

DEVELOPMENT OF INTELLIGENT AGENTS THROUGH COLLABORATIVE INNOVATION

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ABSTRACT

This study focuses on the development of a specific type of Intelligent Agents — Business Virtual Assistants (BVA). The paper aims to identify the scope of collaboration between users and providers in the process of agent development and to define the impact that user interpretations of a BVA agent have on this collaboration. This study conceptualises the collaboration between providers and users in the process of the BVA development. It uses the concept of the collaborative development of innovation and sensemaking. The empirical part presents preliminary exploratory in-depth interviews conducted with CEOs of BVA providers and analyses the use of the scheme offered by Miles and Hubermann (1994). The main results show the scope of the collaboration between BVA users and providers in the process of the BVA development. User engagement is crucial in the development of BVA agents since they are using machine learning algorithms. The user interpretation through sensemaking influences the process as their attitudes guide their behaviour. Apart from that, users have to adjust to this new kind of entity in the market and learn how to use it in line with *savoir-vivre* rules. This paper suggests the need to develop a new approach to the collaborative development of innovation when Artificial Intelligence is involved.

KEY WORDS

Business Virtual Assistants, artificial intelligence, innovation development

DOI: 10.2478/emj-2019-0018

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INTRODUCTION

Artificial Intelligence technology provides a revolutionary way of collaboration to create innovative products and services and to deliver value for customers. The development of Artificial Intelligence technology gives rise to new challenges and spurs innovations in the process of its development. The reason behind such an effect is the nature of such

intelligence, especially machine learning, which gives it the opportunity to develop not only in the traditional way of gathering feedback but also through the observation and analysis of the ongoing interactions with users.

This paper focuses on the collaborative development of intelligent agents and the potential influence that user interpretations of a Business Virtual Assis-

tant (BVA) have on the development of such innovations. The willingness to cooperate can be influenced by actor opinions regarding a BVA or the collaboration with the provider. The way collaborative innovation is performed depends heavily on the way a BVA will be used, and this depends on the attitude of users towards it.

Human actors that use a BVA are placed in a situation, in which they have to communicate with an artificial entity instead of a human being, which can result in various types of attitudes. Therefore, this paper aims to (1) identify the scope of collaboration between BVA users and providers in the process of the development of a BVA software agent, and (2) define the impact that user interpretations of a BVA agent have on this collaboration. This paper connects the concepts of collaborative innovation and sense-making to reach the research aims. Therefore, this is a multiple-lens contribution (Nicholson et al., 2018). The paper also presents some research questions, the answers to which are based on the preliminary qualitative study. Finally, conclusions are offered.

1. BVA IN BUSINESS INTERACTIONS

Research on Artificial Intelligence concerns any device that perceives its environment and takes actions to maximise its chances to successfully achieve its goals (Russell and Norvig, 2009). Contemporary Artificial Intelligence is a discrete system that performs selected functions in one of three areas: interactions based on natural language, image recognition, biometrics and learning systems. The use of Artificial Intelligence is discussed in many areas of business, also in enterprise management studies (e.g. El Kadiri et al., 2015). Studies focus on data analysis, market forecasting, customer analysis and relationships (e.g. Gordini and Veglio, 2017); sales (Syam and Sharma, 2018) and supply chains (Vendrell-Herrero et al., 2017). However, a gap seems to remain in the area of investigations regarding the development of Artificial Intelligence technology in collaboration with users.

The advancing development of multifunctional and flexible intelligent agents requires much more research, compared to that which exists on agents that perform only one, narrow task (Adams et al., 2012). Such intelligent agents are Artificial Intelligence systems that perceive and operate in a given environment through actuators (Russell et al., 2015). One of the applications used for intelligent agents is

