Heinrich C. Mayr, Martin Pinzger (Hrsg.): INFORMATIK 2016,
Lecture Notes in Informatics (LNI), Gesellschaft für Informatik, Bonn 2016 753

Shaping the Future of Mobile Service Support Systems – Ex-Ante Evaluation of Smart Glasses in Technical Customer Service Processes

Christina Niemöller[1], Dirk Metzger[1], Michael Fellmann[2], Deniz Özcan[1] and Oliver Thomas[1]

Abstract: The recent introduction of smart glasses through media spurred new concepts of service support systems. Especially in the domain of Technical Customer Services (TCS), the opportunity to access information hands-free provides additional benefits. However, due to the novelty of the technology besides various technical issues the question of usefulness is of vital importance. To date, little research provides guidance for researchers and practitioners. Goal of this contribution is to systematically elicit functionalities of smart glasses to offer an overview of the emerging technology and apply the functionalities to requirements of the TCS to investigate the benefits of smart glasses in this domain. Therefore, a multi-method approach for the elicitation of 20 features has been conducted followed by mapping the features to 36 previously derived requirements. In total, the contribution can serve as guidance for the strategic evaluation of smart glasses supporting service processes.

Keywords: Smart Glasses, Augmented Reality, Technical Customer Services, Taxonomy.

1 Introduction

Due to recent technological advancements in hardware and software, the character of IT transformed from an attached commodity to the center of new product and service ideas [BLM14]. Especially services whose work is performed in the field, such as Technical Customer Service (TCS) processes, may profit from mobile devices [AH10]. Mobile services enable technicians to directly capture information more quickly and more precisely, while they are performing maintenance, inspection or repair tasks [Le11]. So far, mobile solutions mostly have been implemented in the form of handheld devices, however, handheld devices are not the likely end of the mobile computing innovation vector [Lu13]. Emerging technologies such as smart glasses are discussed to support complex service processes [HE15].

Although the potential induced by traditional head-worn-displays has already been discussed in research in the field of maintenance [HM05, HF09, LP98, RBH03], still only

[1] Universität Osnabrück, Informationsmanagement und Wirtschaftsinformatik, Katharinenstr. 3, 49074 Osnabrück, vorname.nachname@uni-osnabrueck.de
[2] Universität Rostock, Wirtschaftsinformatik insbes. Betriebliche Informationssysteme, Albert-Einstein-Str. 22, 18057 Rostock, michael.fellmann@uni-rostock.de

few scientific papers exist that address smart glasses. Especially in the professional context, such wearable devices meet the need of workers that are not able to use handheld devices due to the nature of their work, e.g. when free or clean hands are mandatory [LH14]. There is a need of studying emerging technologies such as smart glasses in a business context, since manufacturers tend to focus predominantly on consumer markets and requirements. Therefore, in our paper, we study the impact of smart glasses on technical customer services. With this, we aim to lead the emerging technology to its full potential in business processes and as a consequence to foster service innovation.

The scope of our work is a structured identification and classification of functionalities of smart glasses as to date there is no typology known from literature. However, to conduct an ex-ante evaluation of smart glasses in the context of TCS which we envision in the paper at hand, such a typology is needed. The rationale for this ex-ante evaluation is that an early evaluation and documentation makes it easier for researchers to communicate intermediate products of a Design Science Research (DSR) process to the research community. With this, not only consensus on the relevance, novelty, and importance of a chosen problem domain can be build early in DSR processes [SB12]. Other researchers can build upon this rigorously developed knowledge right away, without waiting for the instantiation of the IS prototype itself. This is why we validated the potential usage of smart glasses for TCS processes through our approach.

As a result, we hope to both provide a solid foundation for further research activities as well as insights relevant for the practical application of smart glasses in enterprise settings. In more detail, our contribution to research is twofold. First, we develop a taxonomy of functionalities of recent smart glasses. Second, we map them to requirements in the TCS. This in turn leads to a strategic decision-making basis for the introduction of smart glasses in companies. With the help of this, functional management is equipped with an instrument to decide – based on their specific requirements – whether smart glasses create value and what functionality contributes to that value. With our research, we fill two research gaps. First, to the best of our knowledge, no taxonomy of smart glasses technology and their functionalities have been published so far. Second, also the actual impact on business cases in the TCS area has not been discussed in the Service Science literature until now which we do in our contribution. This provides a fertile ground for future research concerning the design of smart glasses systems in TCS carrying out the system design and ex-post evaluation.

Against this background, the questions that guide our research are: RQ1: What functionalities do the emerging technology smart glasses offer? and closely connected to the previous question: RQ2: Are the requirements of the TCS addressed by the capabilities of smart glasses? To address our research questions, we proceed as follows: In Section 2, we give an overview on our methodical approach which also introduces the structure of this paper. In Section 3, we give background information about TCS processes. In Section 4, functionalities of smart glasses are explored. Further in this section, we will examine whether smart glasses create value for the TCS. In Section 5, we discuss our findings, conclude our approach and point to future research.

