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The Impact of Augmented Reality on the Technical Customer Service Value Chain

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Abstract **-** Given to the fact, that the leading innovation companies in the field of consumer IT announced the production and distribution of Augmented Reality (AR) devices, the previously expensive technology dropped in prices. This makes them affordable not only for big but also for small and medium sized companies; subsequently, new fields of business are opened up. Especially the Technical Customer Service (TCS) can benefit from new and affordable mobile technology. Due to the variety of tasks and his operating place at the site of the machinery, the TCS technician has to be provided with current and case-related contextual information in a short time. Above that, the environmental issues such as oil-smeared hands during the service, repair and maintenance case require innovative technologies to support the technicians at their point of service. Goal of this contribution is the identification of the phases of the TCS value chain that can benefit from specific features of AR technologies. In differentiation to existing literature, this conceptual paper focuses on the business process of TCS not only on the technology of AR itself.

Keywords**:** Augmented reality, Technical customer service, Value chain, Maintenance, Repair.

1. Introduction

Within the last few years, in particular the customer market grow to the most powerful and innovative market. New technologies such as smartphones, tablets and faster mobile internet connections triggered a revolution in households around the globe. Suddenly, individuals got more innovative and equipped with more technologies at home than the average company with their professionals are. With this progression in mind, the source of innovation and the way new technologies reach companies changed. This leads to new processes companies have to deal with that focus on how to integrate private devices into company structure, how to keep in step with new technologies and finally how to benefit from new technological trends.

One of the recent technologies that was developed years ago and that is on the edge of becoming living room technology is Augmented Reality (AR). Recently, substantial companies as Google, Sony and Epson announced that they are developing AR devices. Consequently, the price for this kind of devices drops to a reasonable amount which makes them available to the majority. When individuals experience change in their private setting the change mostly does not stop in their business context. So, the need to discuss the potentials of AR devices in business context has risen. The direct consequence for the discipline of information systems is to accept the challenge of broadly available AR devices as well and focus in particular on the business value of them.

Subsequently, this paper focuses on one particular field that might find AR technologies remarkably beneficial. This field is Technical Customer Service (TCS) as it deals with huge and expensive machinery and the need for real-time information. As the technician in TCS processes is mostly in direct contact to the customer there is only little time to search for the information that is needed to repair or maintain the machines (Fellmann et al. 2011). Due to this fact combined with the high variety of the necessary information, an intelligent proactive information provision has to be established (Özcan et al. 2013). In addition, idle machines imply a great financial loss as they are not able to produce goods.

This paper addresses the potential of AR technologies for the TCS and therefore defines the following research questions that are leading through the entire examination:

1. *Which phases of the TCS value chain can benefit from AR?*
2. *What features of AR can be beneficial for the TCS phases?*

Besides the research questions the paper is structured as follows. First the methodology including the Design Science Research approach for the paper is described. Second, in Chapter 3 the TCS value change is described followed by the potential features of AR. Within the main chapter (Ch. 5) the mapping of AR features to the TCS phases is done which describes the main contribution. After a short literature overview, finally, a conclusion and outlook is given.

2. Methodology

Within the discipline of information systems discipline the ubiquitous design science research (DSR) is the probably most used methodological background for research. Therefore, this paper is also specified in terms of DSR by HEVNER (HEVNER ET AL. 2004). To bring together the Augmented Reality (AR) and the technical customer service (TCS), parts of the knowledge basis will be taken and applied to a new relevant technology. As part of the knowledge base, the well-known value chain of the TCS will be used. The new relevant technology within this paper is the AR that in particular due to recent developments is on the edge of becoming widely-spread consumer technology. Afterwards, the mapping of AR applied to parts of the TCS value chain is build and gets justified later on. The figure 1 sums up the methodological background.