a Virtual Assistant. Virtual assistants are software agents that perform specific tasks or services for their users. For example, consumer markets have such agents as Siri by Apple or Google Assistant, and their aim is mainly to improve the device and user interface with the help of natural voice or a keyboard for communication input. An extension of Google Assistant can even call a service provider or schedule a restaurant reservation. In business settings, Virtual Assistants are currently tasked with the scheduling of meetings, but can also be potentially used for initial communications in sales, or to collect offers in a tender in procurement, or to assist in resolving simple issues related to a service/product in customer care, or to communicate with hotels or airlines and gather invoices to assist in travel planning activities in the field of administration. A BVA interacts with humans in a normal business setting, and it does not require any software coordination between parties. Thus, it can be used by customers and suppliers to interact with an organisation. An assistant communicates by an email interface but introduces itself as an Artificial Intelligence agent and not a human. Still, from the connectionist point of view (Kaplan and Haenlein, 2019), as a BVA has elements of cognitive and emotional intelligence, it can be classified as Human-Inspired AI.

From a marketing point of view, Virtual Assistants obtain some features of a product (as they are, essentially, software) that helps to deliver a service as they assist in some activities (still, it will be referred to as “product” in this paper). BVAs are an innovative product because they offer a better solution for some business activities, making communication and scheduling mode effective (Frankelius, 2009). They also offer a new digital experience to human participants of business interactions (Morgan and Piccinini, 2018). As an innovative product, a BVA requires extensive efforts for its design, construction and development. This paper discusses how it can be done in collaboration with BVA users and what impact user interpretations of a BVA agent have on this collaboration.

2. COLLABORATIVE DEVELOPMENT OF INNOVATION

The need to reach outside one's boundaries to innovate is a result of points of knowledge dispersed across the business network (Powell et al., 1996).

A single company is rarely able to innovate on its own, as the process requires external resources to function (Hakansson and Snehota, 1996). Brown and Duguid (1991) showed that the creation of new knowledge and learning are fundamentally a social construction process within a community; in other words, a network. Depending on those points of contact with suppliers, customers or research facilities, innovation can be created (Ford and Redwood, 2005).

The external acquisition of new knowledge to create new products, services or solutions is referred to as “open innovation” (Chesbrough, 2006). Collaborative innovation is a specific way of performing open innovation, with the emphasis on the collaborative process between companies in the effort to innovate (Gallaud, 2013, p. 237). It is not simply an exchange of information or a flow of knowledge from one company to another. Rather, it is two or more actors working together with collaborative attitudes in the effort to innovate, i.e. when “organisations agree to pool their resources or to share their information and knowledge to develop one project” (Gallaud, 2013, p. 237). According to Dahlander and Gann (2010), collaborative innovation is an inbound innovation based on sourcing activities. There is no direct pecuniary re-compensation as both companies work together, sharing resources and information in pursuit of a shared goal. It is especially interesting in the case of collaboration between suppliers and their customers, as innovation may not be a part of a product or service itself, but a form of adaptation to minimise costs (Baldwin and von Hippel, 2011). The collaborative development of innovation as a concept accentuates two aspects of collaboration: resources that need to be exchanged and actors who exchange them.

Collaboration between network actors requires the sharing of resources and extensive communication (Baldwin and von Hippel, 2011). The much needed “flow of knowledge” between actors can differ depending on the degree to which actors rely upon each other, the difference between them and how dynamic is the market (Tracey et al., 2004). Tracey et al. (2004) distinguished three types of knowledge flow: transfer, interpretation and transformation. When the market is stable, and the differences between actors are subtle, knowledge is being transferred almost like information — in an easy, more or less coordinated way. In a more dynamic market, the meaning of events and actors is not as obvious. Therefore, both sides have to interpret the information they

receive from the other party and turn it into knowledge. If a market is dynamic, differences between actors are substantial due to the potentially different aims relating to the innovation creation, and knowledge has to be transformed by using boundary objects or other tools.

The participation of a customer (or a user) in the development of a new product has been emphasised by authors, who generally agree, that good relationships with customers have a positive influence on outcomes of new product development (Jer et al., 2013; Cuevas-Rodriguez et al., 2014). Involved customers play a vital role in innovative efforts. At the beginning of this process, they can help in solving problems, launching the product, collecting user comments and sharing responsibility (Cui and Wu, 2016). This is especially important in business markets, where specific knowledge and feedback are required (Eslami and Lakemond, 2016). The literature also underlines that a service is co-created by a service provider and its users. Users heavily influence the outcomes and its later development (Gumesson, 2002). Thus, without the openness of a customer to collaborate in the design, development and improvement of new products or services, the process is less effective. Supposedly, such statement undertakes a new meaning when innovative solutions are based on Artificial Intelligence, as in the case of a BVA.