2 Research Model

As our research focuses on the design of an artefact to support the service processes of the TCS we follow a DSR approach [cf. Pe07, SB12]. As SONNENBERG AND VOM BROCKE suggest, we conducted an ex-ante evaluation before constructing the artefact itself [SB12] to validate e.g. system designs, requirements or guidelines [Of10]. Thus, as shown in Figure 1, we follow a two-step approach: (1) We analyze the support technology smart glasses and their functionalities (technological perspective). After that, we conduct an ex-ante evaluation to validate whether smart glasses act as technology to support the TCS, (2) we establish the relations between the two aspects via a mapping that allows us to derive the impact of smart glasses on TCS. With the ex-ante evaluation, we validate on the one hand the applicability and the suitability of using smart glasses to support the identified requirements and, hence, the TCS process. On the other hand, while mapping the requirements with the smart glasses functionalities, we implicitly also evaluate completeness, correct level of detail, internal consistency and applicability of our derived smart glasses taxonomy [SB12].

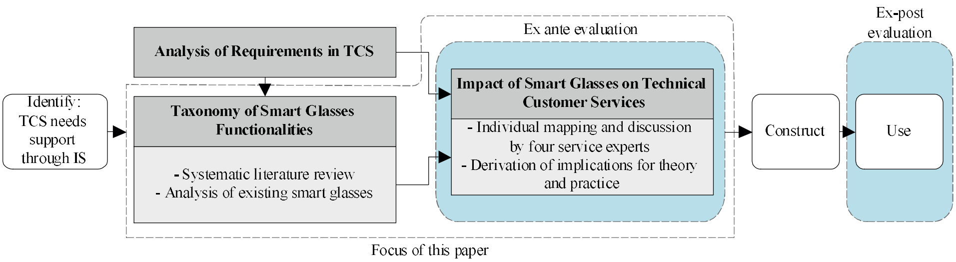

Figure 1. Research model referring to SONNENBERG & VOM BROCKE [SB12]

In previous work, requirements of TCS were elicited by observing 77 TCS processes (one process = one customer order) of a leading company in the intralogistics sector in Germany. The processes obtained maintenance, repair, and adjustment and consultation orders. A detailed description of the research methodologies and their findings has already been published in [Ma13].

Due to the novelty of the smart glasses topic, we had no access to practitioners with real-life implementation of a smart glasses system and just a few scientific papers have been published. For this reason, we decided to elicit the functionalities from a systematic literature review (cf. [BR09, WW02]) in the classical IS databases as well as investigate a market analysis of the smart glasses that are already available or announced to be available in 2015/2016 (cf. Section 4). The search term “smart glasses” was used. Querying the databases returned 211 hits, which were reviewed in respect to title, abstract and keywords (if available). We excluded articles if they do not focus on smart glasses defined in terms of augmented reality, mobility or head-worn displays. Thus, 169 papers were classified as out of scope and five duplicates were eliminated. This revealed a total of 37 relevant articles. This set of articles contains theory-oriented papers [RBI15, cf. Wa14a] as well as application-oriented papers [Gi12, cf. He14b] also listed in the mentioned databases. The remaining articles were discussed by the research team. By the analysis of the papers for smart glasses functionalities another nine papers were excluded. We excluded papers if (1) they did not address functionalities in an IT-related sense or if (2) they provided mere hardware descriptions such as the weight or battery life that did not count as a feature in our analysis or if (3) they provide pure project descriptions or business-oriented use case descriptions lacking a sufficient level of detail were excluded. After implementing the exclusion criteria, 28 papers remained. Passing on to the analysis of our search results, in a first step, we assigned keywords to the articles in a process comparable to open coding [CS15]. In this process, we identified key features of smart glasses and assigned corresponding keywords (codes) to the articles such as e.g. "GPS Navigation". Due to the reason that there are only a few scientific papers found and the publishing process sometimes has a longer time to succeed than the announcements of new technologies from the manufacturer of new information technologies, we decided to complete and double check the list of smart glasses features with a market analysis of the existing and announced smart glasses. Therefore, we analyzed the 10 most recent and most relevant smart glasses specifications. To include all current and future features, we used a mixture between already released smart glasses and announced ones that are likely to be release within the next 2 years. For the collection of the features official websites and specifications were used. After having identified the single features of smart glasses, we clustered them inductively into groups [Ma10].

To answer the question whether smart glasses have an impact on the TCS, we analyzed if the functionalities do meet the requirements for mobile support systems in TCS. Hence, in a team of four service experts, we matched the functionalities with the TCS requirements. All experts share a Service Science background.

3 Technical Customer Service Process

For the development of a service support system for the TCS, it is necessary to identify and structure underlying requirements based on service processes. For this purpose, a reference maintenance process is used as initial point for service activity description. Figure 2 represents a reference maintenance process in the field of the TCS.