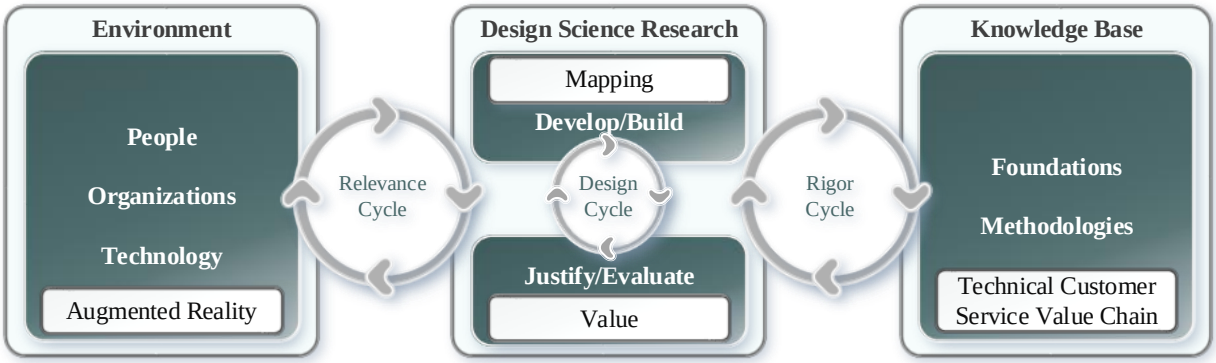

Fig. 1. Method and DSR (Referring to Hevner 2007; Hevner et al. 2004).

3. Process of TCS

The Technical Customer Service (TCS) plays a central role in the product-service-lifecycle (Blinn et al. 2008) being the interface between the production of machinery and its operational application at the customer site (Harms 1999; Bolumole et al. 2003; Thomas et al. 2007; Deuse et al. 2009). Scope of his duties are service, repair and maintenance work. These duties are complemented by further support activities, e.g. customer hotlines, done by the service employees in the back office or providing the customer with professional advice about the right usage of the machinery.

Due to the variety of tasks and the technicians operating place at the operating station or console of the machine or at the machinery itself, the TCS technician has to be provided with current and case-related contextual information at the mobile "Point of Sale" respectively "Point of Service". Having access to the right information at the right time is a critical success factor for performing service work at increasingly complex machineries in a short time (Fellmann et al. 2011). Hence, Information Systems preferably mobile support systems have to be used. Those mobile systems provide a flexible support for the technician and have the potential to increase both the productivity as well as the empowered decision process of the TCS (Fellmann et al. 2012). As a large variety of information and data exist that is instantly

needed for a the fast diagnosis and realization at the Point of Service, a proactive information provision has to be established (Özcan et al. 2013).

To identify the possible starting points at which AR technologies can improve the TCS work, the TCS process and the involved parties has to be analysed. MATIJACIC ET AL. have already established a general TCS process based on (Hermes 1999; Kallenberg et al. 2004; DIN EN 13460 2009) (Matijacic et al. 2014). In order to achieve an aggregation level accurate to work with, we compiled the following TCS value chain, shown in figure 2, from the general TCS process and further detailed steps as described in the mentioned literature.

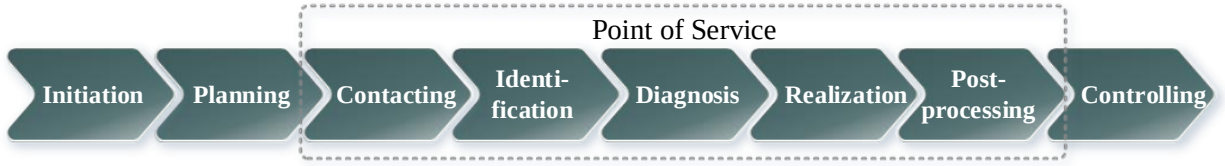

Fig. 2. TCS Value Chain (Referring to Hermes 1999; Matijacic et al. 2014).

First of all, the service is *initiated* by an engagement between the customer and the back office. Possibly, first information about the service case and the customer is exchanged. After having recorded the service case, the progress has to be *planned* and scheduled. If the work is proposed, it has to be released and assigned as a work order (DIN EN 13460 2009). At the Point of Service the technicians makes *contact* to the customer and *identifies* the service case. Having received the information of the customer and found the location of machinery, the *diagnosis* of the service object starts. The actual service, repair and maintenance work is done is the *realization* phase. The *post-processing* work includes reporting a feedback to the back office about the executed steps and occurred problems by the technician himself. During the *controlling* phase, the achievements have to be checked and transferred into the reporting systems to monitor the quality and to reveal weak spots within the maintenance process (Matijacic et al. 2014).

4. Features of Augmented Reality

Augmented Reality currently is a huge trend that provides several features. Generally, the information can be divided in incoming and outgoing information as information can be transferred to the AR device and vice-versa. The information that is transferred also differs in particular regarding its media richness. So, the potential information that interacts with the devices can be classified as:

- Picture:
  First of all, simple pictures or graphics can be transferred to the AR Glasses. Vice-versa the glasses can also take pictures of what is in front of them and then transfer these pictures.
- Audio:
  Furthermore, as AR devices are equipped with speakers or headphones, the transfer of audio to the devices is also applicable. In return, most of the devices also feature a microphone which allows capturing the voice of the one wearing the AR device. So, telecommunication is also possible.
- Video:
  Finally, AR devices are mostly able to display small videos as well as record them with their built in camera. This includes video telecommunication.

