2011:60-71]. Chatbots are not often completely rewritten by companies that purchase them; therefore, forms of implementation differ quite a bit across companies. There are several different forms of virtual assistants (IKEA, WSHIFM, PayU), including floating windows (WSHIFM and PayU) and tabs (Villa Pan Tadeusz and Kredytum.pl).

The main website can include both a built-in window and a pull-out side menu (Orange) in certain cases. It was assessed as very good that a built-in window was combined with a pullout side tab as a method of

implementing chatbots. Table 3 presents the results of comparing the pull-out side tab with the fixed built-in window and small floating window. Pull-out side tab remains the best solution, but built-in window and small floating window are also acceptable.

Chatbot name (works on behalf of)	Form of implementation on the website	Rating
Ania (IKEA)	floating window	3
Zosia (Villa Pan Tadeusz)	pull-out side tab	4
Karen (WSHiFM)	built-in window	3
Wirtualny Doradca (PayU)	built-in window	3
Ewa/Adam (Kredytum.pl)	pull-out side tab	4
Ewa (Orange)	flexible combination	5

Table 3. Form of implementation of chatbot on the website

VI. SPEECH SYNTHESIS UNIT

A Text-to-Speech module is an important aspect of a virtual assistant that converts writing into an artificial voice [Van Deemter et al., 2008:1239-1243]. Embedded conversational agents can increase user trust by using their synthesized voice [Elkins, Derrick, 2013:910-912].

Many virtual agents are able to perceive their conversations through silence (IKEA, PayU). In contrast, others use a voice synthesis machine to produce human-like speech (Villa Pan Tadeusz, WSHiFM, Kredytum.pl, Orange). An external supplier may provide a standard speech synthesis module (Villa Pan Tadeusz, WSHiFM, Kredytum.pl) or a specific implementation, a uniquely prepared voice (Orange).

With a custom voice and shut down option, the speech synthesis unit was rated as good. While standard text-to-speech solutions equipped with shutdown options represent another good speech module, standard voice solutions without shutdown options were only rated as satisfactory. Based on the results presented in Table 4, the absence of voice is considered very poor.

Chatbot name (works on behalf of)	Speech synthesis unit	Rating
Ania (IKEA)	voiceless	1
Zosia (Villa Pan Tadeusz)	standard voice, no shutdown option	3
Karen (WSHiFM)	standard voice, shutdown option	4
Wirtualny Doradca (PayU)	voiceless	1
Ewa/Adam (Kredytum.pl)	standard voice, shutdown option	4
Ewa (Orange)	unique voice, shutdown option	5

Table 4. Speech synthesis unit and its evaluation

VII. KNOWLEDGE BASE: GENERAL AND SPECIALIZED

Knowledge bases are software that contains all relevant information, knowledge and data about reality for a virtual assistant. This is why their importance is fundamental to the functionality of such a robot [Gaudiano, Kater, 2000:122-123]. It is the primary reason for the creation of chatbots and has always been the essence of their existence. It should be possible to communicate on any topic with a conversational agent. It is difficult therefore to evaluate knowledge base since a sufficiently broad knowledge base includes both off-domain as well as on-domain answers. The evaluation of knowledge bases is therefore divided into two parts: general information topics and specialized business information topics.

A basic level of general information is available on all commercial chatbots examined. Even fewer of these organizations (IKEA, Villa Pan Tadeusz, WSHiFM, Kredytum.pl, Orange) know when their functioning began on the website (Villa Pan Tadeusz, WSHiFM).

(WSHiFM, Kredytum.pl, Orange) While a few virtual assistants can tell you the current time and date, others do not. There is only one commercial chatbot (Orange) that has knowledge of geography, history, astronomy, the meaning of their names, and is able to do simple mathematical calculations. Each chatbot was presumed to be able to answer five simple key questions checking the built-in knowledge in order to make the results comparable. Question 1 asks your name, Question 2 your abilities, Question 3 your employer, Question 4 What time is it, and Question 5 asks what is the capital of Poland.