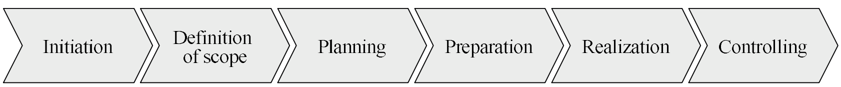

Figure 2. Reference maintenance process of the TCS [Da15]

The first phase of the service process starts with the *initiation* which is usually triggered by a service request induced by the customer. This phase can in turn roughly be distinguished into the sub-processes customer request management in which the TCS receives the service order in form of claims, repair or supply requests from customers and the equipment management composed of scheduled maintenance and on-request maintenance

[LX96]. However, since both activities are heavily intertwined, we do not further distinguish between them as separate steps. After the *initiation*, the *scope of the service order is defined* which builds the foundation for the service planning phase. The appropriate service technician is informed about the symptoms obtained from the customer himself or the service center as point of contact [LX96]. Aiming to fulfil the determined goals, required resources such as spare parts or tools need to be checked for service delivery. Following the *planning* of the forthcoming service tasks, additional control measures need to be considered and the ascertainment of the service delivery begins. For this purpose, dates, specific work orders and the required resources must be provided and *prepared* [Da15]. During *realization phase*, the service technician delivers his work order in physical appearance on the service object at the customer's site [MBM03]. The process ends with the *controlling phase* comprising the analysis and reflection of the service delivery, with respect to the quality and productivity of the service technician's activities [Da15]. In the latter, the *controlling phase* is dropped as it is a cross-departmental function that only indirectly benefits from smart glasses.

4 Functionalities of Smart Glasses

Within the 28 publications, a consolidated number of 20 features, consisting of a combination of hardware and software components, were mentioned. Except for a *Temperature Gauge*-feature, which was presented as special feature within one paper, all of them were mentioned in at least three publications. The most mentioned features include *Voice Recognition*, *Picture and Video taking* as well as *GPS Navigation* and *Information Searching*.

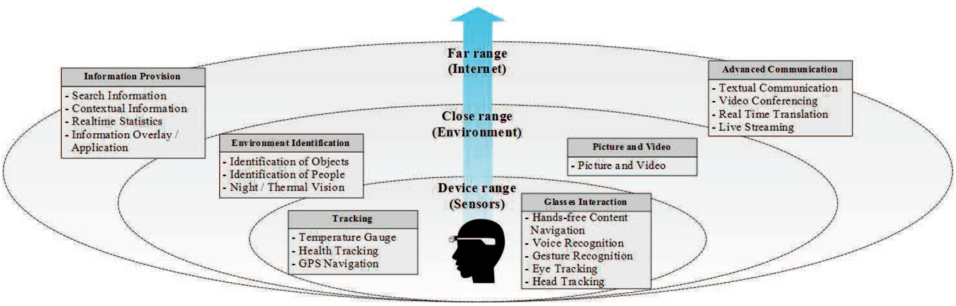

Figure 3. Categorization of functionalities

When it comes to categorizing the functionalities, we clustered them into six groups by their topical closeness: the identified groups (1) *Tracking* and (2) *Glasses Interaction* include features existing on the device itself working with sensors; (3) *Environment Identification* and (4) *Picture and Video* contain features operating at the environmental range close to the device; (5) *Information Provision* and (6) *Advanced Communication* comprise features working also in far distance e.g. via internet connection (cf. Figure 3).

Range	Group	*Feature*	*Description*	*Literature*
Device Range (Sensors)	(1) Tracking	Temperature Gauge	Measurement of the ambient temperature.	[Ka13a]
		Health Tracking	Tracking of health activities by measuring for example the heart rate using sensor components.	[Be14, He14a, Ov13, Wa14a, Wi13]
		GPS Navigation	A navigation system that provides location information.	[Go13, He14a, Vu13, Wa14b, Wa14a, Wi13, He14b, Ka13b, Ka13a, Mu12, Ol13a, Ol15, Ov13, RBI15]
	(2) Glasses Interaction	Hands-free Content Navigation	Navigation without using hands, in order to carry out commands or browse content.	[Ca13, Da14, Ol13b, Ov13, Vu13, Wa14b, Go13, He14a, He14b, Ka13c, Ka13b, Ka13a, Mo15, Ol13a]
		Voice Recognition	Receiving and interpreting dictation, or understanding and carrying out spoken commands.	[Be14, Ca13, RBI15, Si13, Vu13, Wa14b, Wa14a, Da14, Gi12, He14a, He14b, Jo14, Mo15, Na13, Ov13]
		Gesture Recognition	Interpretation of human gestures via mathematical algorithms in order to carry out commands.	[Be14, Da14, Fo13, He14a, Jo14, Mc15, Na13, Ol15, Ov13, Wi13]
		Eye Tracking	Measurement of either the point of gaze or the motion of an eye relative to the head. It can be used for either analysis or navigation.	[Be14, Ov13, Wa14b, Wa14a, Wi13]
		Head Tracking	Monitoring the head movement. This allows moving the camera in the same orientation as the user's head does.	[Ca13, Jo14, Ka13a, Mu12, Ol13a, Ol15, Vu13, Wa14b]
Close Range (Environment)	(3) Environment Identification	Identification of Objects	Using camera function to identify, track and recognize objects.	[Be14, Ca13, He14a, Mu12, Na13, Ox14, RBI15, Si13, Wa14b, Wa14a]
		Identification of People	Using camera function to identify, track and recognize people.	[Be14, Go13, He14a, He14b, Ov13, Ox14, Si13, Wa14a]
		Night/ Thermal Vision	Collecting the infrared radiation from objects in the scene to be able to see in low light conditions.	[Mu12, Ov13, Ox14]
	(4) Picture and Video	Pictures and Video	Taking pictures and videos using the internal camera.	[Be14, Ca13, Ol13a, Ox14, Vu13, Wa14b, Wa14a, Wi13, Gi12, Go13, He14b, Ka13c, Ka13a, Ma14, Mc15, Mo15]
Far Range (Internet)	(5) Information Provision	Search Information	Search for information based on search terms, pictures etc.	[Be14, Ca13, Ov13, RBI15, Wa14a, Da14, Gi12, Go13, He14a, He14b, Mo15, Mu12, Na13]
		Contextual Information	Collection and analysis of data about a device's surroundings in order to present relevant, actionable information.	[Be14, Ca13, Da14, Fo13, He14a, He14b, Jo14, Na13]
		Real-time Statistics	Compiling of real-time statistics about relevant information and displaying them.	[Be14, Ca13, Fo13, He14a, Ka13a, Ol15, Wi13]
		Information Overlay/ Application	Adding additional information by overlaying virtual objects upon the user view of the real world.	[Be14, Gi12, He14a, Mu12, RBI15, Wi13]
	(6) Advanced Communication	Textual Communication	Send and receive textual messages using communication channels such as e-mail in conjunction with input mechanisms such as voice recognition.	[Ca13, Gi12, Go13, Ka13b, Ka13a, Mo15, RBI15, Vu13, Wa14a]
		Video Conferencing	Communication of the user with two or more other users by real-time bidirectional video and audio transmissions.	[Ca13, He14b, Mo15, Wa14a]
		Real-time Translation	Translation of foreign languages on-the-fly and displaying subtitles.	[Be14, Go13, He14a]
		Live Streaming	Video content is sent in compressed form over the Internet and displayed by the viewer in real time.	[Da14, He14a, Ka13a, Mo15, Mu12, Ol15, Ov13]