When transferring information from the AR device there are basically two ways of interactions possible. The first interaction is with a system that somehow analyses the given information and responds accordingly. The second interaction is with a human being to whom the information from the AR device is shown and that can also responds and even interact with the AR device wearer. The following figure 3 gives an overview of the potential interaction of AR devices.

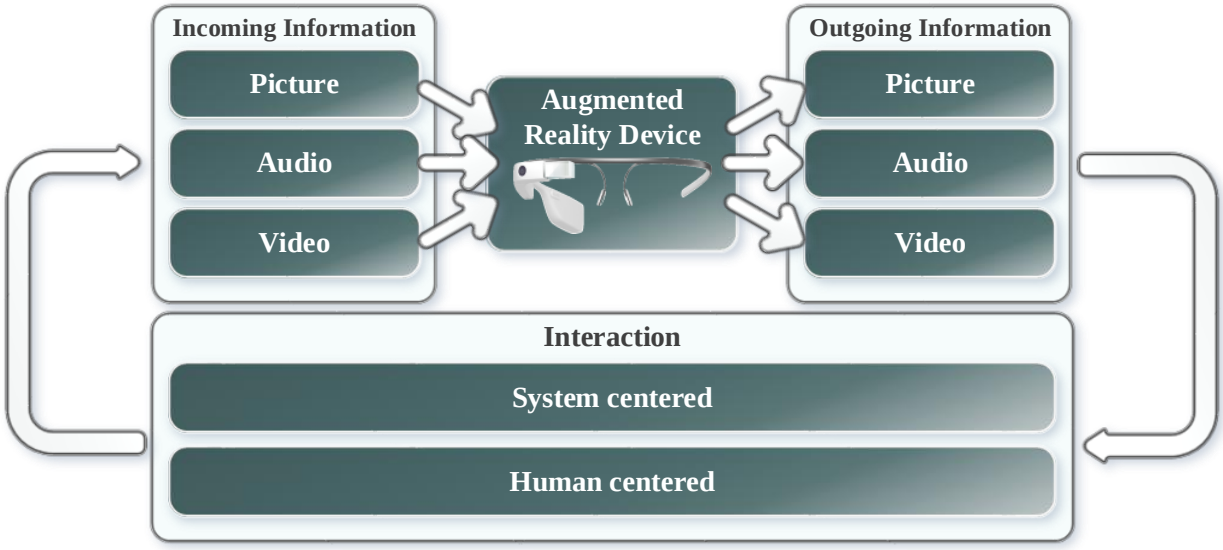

Fig. 3. Interaction of AR devices with their environment.

5. Mapping

When mapping both of the given fields the possible impact of AR devices on TCS can be determined. Starting from the TCS Value Chain first the justification for every part takes place. As a mobile technology, AR devices can especially be used to support those TCS service phases that are executed at the Point of Service. As already stated in Section 3, this includes the contacting, identification, diagnosis, realization and post-processing phases.

- *Initiation*: The service starts with the contact of the potential customer that is giving basic information about what kind of service is requested. As the kind of information is more of a formal nature there is no benefit through AR devices. However, the recorded information about the customer and the service case can be used later on the AR device.
- *Planning*: When the service is requested some basic planning steps take place to schedule the repair/maintenance request. This phase is mostly carried out by the back office which therefore again includes no potential for AR devices.
- *Contacting*: The contacting is basically realized by the technician on the first contact to the customer. Although this step already includes different information their more formal nature does only provide little potential for AR devices. It might be imaginable that the technician when traveling to the customer is already wearing an AR device with all relevant information about the customer.
- *Identification*: The identification phase deals with additional information about the exact problem the technical machine has. Within this phase there are usually two participants: The customer and the technician. Normally, the technician is for the identification of the problem on site. He can bring an AR device with him to get access to information that resides in knowledge systems. He can additionally ask colleagues to have a remote look at the technical machine as well to make sure that he gets the correct identification of the problem. Furthermore, with AR there is potentially no need to travel to the site anymore. The traveling of technicians to the site where the technical machine is used is expensive and time consuming. Through the remote picture feature of AR the customer can transfer the relevant information about the technical machine directly to the technician in the office. Even more, a remote identification can take place with the customer wearing the AR device looking at the technical machine and the technician connected via video telling the customer what to do. There are

different ideas possible as guided system-based identification is imaginable as well. Altogether, the potential of AR devices within the identification phase is given.