3. COLLABORATIVE DEVELOPMENT OF INNOVATION IN THE CASE OF A BVA

We can set apart three different approaches to the perception of Artificial Intelligence and the way it should be developed. According to a symbolic approach, Artificial Intelligence is based on mathematical models of analysed problems. In the symbolic approach, Artificial Intelligence in the form of computer programs embodies specific dimensions of intelligence. The sub-symbolic approach involves the creation of structures of machine learning that can find patterns and create predictions basing on Big Data. Finally, there is an agent approach that deals with the development of different forms of autonomous entities that observe the environment through sensors, act using actuators and direct their activity towards achieving goals (Nilsson, 1998; Russel and Norving, 2009). When it comes to modern intelligent agents, especially virtual assistants, two latter

approaches are important, because they equip those agents with a capability to show the desired behaviour and change it, and to make decisions based on the obtained knowledge and experience.

Researchers have indicated the need to recognise the help of users of a product or a service in the form of participation in the innovation process of digital solutions (Bogers et al., 2017). When considering the collaborative innovation in the case of Virtual Assistants, the aim of the collaboration differs depending on whether the product is being designed or whether it needs to be improved or further developed at a later stage. In the case of the design of Virtual Assistants, human actors are important for helping them to learn how to interact with people. For example, Facebook has been teaching its M virtual assistant using blended Artificial Intelligence and human trainers as beta users. The aim is to teach the agent to communicate like a human rather than in a “robotic” manner. People make mistakes, use different types of hesitation expressions, such as “hmmm”, and they do not always behave rationally. Therefore, a BVA must be shaped considering these humans peculiarities. Another issue is to employ cognitive technology to interact with people on multiple related topics and react to the emotional content of a conversation (Ibrahim, 2019). The innovation can be guided by the provider who gathers feedback and improves algorithms, but more importantly, it can be left to a BVA, which can develop autonomously, thanks to learning algorithms.

When a BVA is implemented, due to machine learning, cooperation with users becomes particularly important. The technology used by Artificial Intelligence allows monitoring and gathering feedback from customers who use verbal and other types of communication. A BVA agent is based on innovative Artificial Intelligence algorithms that learn and evolve with every encounter. Providers can use collaborative innovation to learn the habits of hosts and guests and improve the software. It can be done using machine learning or by getting feedback from the

users. However, machine learning needs interactions with users to evolve, and IT developers need feedback from the users. Therefore, the users of the service willingly or unwarily collaborate with the developer of a BVA.

We assume that in the case of a BVA, collaborative innovation can proceed on two levels — the configuration settings and the core of the service. The configuration settings are the basic way users can adjust the service to its needs. This level represents standard functionality in the software and is not a subject of collaborative innovation. The object of interest is the second level, which refers to the functionality and usability of a BVA, and especially the method used by the provider to collaborate with the host and the guest to improve core functionalities and capabilities of an agent.

Three types of actors are involved in the development and use of a BVA. The first is the provider, which is the company that creates the system and develops it through the collaborative innovation process. The second is the host, which is the organisation that hires the BVA software agents for its employees, who use the BVA to set meetings with other stakeholders. The BVA has access to the host’s calendar and can manage it to some degree. The third type of actor is the guest, which is the organisation whose employees want to meet with the host employees and have to interact with the BVA in order to do so. Innovation is a process that happens between the provider, the host and the guest requiring some form of collaboration between them. The provider can observe the behaviour of the users to adjust the software and develop new software capabilities. The types of actors are summarised in Tab. 1.