Table 1. Overview of smart glasses features from literature

Noteworthy about the categories is that although the *Glasses Interaction* is a support function and is not completely distinct from the other groups, it forms a separate group as the interaction with the emerging technology is one of the key factors for its success. Furthermore, the *Picture and Video* functionality led to its own category as it was the most mentioned feature. Table 1 provides further information for the introduced features with a short description, the group they were assigned to and the supporting literature that initially mentioned them.

Within the 10 smart glasses that were analyzed, we found that most but not all of the features from literature are mentioned. Especially in *Tracking* the features *Temperature Gauge* and *Health Tracking* as well as *Identification of People* and *Night/Thermal Vision* are not found on the 10 smart glasses analyzed. We explain that mainly by the specialness of the first two and privacy concerns for the last.

Category	*Feature*	*Google Glass*	*Vuzix M100*	*Glassup*	*Moverio BT-200*	*Golden-I*	*Motorola HC1*	*Atheer One*	*Meta Pro*	*Recon Jet*	*Microsoft Hololens*	**Total**
(1) Tracking	Temperature Gauge											**0**
	Health Tracking											**0**
	GPS Navigation	x	x	x	x		x			x		**6**
(2) Glasses Interaction	Hands-free Content Navigation	x	x		x		x	x	x	x	x	**8**
	Voice Recognition	x	x			x	x				x	**5**
	Gesture Recognition		x			x	x	x	x		x	**6**
	Touch Recognition							x	x		x	**3**
	Eye Tracking										x	**1**
	Head Tracking	x	x	x	x	x	x	x	x	x	x	**10**
(3) Environment Identification	Identification of Objects	x	x					x	x		x	**5**
	Identification of People											**0**
	Night/Thermal Vision											**0**
(4) Picture and Video	Pictures and Video	x	x		x	x	x	x	x	x	x	**9**
(5) Information Provision	Search Information	x	x		x		x	x	x	x	x	**8**
	Contextual Information	x	x	x	x		x	x	x	x	x	**9**
	Real-time Statistics	x	x	x						x		**4**
	Information Overlay/Application				x			x	x		x	**4**
(6) Advanced Communication	Textual Communication	x		x			x			x	x	**5**
	Video Conferencing	x	x							x	x	**4**
	Real-time Translation	x		x	x							**4**
	Live Streaming	x	x		x						x	**4**
	Total	**13**	**12**	**6**	**9**	**4**	**9**	**9**	**9**	**9**	**14**	

Table 2: Overview of smart glasses and features from market data

An additional feature was found that was not mentioned in literature before which is *Touch Recognition*. This feature enables the smart glasses to track the contact to virtual object that are projected. Therefore, a depth camera is needed to enable the measurement of hands distance. It can be used for virtual graphic user interfaces and interaction with virtual objects. Regarding groups, we included the new feature in *Glasses Interaction*. An overview of the found features and the smart glasses is given in Table 2. We put an x when the feature is mentioned for the smart glasses.