The virtual assistant gained one point for every correct answer. Where the virtual assistant was unable to provide a correct answer, if the context and meaning of the question were understood correctly, she was awarded a halfpoint. Because no reasonable answer could be provided within the dialog scope, no points were earned. On Table 5, you can see the

correct answers for basic knowledge topics (general information), their points earned and their ratings.

Chatbot name (works on behalf of)	Q1	Q2	Q3	Q4	Q5	Sum	Rating
Ania (IKEA)	1	1	1	0.5	0.5	4	4
Zosia (Villa Pan Tadeusz)	1	1	0.5	0.5	0	3	3
Karen (WSHiFM)	1	1	0.5	1	0.5	4	4
Wirtualny Doradca (PayU)	1	1	0	0	0	2	2
Ewa/Adam (Kredytum.pl)	1	1	0.5	1	0.5	4	4
Ewa (Orange)	1	1	1	1	1	5	5

Table 5. Basic knowledge questions and answers

for specialized knowledge topics (competence, expertise), point values, and ratings.

Chatbot name (works on behalf of)	Q1	Q2	Q3	Q4	Q5	Sum	Rating
Ania (IKEA)	1	1	0	1	0.5	3.5	4
Zosia (Villa Pan Tadeusz)	0.5	1	0.5	1	1	4	4
Karen (WSHiFM)	1	1	1	0.5	1	4.5	5
Wirtualny Doradca (PayU)	0.5	1	1	1	0.5	4	4
Ewa/Adam (Kredytum.pl)	1	0	0	1	0.5	2.5	3
Ewa (Orange)	1	1	1	1	1	5	5

Table 6. Specialized knowledge questions and answers

Throughout the testing, all commercial chatbots displayed specialized knowledge about the represented company, its products, and services. Nevertheless, the effective utilization of this knowledge differs from company to company, since it is heavily influenced by the industry branch by which the virtual assistant represents the company. While contrast studies are difficult due to the above-mentioned difficulties, we assumed that every commercial chatbot should be able to answer 5 key questions that verify the knowledge that is ingested.

Objectivity and broadness were the guiding principles of the questions, without favoring any industry. These questions are as follows: Describe the offer/display product catalog, describe costs/display prices, describe how to get a discount/display rebates, describe how to contact the company/show contact information, describe any accomplishments/display success stories, and describe any achievements of your company. Several questions regarding products and services offered are asked in Q1, Q2, and Q3. Question Q4 inspects the company's contact information. In question Q5, the candidate verifies their understanding of the company's accomplishments. For each exhaustive answer to a question, the virtual assistant received one point. As long as the context and meaning of the question were correctly understood, the virtual assistant will receive a half-point for a partial answer. There were no points due to the lack of answers reasonably consistent with the dialogue scope. In Table 6, we present correct answers

VIII. PRESENTATION OF KNOWLEDGE AND ADDITIONAL FUNCTIONALITIES PERFORMED BY CHATBOTS

Most conversational embodied agents only provide initiation of conversations as autonomous functionality. A critical characteristic of commercial chatbots is the ability to use additional functionalities and trigger behavior based on the context [Cassell et al., 1999b: 30] [Gerhard 2006: 3] [Kumar, Rosé, 2009: 5-7]. Thus, the competence assessment must include evaluating the exceptional way in which knowledge is presented, as well as all the additional services offered by the virtual agents, and all the ways available to facilitate user navigation on the website.

Within every utterance of every virtual assistant tested, clickable links were embedded. They can be clicked and answers can be received immediately, without having to write questions manually. These embedded links are essentially tags on chatbots (IKEA, Villa Pan Tadeusz, WSHiFM, PayU, Orange) that can be clicked by users so as to continue the conversation. Some chatbot descriptions are displayed with links (Kredytum.pl). It is possible that some users will not click embedded links. Commercial chatbots should have the possibility of autonomously acting in these situations. The ability of virtual assistants to dynamically load new tabs or subpages in the background during a conversation (IKEA, Villa Pan Tadeusz, WSHiFM) was exhibited by 50% of them.