According to the presented literature review and assumptions made by the authors of this article, collaboration with the immediate users — employees of the host and guest organisations — could be important for the provider not only during the new product development process but also when the agent is used

Tab. 1. Types of actors involved in the Collaborative Development of Innovation in the case of a BVA

TYPE OF ACTOR	DEFINITION
Provider	A Provider is the main developer responsible for the creation of a BVA. The Provider sells the agent to the Host
Host	The Host buys the agent from the Provider. Its employees use it to schedule meetings with other actors inside and outside of their organisation. The BVA learns the habits of the employees and has access to their calendars
Guest	Its employees engage in the interaction with the BVA to schedule a meeting with the Host’s employees. They are facing a <i>fait accompli</i>

on a daily basis, as it can self-improve thanks to machine learning. Thus, the provider, as well as the BVA, need users to interact with the agent and to share their experience with it. However, the interaction with an artificial entity, such as a BVA that uses normal language, can be extraordinary for human actors. As computer programs can be perceived by their users as social actors (Nass et al., 1994), we do not know how a BVA will be interpreted and what effect this will have on the interaction and the collaborative innovation process. Recent studies have shown that people react differently to Artificial Intelligence agents compared to humans (Mou and Xu, 2017), and the way an agent is constructed can have significant effects on human reactions during the interaction (Ciechanowski et al., 2018). User interpretations can, therefore, impact the collaborative innovation process as they shape attitudes of human actors towards the service. We assume that the motivation to give feedback depends on the perception of a BVA.

Surprising events, such as interaction with an artificial entity, can trigger sensemaking (Weick, 1995; Cornelissen, 2011), which “unfolds as a sequence in which people concerned with identity in the social context of other actors engage ongoing circumstances from which they extract cues and make plausible sense retrospectively, while enacting more or less order into those ongoing circumstances” (Weick, Sutcliffe and Obstfeld, 2005, p. 409). Considering the context in which they find themselves as well as their previous experiences and organisational narratives, human actors assess the situation and act accordingly. For example, this means that regarding the sensemaking, human actors will judge a BVA as more or less worthy of their social response, this way impacting on its ability to learn. Sensemaking can influence the provider’s ability to innovate a BVA and the direction, in which the agent will evolve. This is due to the fact that the Artificial Intelligence algorithm needs vast amounts of information from users and may be affected depending on the quality of their response and their willingness to cooperate in the collaborative innovation process.

According to the constructivist paradigm, a BVA can be assumed as a new entity that evokes intensive sensemaking. This research assumes it to be a process of learning and sharing information with a BVA (such as Artificial Intelligence) and/or with the provider. The process results in an interpretation of the BVA, that can influence the collaborative behaviour of the host and the guest employees towards the BVA agent

or its provider. Thus, motives to share the experience with the provider need an explanation (Bogers et al., 2017).

4. RESEARCH METHOD

Our basic question is about the collaboration model of the BVA development and the influence of user interpretations of the BVA on their participation in the development process. In the inter-organisational context, the interactions with a BVA occurs on two levels: individual and organisational. The interface between the provider and the users as an organisation and its employees becomes an important study object (Hargrave and van de Ven, 2006). The BVA provider can bring the host and guest organisations together to collaborate but to develop the BVA, it also needs to engage the host and guest staff for they are the actual interlocutors of interactions.

In this study, BVA providers are treated as key informants as they have to deal with the collaboration between hosts and guest to develop the agents. The study consists of three steps: the first step identifies and compares BVA solutions worldwide. Eight companies that offer BVA solutions worldwide were found (Tab. 2).

Tab. 2. Virtual Assistants worldwide

PROJECT NAME	BASED IN	VIRTUAL ASSISTANT IMAGE
Calendar.help (Cortana)	Redmond	Artificial
Clara	San Francisco	Humanoid
Evie	Singapore	Humanoid
Julie Desk	Paris	Humanoid
Konolabs	Seoul	Artificial
Meet Sally	New York	Humanoid
X.ai	New York	Humanoid
Zazu	Amsterdam	Humanoid

In the next step, e-mail, LinkedIn and Facebook invitations were used to ask CEOs of all providers to participate in interviews. Four out of eight CEOs responded to our invitations. However, some of the interviews had to be discarded as some companies were bankrupt. Finally, two in-depth interviews with the CEOs of Kono and Evie companies were conducted. In one, the BVA is available in the form of a Humanoid, and in another, it is a straightforward

artificial image (Tab. 2). These interviews considered three aspects: the role of the BVA in host/guest interaction, the attributes of the BVA promoted to users, their attitude towards the BVA and the development of the agent. Respondents were open to sharing their knowledge and experience; however, they tended to talk about BVA usage and implementations rather than its development. In the last step, the interviews were analysed according to the scheme of analytical work with qualitative data by Miles and Hubermann (1994). Interviews were coded and deconstructed, then interpreted and, finally, reconstructed to show relationships and insights derived in the interpretation phase and to find explanations and refer them to existing theory and practice.