4.1 Using Smart Glasses to Support Technical Customer Service Processes

In the previous sections of this chapter, several functionalities of smart glasses have been identified and described. To investigate whether those functionalities support the service technician better, it has to be analyzed whether the functionalities do meet the requirements for mobile support system in TCS. We repeated the incremental approach of first working independently and then consolidating the results that we already used for Table 1. The results are shown in Table 3. Within the analysis we put an "x", if the functionalities of smart glasses create added value. No "x" is stated, if the functionality does not offer a direct benefit. For example, *Glasses Interaction* – e.g. *Hands-free interaction* – can be helpful with almost every process step and requirement, but we just put an "x" when the requirement concerns a work step where the technician needs his hands for another activity as like repairing the service object or environmental circumstances such as soiled hands occur. For example, the *Filling-out assistant for forms and reports* could be used with handhelds, with just winking or voice control, to fill in the invoices, but there is no direct advantage compared to using a handheld keyboard. However, concerning the *Electronic checklist for customer service operations* or the *Interactive assistance for customer service operations*, hands-free interaction helps to communicate with the device while operating at the service object. Finally, we used an "(x)" if the benefit is not evident in the first place but under certain conditions. Regarding an overall of 36 requirements, we conscientiously evaluated and discussed every mark. In the following three examples are given.

First, regarding the requirement *Diagnostic function for maintenance objects,* we detected a beneficial influence by *Environment Identification*, *Information Provision* and a minor influence by *Tracking*. This is due to the fact that along the service process the technician, first of all, has to identify the service object by *Object Recognition*. Second, he has to investigate the object which can be assisted by *Information Provision* in form of an information overlay of non-visual parts of the machine or next service steps. Conditionally, the *Tracking* can be beneficial as for instance the room temperature can be tracked and might be an indicator for the systems malfunction.

Second, considering the requirement *Electronic checklist for customer service operations* an aid is created by *Glasses Interaction*, *Environment Identification*, *Information Provision* and *Tracking*. When the technician arrives at the customer-site the checklist is automatically shown based on *Tracking* (e.g. *GPS Navigation*) and leads him through the service process. The ability of *Glasses Interaction* with *hands-free content browsing* and *Voice Recognition* allows the hands-free navigation through the checklist.

Requirements / **Functionalities**	(1) Tracking	(2) Glasses Interaction	(3) Environment Identification	(4) Picture and Video	(5) Information Provision	(6) Advanced Communication	**Total**
Customer complaint management				(x)			**1**
Localized information				(x)			**1**
Order description				(x)			**1**
Returns management				(x)			**1**
Diagnostic function for maintenance objects	(x)		x		x		**3**
Electronic checklist for customer service operations	x	x	x		x		**4**
Interactive assistance for customer service operations		x	x		x	x	**4**
Interface for the parameterization of maintenance objects		x					**1**
Preview function of documents					x		**1**
Remote diagnosis functions for maintenance objects	x					x	**2**
Scan function for optical and electromagnetic codes	x	x					**2**
Updating information resources	x	x	x	x			**4**
Electronic spare parts procurement			x	x	x		**3**
Linked information objects			x		x		**2**
Plausibility check for data collection	x		x				**2**
Search and call of structured and unstructured data		x			x		**2**
Intelligent disposition	x				x		**2**
Filling-out assistant for forms and reports	x	x	x	(x)	x		**5**
News service					x		**1**
Proactive information provision			x		x		**2**
Proactive order provision (Management of orders)	x		x		x		**3**
Real-time transmission of order-related data					x		**1**
Real-time communication with int. and ext. Actors						x	**1**
Service-related Key Performance Indicator measurement	x		x				**2**
Updating of the knowledge database	x		x	x			**3**
Updating of the service history	x	(x)	x				**3**
Opportunity to influence the disposition	x						**1**
Support of weakly structured processes					x	x	**2**
Forecast function for resource and tool requirements	(x)		x		x		**3**
Local contact persons (contact info, kind of knowledge)			x		x		**2**
Reminder function for appointments	x				x		**2**
Report error				x		x	**2**
(Partially) automated document creation	x		x	x			**3**
Decision support for customer service					x		**1**
Management of suggestions for improvement				x			**1**
Preparation of cost estimates	(x)		x		x		**3**
Total	**17**	**8**	**17**	**11**	**19**	**5**	

Table 3. Coverage of the requirements by smart glasses functionalities

So, working with both hands and concurrent information supply via checklist enhance the technician. On top the *Information Provision* via *Contextual Information* offer additional information directly when needed. Finally, *Environment Identification* is useful in terms of *Object Recognition* as it can be used for identification of the serviced object and might automatically check items on the checklist when the completion is detected.

Third, one requirement is *Report Error* which deals with the demand of immediate help when something goes wrong. Advantages of smart glasses attached to this requirement are *Advanced Communication* as well as *Picture and Video*. In case of an error, the need for timely expertise is crucial to prevent further damage. Therefore, *Advanced Communication* with *Video Conferencing* is beneficial as a colleague or supervisor can be called and with *Live Streaming* the Point-of-view is transferred which enables the technician at site to show the current problem. On top he can document the problem by taking pictures or videos.

Interpreting Table 3, the greatest impact can be achieved by fulfilling requirements concerning the operations at the service object; for example *Electronic checklist for customer service operations* and *Interactive assistance for customer service operations.* In addition, requirements that concern the feedback linked to the service operations as for example *Updating information resources* or *Filling-out assistant for forms and reports* are as well considered positive. Expected as the most value-creating functionalities are *Information Provision*, *Environment Identification* and *Tracking.* This could be explained, analogous to the statement concerning the requirements that the biggest benefit occurs while operating at the service object. The *Advanced Communication* is not as value-creating as the others. This might be due to the fact, that the service technician is able and encouraged to perform independently. Additionally, the added functionalities as for example through *Information Provision* decrease the need for additional communication even further. The small benefit of *Advanced Communication* could be explained by the fact, that the interaction with the device is beneficial in situation where hands-free interaction is needed, but due to the other functionalities, such as *Environment Identification* or *Information Provision*, the communication happens partly automated. Finally, there are four requirements that do not directly benefit from the functionalities of smart glasses. This could be explained by the fact that those four requirements are solely linked to the first two phases *Initiation* and *Definition of Scope* where the focus of the technicians is on customer contact and *planning*, mostly operated at the service center and not at the point of service.