- *Diagnosis*: Another field where the use of AR devices can be beneficial is the field of diagnosis. Basically, when the problem is identified the way of fixing it has to be determined as well. This phase can be supported by the technician that is in his office having access to all information and all potential spare parts that can be used to fix the problem. The AR device can be used by the customer to provide enough information about the potential way of replacing parts as well as the exact spare parts number. In addition, when the technician is on site he can use an AR device to get access to the database and gets information about the availability of the particular spare part displayed directly when standing next to the technical machine. Even further, the AR device can support the technician with the identification of the machine through image recognition.
- *Realization*: Finally, the problem is identified and the way to fix it is also defined. Now the replacement itself takes place. Therefore, typically again a technician is traveling to the site and the technical machine to perform the service operations. With the use of AR potentially there is no or only little need for a technician to be present at the site as with guidance the customer can perform the maintenance steps himself. He could wear the AR device and perform the steps while a technician is remotely connected and observes that everything goes well. When the technician for whatever reason is needed on-site he can use AR technology as well to gain access to further instructions, information and detailed maintenance processes. All in all, the potential in the phase of realization is as well quite promising.
- *Post-Processing*: After the maintenance or repair took place the post-processing follows to make sure all the information about the progress is added to the knowledge base. This enables later service cases to learn from the experience gained within this case. However, the use of AR devices is only indirectly beneficial as there might be an advantage when AR devices were used in the previous phases. The direct use within this phase does not provide substantial additional use.
- *Controlling*: Quite similar to the post-processing when calculating the business value and mercantilistic numbers AR does not provide direct benefit, but potentially indirect benefit when AR is used throughout the other phases of the value chain.

Overall, there are several phases within the value chain of technical customer services that are appreciable for the use of AR devices. In particular the phases where the technicians deal directly with the customer next to technical machine at the point of service are quite promising. Although, the TCS process steps Initiation, Planning, Post-Processing and Controlling cannot be supported directly through the use of AR technologies, the information generated at the Point of Service have a high impact on improving the back office steps and vice-versa, which is going be analysed in future research.

6. Related Work

The field of Augmented Reality has been in the research for a while. For instance, already in 1993 FEINER ET AL. found, that maintenance and repair tasks provide a good field for AR applications (Feiner et al. 1993). Furthermore, the need for AR in maintenance, assembly and repair of complex machinery was as well mentioned by AZUMA within a survey on AR (Azuma 1997). After several contributions on how to use AR in a certain use case in maintenance (Lawson & Pretlove 1998; Haritos & Macchiarella 2005; Henderson & Feiner 2009) there were some more general ones on the benefit or AR such as (Henderson & Feiner 2011). However, there has never been a more theoretical approach starting from the value chain giving a foundation of AR in TCS.

7. Conclusion and Outlook

When it comes to the use of AR technology there is huge potential in several fields. Within this paper the potential in the field of TCS was examined with results in various phases of the value chain. Combined with the special needs of TCS the use of AR devices furthermore seems not only promising but rather the consequent next step. This is in particular based on the need for fast and reliable information directly at the Point of Service combined with the benefit of hands-free provisioning through the glasses and therefore answers the second research question.

Analysing the different phases of the value chain revealed the different participants. Combined with the fact of affordable, widely spread AR devices the innovative idea came up, that in the phases with customer involvement for the first time the use of AR technology empowers the customers to provide maintenance and repair to their machines on their own. Therefore, the AR devices could be included in the delivery of the technical machine. This comes not only with the financial savings for less traveling but also a more agile reaction to faults on machines through the customer. Even when the customer is not able to fix the problem by himself the spare parts can be ordered right away. So, not only the technician but as well the customers are empowered by an AR technology based system to realize certain steps in maintenance and repair of machines. The promising phases of identification, diagnosis and realization are ideal for the use of AR devices. This answers the first research question.

As seen in the related work section, there are already several systems and substantial work in the field of AR and maintenance. However, within this paper the more conceptual approach starting from the value chain was missing so far. Within further research a classification of the known approaches on basis of the value chain will be examined. This provides a foundation for the design of a technical customer self-service process and the implementation of the AR service support system that will be conducted in a future research project.

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