5. RESULTS

Strategically, both BVA cases are focused on business applications where the host is a company trying to increase the effectiveness of its communication in scheduling meetings with the customers. BVAs are not perceived as an Artificial Intelligence phenomenon, but more as a tool for the scheduling of meetings. In the future, BVAs should be able to organise every aspect of a business trip. According to one of the respondents: “We are trying to reduce the number of actions made by a human, by providing these various innovations”. For both companies, the key targets are industries that involve the scheduling of vast numbers of meetings, such as Human Resource departments or healthcare and education institutions. In such cases, BVAs can have an important influence on the effectiveness of work and deliver value to the customers.

In both cases, the providers are trying to improve BVAs by observing and analysing interactions between hosts or guests and their agents. They are aware that scheduling of meetings with the help of a BVA, even though it is set to mimic human interactions, has some peculiarities. In internal meeting scheduling, people do not like to give away too much control. So, even though a BVA could schedule an internal meeting single-handedly, the process must involve more points of contact with the users. This makes users feel involved in the decision-making process. In the case of external communication, the rules are almost identical to real human communication (“Rules of behaviour are no different than if you were interacting with any human being; I think people forget that sometimes. They seem to think that there

are new rules that apply to Artificial Intelligence when really the old rules apply best”). These rules are most noticeable when it comes to deciding on the appropriateness of the use of an assistant to schedule a meeting. When dealing with important accounts, it can be out of place to use even a human assistant, as a guest might feel unappreciated. For example, in a job interview, most cultures consider it bad manner to include an assistant.

Interactions with human users are crucial for the development of a BVA as both respondents noted that the main assumption is that a BVA must adapt to humans. Due to that, the interface for interactions is e-mail, and the style of the BVAs messages is comparable to those written by a human assistant. The whole process of including a BVA into the conversation is also similar: the host has to CC the bot to add it to the conversation and introduce it in the e-mail. Then, the agent can send the guest a separate e-mail with a list of proposed dates for a meeting.

Associating a BVA with Artificial Intelligence can evoke a certain user attitude. Currently, people are still learning to interact with Artificial Intelligence agents, so different perceptions and anxieties are possible, and they are not necessarily always realistic. On the other hand, due to the same reason, the connotation attached to Artificial Intelligence can elicit reactions that will make interactions with Artificial Intelligence agents more fluent. Guests are not always aware that they exchange emails with an artificial agent. It happens because people expect a reply from a human. This happens despite clearly given information regarding the third party of the conversation being a bot. Therefore, differences are possible in attitudes towards the introduction of a BVA between those who see it as an artificial entity and those who mistake it for a human. The guests who do not realise the true identity of their interlocutor expect that the BVA will show up at the meeting (“People show up for a meeting and ask, “Where is Evie”, “Will Evie be joining us for a meeting”. It is not because we want to fool them but because the interaction is more like what people expect from a human being”). For now, as one of the respondents mentioned, this is an interesting topic for the users to discuss. However, this situation is typical for the introductory stage of the product and may be irrelevant in the following stages.

Guests that realise the artificiality of a BVA can be divided based on their reaction. Often, they feel strange when they are involved in a conversation with Artificial Intelligence in interactions typical for a human-to-human interface. It is also important to

state that they are left with no choice when it comes to these encounters. Apart from that, they can be tempted to test the bot, play with it in order to understand its features and boundaries. Especially, hosts can be characterised by this temptation, impairing the development process, by having extraordinary interactions with a BVA. This is why emphasising that the Virtual Assistant is a tool based on Artificial Intelligence has some drawbacks.