Although most requirements benefit from the support through smart glasses, there are process steps were smart glasses might have negative implications. The service process comprises a lot of documentation which at first do not seem more natural on smart glasses, depending on the model of the smart glasses and their display size. This documentation work is already implicitly included in requirements, for instance, *Updating of the service history* or *Automated document creation*. Using smart glasses, these requirements can directly be met (video, audio, environmental identification etc.). Hence, in future research we will analyze which influence the benefit of the features of smart glasses on the one hand and the disadvantages of their limited display size at the other will exert on the overall acceptance and satisfaction of the service technician. However, when it comes to documentation the use of smart glasses might also have negative impact as the different input methods do need some kind of adaption phase. Further, they might not satisfy the user when he is forced to insert information as text.

5 Conclusion and Outlook

Based on a literature review and smart glasses manufacturer's data, we derived and determined relevant features of smart glasses regarding the TCS. In order to check the applicability and usefulness of smart glasses and to make sure that smart glasses functionalities support the service technician better, we examined the capabilities of smart glasses by satisfying the existing requirements for mobile service support systems. According to our results, the greatest impact using smart glasses can be achieved by fulfilling requirements concerning the direct operations on the service object (e.g. a machine that is to be repaired). The service technician has the ability to process the service order while wearing the support system instantaneous in front of his eyes. So, he can receive information while working and without stopping the service delivery as it would require interacting with a traditional handheld device. The most value-creating functionalities of smart glasses are expected in *Information Provision*, *Environment Identification* and *Tracking*. These are features that are inevitable for the service technicians while operating at the service object.

A limitation of our research is that our insights are not based on the real use of smart glasses in the TCS since experiences in that direction that are backed by large datasets of real use cases are not yet available. Therefore, we go the first step into this direction in describing smart glasses functionalities and confronting them with requirements from the TCS. In doing so, we pave the way for further research and implementation activities with the ultimate goal of evaluating smart glasses in the TCS domain in real-world field studies. As part of our future research, we will also address the potentially negative effects that smart glasses may exert on work processes. For example, the customer may feel disturbed by a technician with a camera mounted on his head that may affect the customer loyalty. Some companies might even forbid devices with cameras due to confidentiality concerns. Also, regarding the ergonomics of smart glasses, some questions remain open. Since information and data are presented immediately in the service technicians' field of vision, a reduction of head and neck movements during repair can be achieved as there is no need to turn to a handheld display [HF11]. Further, the investigation of the actually perceived positive effects in terms of ergonomics would also require real-world experiments and the result may be highly dependent on the concrete tasks. However, our research results are still valuable since they form the basis to easily generate hypotheses regarding the value of smart glasses which then can subsequently be confirmed or rejected. This, in turn, may be highly dependent on the characteristics of the cases that are going to be analyzed. It, thus, requires a lot of future research effort to finally come up with a valid theory of smart glasses impact on TCS which finally may be formulated e.g. as an explanatory design theory [BP10]. Our results contribute towards the development of such a theory.

All in all, the main contribution we provide is twofold. First, the systematical analysis of smart glasses functionalities (RQ1) and creation of a taxonomy can be used for further research and deal as foundation of a state-of-the-art. Second, the application on requirements in TCS (RQ2) enables a more deeply understanding of why the emerging technology might change the field. Consequently, the impact on the theoretical work on TCS in future certainly has to keep the technology in mind. The practical impact of the contribution is that it might support decisions about using functionalities of smart glasses in terms of the requirements that they help to address. Even if many questions about the acceptance of smart glasses and the design of a system are still unanswered, this contribution can provide answers to the question about the general usefulness of smart glasses in TCS. Consequently, a responsible manager could use the contribution to match their own requirements with the ones given and determine whether smart glasses are beneficial.

6 References

[AH10] Andersson, B. ; Henningsson, S.: Developing mobile Information Systems: Managing additional Aspects. In: Alexander, T. ; Turpin, M. ; van Deventer, J. (Hrsg.): Proc. of the 18th Europ. Conf. on Information Systems. Pretoria, South Africa, 2010, S. 1–12

[BP10] Baskerville, Richard ; Pries-Heje, Jan: Explanatory Design Theory. In: Business & Information Systems Engineering Bd. 2 (2010), Nr. 5, S. 271–282

[Be14] Bendel, Oliver: Die Datenbrille aus Sicht der Informationsethik. In: Informatik-Spektrum, Springer Berlin Heidelberg (2014), S. 1–9

[BLM14] Böhmann, Tilo ; Leimeister, Jan Marco ; Möslein, Kathrin: Service Systems Engineering. In: Business & Information Systems Engineering Bd. 6 (2014), Nr. 2, S. 73–79