For instance, the interactive connection to an external database relates to the product catalog in one case (IKEA), and in the other - to the intranet and the possibility of searching information on the web to find a relevant answer (Orange). You can display previously displayed answers by pressing the "Back" button (Kredytum.pl, Orange), or by scrolling the chat history (WSHiFM, PayU, Kredytum.pl). If a user enters "help", or presses the "Info" and "i" buttons, or "?" (like IKEA, Kredytum,) some chatbots can explain their functions. Using the "Home" button speeds up the return to the main menu, where the most important information for customers is displayed (Kredytum.pl, Orange). In Table 7, the possible methods of presenting information and additional functions that virtual assistants can perform are presented.

Chatbot name (works on behalf of)	Autonomous dynamic loading new subpages or tabs in background or in a new window	Interactive connection to an external database	"Back" button or scrolling the chat history	Term "Help" or "Info", "i", "?" button	"Home" button - return to the main menu	Sum	Rating
Ania (IKEA)	+	+	-	+	-	3	3
Zosia (Villa Pan Tadeusz)	+	-	-	-	-	1	1
Karen (WSHiFM)	+	-	+	-	-	2	2
Wirtualny Doradca (PayU)	-	-	+	-	-	1	1
Ewa/Adam (Kredytum.pl)	-	-	+	+	+	3	3
Ewa (Orange)	-	+	+	-	+	3	3

Table 7. The presentation of knowledge and functionality provided by chatbots

IX. EMERGENCY RESPONSES IN UNEXPECTED SITUATIONS

Virtual assistants are often rudely probed by users, who probe their knowledge, behavior, and stress tolerance. They mislead chatbots, express derogatory attitudes, or ask about abstract concepts. Studies have found that verbal abuse and sexual harassment directed towards chatbots are common during conversations [De Angeli 2006:21-24] [Brahnam 2006:13-16] [De Angeli, Carpenter, 2005:21- 25]. A virtual assistant should be able to respond to such emergency situations in an intelligent, diplomatic, and patient manner. Additionally, Chatbot should take note of any typos, misspellings, or colloquialisms being used.

A virtual assistant may have a difficult time understanding a user's statement or interpreting it, so they need to handle this unexpected circumstance somehow. In some cases, virtual assistants comprehend large amounts of speech and try many creative solutions when they are unable to answer a specific question. During hesitation, they check if the answer was helpful (IKEA) or provide information on the website and intranet (Orange) demonstrating web mining capabilities [Heudin, 2010:7-10] [Millet, Heudin, 2007:3-4].

Another diplomatic option is for the virtual assistant to gather information from the user when it finds that they lack knowledge, such as asking them their age, education, occupation, monthly income, the size of their house and the name of their city of origin (Villa Pan Tadeusz). Another clever solution is displaying important information and changing the topic of conversation periodically (WSHiFM, Orange).

Users commonly make typographical errors and misspellings in their statements. To overcome these mistakes is a big challenge for chatbots. Not all typos can be recognized, of course. Nevertheless, there should be at least some ability for bots to understand utterances without asking for a reformulation. Two chatbots (IKEA, Orange) are hands down the most efficient when it comes to detecting typos, misspellings, and other errors. While the other three are capable of recognizing distorted statements, it happens very rarely (Villa Pan Tadeusz, WSHiFM, PayU). Typos and misspellings are not detected by some virtual assistants (Kredytum.pl). A commercial chatbot should never be provoked by offensive remarks and insults and should not let frustration or anger rise to the level of the customer.

It is recommended in a number of CRM methods of dealing with verbally abusive customers to control

emotional reactions, model professional behavior, and refocus on problem solving methods. [Brahnam 2005:64] A virtual assistant can only ignore the calumnies or feel pity for the user and subsequently return to the subject of the conversation (IKEA, Villa Pan Tadeusz, PayU, Kredytum.pl, Orange). It is inefficient to respond to insults by returning the same behavior.