6. DISCUSSION

The collaboration between the provider, the host and the guest is crucial for the development of a BVA. However, this collaboration may not take place in the usual format. Due to the use of machine learning algorithms, users influence the development of a BVA with every interaction. The success and effectiveness of the development process depend on attitudes, interpretations and habits of users.

Apart from the interaction pattern, the personality of an assistant needs to be adapted to the attitudes and preferences of human users. Most BVAs are usually created to imitate humans, with the exception of Kono and Calendar.help. Nonetheless, according to the results of the preliminary research, user interpretations of the BVAs' identity may be different from what the provider assumed. Through sensemaking processes, users create their own interpretation of a BVA, which is in line with social constructivism (Guba and Lincoln, 1994).

The use of a BVA in a host organisation has wider consequences. Navigating within the rules of business *savoir-vivre* can be troublesome for those who never had an assistant. BVA technology is affordable for most companies, so it becomes possible for more people to have a quasi-private assistant for the first time. Providers encourage their potential customers to equip every white-collar employee with such assistants and save their time by freeing them from notorious scheduling activities. Managing such assistants requires some knowledge, so could the provision of guidelines could be necessary.

CONCLUSIONS

This study suggests some preliminary conclusions. BVAs are developed in the process of collaborative innovation in two ways. The software itself is introduced basing on R&D processes. Then, two ways

are possible for development: 1) the provider gathers feedback from its users and by using their experience, creates another version of the software; or 2) the provider designs the Virtual Assistant to learn autonomously using the analysis of interactions with users and machine learning. In the case of the second way, which uses Machine Learning, there might be a need to modify the approach to the collaborative development of innovation. The method of collaboration with learning artificial systems in innovation development must be considered, especially when such systems implement reinforced learning (Kaplan and Haenlein, 2019).

The BVA image is comparable among providers and users. Users are interested in the solution but feel anxious about it. However, this feeling is not related to the use of Artificial Intelligence, but to the way a BVA communicates with users. As scheduling of meetings is usually initiated by a human rather than an artificial entity, the reactions could be influenced by a different propensity to answer an invitation sent by a bot.

A BVA connects organisational aspects with individual interactions, so the propensity of users to cooperate can have a significant impact on the collection of their feedback and collaborative innovation. Users often interact with such form of Artificial Intelligence for the first time, which leads to sensemaking processes. Sensemaking can easily be described as a process "of meaning construction whereby people interpret events and issues within and outside of their organisations that are somehow surprising, complex or confusing to them" (Cornelissen, 2012, p. 118). Sensemaking leads to the identity attribution, which can influence the way people interact with a BVA, the propensity to collaborate with it and share their experiences. Collaborative development of a BVA can require a specific image of the BVA among its users (to influence the sensemaking processes) and acknowledgement that users will learn to interact with the BVA and share their experiences along with consecutive interactions.

LIMITATIONS AND FUTURE RESEARCH

As research on business applications of Intelligent Agents is still in an early stage, the authors aimed to share their preliminary findings with the academic audience while being aware of the limitations. This

paper is based on preliminary empirical research, namely of two interviews, which may bias the results and conclusions. Data was collected from companies that acted as pioneers on the market, so their interpretations of the innovativeness of BVAs may differ from the followers. Probably, intelligent agents as such were new also for their users (hosts and providers) what might have strengthened the interest but also impart some anxiety on the collaboration.

We expect to broaden the presented results. It will be a consequence of exploring further opinions but also studying other BVA software agents that are being introduced to the market, potentially having different business models in mind. This market is growing: at the beginning of this research, eight providers were identified, while at the end, 20 providers were already operating worldwide. Therefore, getting more data about BVA development in collaboration with hosts and guests as well as the influence of their sensemaking on that collaboration should be continued. This appears to be an absorbing academic task as BVAs are expected to develop from Human-Inspired AI to Humanised AI, which will be a challenge in terms of confidence, change and control of organisations (Kaplan and Haenlein, 2019).

ACKNOWLEDGMENT

This study was conducted as a part of “UEP dla Nauki 2” research project granted by Poznań University of Economics and Business.

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