[BR09] vom Brocke, Jan ; Simons, Alexander ; Niehaves, Björn ; Riemer, Kai ; Plattfaut, Ralf ; Cleven, Anne ; Brocke, Jan Von ; Reimer, Kai ; u. a.: Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process. In: 17th European Conference on Information Systems (2009), S. 2206–2217

[Ca13] Canaday, Henry: Maintenance Mobility. In: Aviation Week & Space Technology Bd. 175 (2013), Nr. 45, S. 14

[CS15] Corbin, J ; Strauss, A: Basics of qualitative research: Techniques and procedures for developing grounded theory. Thousand Oaks, California : Sage Publications Ltd., 2015

[Da14] Davis, Brian: Ready to Wear. In: Professional Engineering Bd. 27 (2014), S. 31–34

[Da15] Däuble, Gerald; Özcan, Deniz; Niemöller, Christina; Fellmann, Michael; Nüttgens, Markus; Thomas, Oliver: Information Needs of the Mobile Technical Customer Service - A Case Study in the Field of Machinery and Plant Engineering. Proceedings of the 48th Annual Hawaii International Conference on System Sciences (HICSS) (2015). Manoa, S. 1018–1027.

[Fo13] Forbes.com: Startup Meta Challenges Google Glass With Sleek, $3,000 Smart Glasses. In: Forbes.com (2013)

[Gi12] Giles, Martin: Through a Glass digitally. In: Economist (2012)

[Go13] Google: Capturing the Value of Smart Glasses. In: Trends Magazine Bd. 10 (2013), Nr. 10, S. 37–41

[HM05] Haritos, T. ; Macchiarella, N.D.: A Mobile Application of Augmented Reality for

Aerospace Maintenance Training. In: 24th Digital Avionics Systems Conference. Bd. 1 : IEEE, 2005, S. 5.B.3–1–5.B.3–9

[HF09] Henderson, S ; Feiner, S: Evaluating the benefits of augmented reality for task localization in maintenance of an armored personnel carrier turret. In: Proceeding ISMAR '09 Proceedings of the 2009 8th IEEE International Symposium on Mixed and Augmented Reality. Washington, DC, USA, 2009, S. 135–144

[HF11] Henderson, S ; Feiner, S: Exploring the benefits of augmented reality documentation for maintenance and repair. In: Visualization and Computer Graphics, IEEE Transactions Bd. 17 (2011), Nr. 10, S. 1355–1368

[He14a] Hegel, Theresa: Through the Looking Glass. In: Wearables Bd. 18 (2014), S. 38–39

[He14b] Hemmadi, Murad: Wearable Tech Comes to the Office. In: Canadian Business Bd. 87 (2014), Nr. 13, S. 12–14

[HE15] Herterich, Matthias M ; Peters, Christoph ; Uebernickel, Falk ; Brenner, Walter ; Neff, Alexander A: Mobile Work Support for Field Service : A Literature Review and Directions for Future Research. In: Internationale Tagung Wirtschaftsinformatik (2015), S. 134–148

[Jo14] Jooyeun Ham, Jonggi Hong, Youngkyoon Jang, Seung Hwan Ko, Woontack Woo: Smart Wristband: Touch-and-Motion–Tracking Wearable 3D Input Device for Smart Glasses. In: Streitz, N. ; Markopoulos, P. (Hrsg.): Distributed, Ambient, and Pervasive Interactions, Lecture Notes in Computer Science. Bd. 8530. Cham : Springer International Publishing, 2014, S. 109–118

[Ka13a] Karp, Andrew: Get ready for Eyewear-able Technology (2013), 20/20 Magazine

[Ka13b] Karp, Andrew: Eye2 Explores Smart Glasses,Glasses Free 3D and More. In: Vision Monday Bd. 27 (2013), Nr. 1, S. 23

[Ka13c] Karp, Andrew: Celebrating a Year of Eye^2 Innovation. In: Vision Monday Bd. 27 (2013), Nr. 16, S. 8

[LP98] Lawson, Shaun W. ; Pretlove, John R. G.: Augmented reality for underground pipe inspection and maintenance. In: Stein, M. R. (Hrsg.): Photonics East (ISAM, VVDC, IEMB) : International Society for Optics and Photonics, 1998, S. 98–104

[Le11] Legner, Christine ; Nolte, Christoph ; Nils, Urbach: Evaluating Mobile Business Applications in Service Maintenance Processes: Results of a Quantitative-Empirical Study. In: ECIS 2011 Proceedings., 2011, S. Paper 247

[LX96] Lee, Jae Sik ; Xon, Yong Xune: A customer service process innovation using the integration of data base and case base. In: Expert Systems with Applications Bd. 11 (1996), Nr. 4, S. 543–552

[LH14] Lindström, John ; Hanken, Claas: Wearable Computing: Security Challenges, BYOD, Privacy, and Legal Aspects. In: Nemati, H. R. (Hrsg.): Analyzing Security, Trust, and Crime in the Digital World : IGI Global, 2014, S. 96–120