Chatbots that resent the user (WSHiFM) and refuse to allow them to ask additional questions (WSHiFM) disrespect the user and will risk damaging the company's reputation [Brahnam 2005:66-67]. When customers abuse websites, they can undermine a company's reputation [Berry et al., 2004:37] [Stern 2003:336] [Van Vugt et al., 2010:19-20] and sour customer relationships. There are a few instances that bots recognise the question "do you speak English" (Villa Pan Tadeusz, WSHiFM, Orange) or the language to speak such as French, Spanish, German (IKEA, WSHiFM). (IKEA, Villa Pan Tadeusz) Some of them state in their native languages that they don't speak foreign languages. Others display simple answers in English, French, Spanish, and German (WSHiFM, Orange) as well as in other languages (WSHiFM). A single virtual agent (Orange) maintains a unique capacity to translate simple English words into Polish-users need only type the English term followed by the command "translate" (in Polish) and click enter.

Chatbot name (works on behalf of)	Over-coming igno-rance	Over-coming typos and mis-spellings	Over-coming insults and humilia-tion	Foreign lan-guages recogni-tion	Trans-lating English words into Polish	Sum	Rating
Ania (IKEA)	+	+	+	+	-	4	4
Zosia (Villa Pan Tadeusz)	+	+	+	+	-	4	4
Karen (WSHiFM)	+	+	-	+	-	3	3
Wirtualny Doradca (PayU)	-	+	+	-	-	2	2
Ewa/Adam (Kredytum.pl)	-	-	+	-	-	1	1
Ewa (Orange)	+	+	+	+	+	5	5

Table 8. Presentation on dealing with emergency situations under unexpected circumstances

X. DISCUSSION

Aiming to identify commercial applications for chatbots, we conducted our study. Several factors determine the quality of any commercial chatbot deployment: visual appearance, implementation on a website, speech synthesis unit, built-in knowledge base (with general and specialized information), presentation of knowledge and additional functionalities, conversational abilities, and an ability to adapt to unexpected situations, personality traits, and personalization options the possibility of rating chatbot.

Chatbot name (works on be-half of)	Vis ual loo k	Form of im-ple-men-tation on the web-site	Spe ech syn-the-sis unit	Knowl edge base (basic knowl edge)	Knowl edge base (spe-cial-ized knowl edge)	Presen tation of knowl edge and addi-tional func-tional-ities	Conver-sational abilities, lan-guage skills and context sensi-tiveness	Pers on al-ity tr ait s	Per-son-aliz atio n op-tion s	Emer-gency re-spons-es in unex-pected situa-tions	Possi-bility of rating chatbot and the website by the user	AVER AGE	RATI NG	OVER ALL QUALI TY
Ania (IKEA)	4	3	1	4	4	3	4	5	1	4	5	3,5	4	good
Zosia (Villa Pan Tadeusz)	5	4	3	3	4	1	4	5	1	4	5	3,5	4	good
Karen (WSHiF M)	5	3	4	4	5	2	3	5	2	3	1	3,4	3	satis-factory
Wirtual ny Doradca (PayU)	1	3	1	2	4	1	3	3	2	2	5	2,5	3	satis-factory
Ewa / Adam (Kredyt um.pl)	5	4	4	4	3	3	3	5	2	1	1	3,2	3	satis-factory
Ewa (Or-ange)	5	5	5	5	5	3	5	5	2	5	5	4,5	5	very good

Table 9. Overview of the ratings of each functionality of the commercial chatbot

XI. CONCLUSION

Presented in this paper is an analysis of commercial chatbots that are already in use. We have presented a lot of emphasis on the development of virtual assistants working for B2C companies, particularly those that target the widest possible range of users.

Each commercial chatbot was rated based on ten quality features: personality traits, personalization capabilities, emergency responses, the user's ability to rate the chatbot and the website, visual appearance, implementation form, Speech Synthesis unit, knowledge base (with general and specialized information).

We evaluated the current dynamics of the commercial virtual assistant market using the factors we identified above and showed how important it is to evaluate performance, usability, and overall quality when evaluating commercial virtual assistants.

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