[Lu13] Luftman, Jerry ; Zadeh, Hossein S ; Derksen, Barry ; Santana, Martin ; Rigoni, Eduardo Henrique ; Huang, Zhengwei (David): Key information technology and management issues 2012–2013: an international study. In: Journal of Information Technology Bd. 28, Nature Publishing Group (2013), Nr. 4, S. 354–366

[MBM03] Mayer, Karl J. ; Bowen, John T. ; Moulton, Margaret R.: A proposed model of the descriptors of service process. In: Journal of Services Marketing Bd. 17 (2003), Nr. 6, S. 621–639

[Ma10] Mayring, Philipp: Qualitative Inhaltsanalyse Grundlagen und Techniken. Weinheim : Beltz, 2010

[Ma13] Matijacic, Michel; Fellmann, Michael; Özcan, Deniz; Kammler, Friedemann; Nüttgens, Markus; Thomas, Oliver: Elicitation and Consolidation of Requirements for Mobile Technical Customer Services Support Systems – A Multi-Method Approach. In: Proceedings of the 34th International Conference on Information Systems (ICIS) (2013). Mailand, Italien, S. 1–16.

[Ma14] Martini, Paul: A secure approach to wearable technology. In: Network Security Bd. 2014 (2014), Nr. 10, S. 15–17

[Mc15] McCandless, Karen: Seeing into the future. In: Automotive Manufacturing Solutions Bd. 16 (2015), Nr. 2, S. 26–28

[Mo15] Moshtaghi, Omid ; Kelley, Kanwar S ; Armstrong, William B ; Ghavami, Yaser ; Gu, Jeffery ; Djalilian, Hamid R: Using google glass to solve communication and surgical education challenges in the operating room. In: The Laryngoscope (2015)

[Mu12] Murphy, David: Vuzix Glasses Bring Augmented Reality to Your Games, Face. In: PC Magazine (2012)

[Na13] Nadler, Daniel: Wearable FinTech Part I: Target, Ticker. In: Institutional Investor-International Edition (2013)

[Of10] Offermann, Philipp ; Blom, Sören ; Schönherr, Marten ; Bub, Udo: Artifact Types in Information Systems Design Science – A Literature Review. In: Global Perspectives on Design Science Research. LNCS, vol. 6105 Bd. 6105 (2010), S. 77–92

[Ol13a] Olson, Parmy: Cheaper Google Glass Competitor Vuzix Ships Developer Units. In: Forbes.com (2013)

[Ol13b] Olson, Parmy: Epson Smart Glasses Browse YouTube With A Nod And Tilt Of The Head. In: Forbes.com (2013)

[Ol15] Olson, Parmy: Smart Glasses Won’t Hit The Mainstream Till Our Bosses Start Buying Them. In: Forbes.com (2015)

[Ov13] Overton, Gail: Head-worn displays: Useful tool or niche novelty? In: Laser Focus World Bd. 49 (2013), Nr. 7, S. 33–37

[Ox14] Oxford, University of: Smart glasses offer spatial awareness to the visually impaired. In: Engineer (Online Edition) (2014)

[Pe07] Peffers, Ken ; Tuunanen, Tuure ; Rothenberger, Marcus a. ; Chatterjee, Samir: A Design Science Research Methodology for Information Systems Research. In: Journal of Management Information Systems Bd. 24 (2007), Nr. 3, S. 45–77

[RBI15] Rauschnabel, Philipp A. ; Brem, Alexander ; Ivens, Bjoern S.: Who will buy smart glasses? Empirical results of two pre-market-entry studies on the role of personality in individual awareness and intended adoption of Google Glass wearables. In: Computers in Human Behavior Bd. 49 (2015), S. 635–647

[RBH03] Rügge, Ingrid ; Boronowsky, Michael ; Herzog, Otthein: Wearable Computing für die Industrie. In: Industrie Management Bd. 6 (2003)

[Si13] SITA Lab: Google Glass Boarding. In: Asian Aviation Magazine Bd. 11 (2013), S. 31

[SB12] Sonnenberg, Christian ; vom Brocke, Jan: Evaluations in the Science of the Artificial - Reconsidering the Build-Evaluate Pattern in Design Science Research. In: Peffers, K. ; Rothenberger, M. ; Kuechler, B. (Hrsg.) DESRIST 2012, LNCS 7286. Berlin Heidelberg, Springer-Verlag (2012), S. 381–397

[Vu13] Vuzix: Futuristic Heads-up Glasses with GPS Go to App Developers. In: GPS World Bd. 24 (2013), Nr. 4, S. 18

[Wa14a] Wang, Chih-Hsuan: A market-oriented approach to accomplish product positioning and product recommendation for smart phones and wearable devices. In: International Journal of Production Research (2014), S. 1–12

[Wa14b] Wang, Chih-Hsuan: Integrating correspondence analysis with Grey relational model to implement a user-driven STP product strategy for smart glasses. In: Journal of Intelligent Manufacturing (2014)

[WW02] Webster, Jane ; Watson, Richard T: Analyzing the Past to Prepare for the Future: Writing a Literature Review. In: MIS Quarterly Bd. 26 (2002), Nr. 2, S. xiii – xxiii

[Wi13] Wiederhold, Brenda K: Time to port augmented reality health apps to smart glasses? In: Cyberpsychology, behavior and social networking Bd. 16 (2013), Nr. 3, S. 157–158