

AI and the efficiency of technical support

How can artificial intelligence help improve the
customer experience?

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Affidavit

I, **DIPL.-ING. VICTORIA MOHR**, hereby declare

1. that I am the sole author of the present Master's Thesis, "AI AND THE EFFICIENCY OF TECHNICAL SUPPORT", 95 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
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Kurzfassung

Die vorliegende Arbeit beschäftigt sich mit einer Vorstudie zur Implementierung eines durch künstliche Intelligenz (KI) unterstützten Chatbots in einen bestehenden Kundensupportprozess. In den letzten Jahren gewannen digitale Technologien immer mehr an Wichtigkeit. Verstärkt wurde dies zuletzt durch die Auswirkungen der Covid19-Pandemie. Covid-19 hat sowohl das Konsum- als auch das Arbeitsverhalten in einer Weise verändert, die den Einsatz vieler digitaler Tools zusätzlich beschleunigt (Du Toit et al. 2020). Generell wurde dadurch auch im Kundenservice der Wunsch nach *Remote Support* und *Self Service* lauter um firmenfremde persönliche Kontakte auf ein Minimum zu reduzieren. Hinzu kommt, dass die Menge an verfügbaren Daten in diesem Bereich schier unüberschaubar ist und von Jahr zu Jahr wächst, wobei die gespeicherten Daten in diesem Bereich gewinnbringend verwendet werden können. Vor allem im Bereich des Kundenservice bzw. –supports können Erkenntnisse einer historischen Analyse nachhaltig zur Verbesserung des Kundenerlebnisses beitragen (Gupta 2021). Diese Arbeit befasst sich mit der Fragestellung wie der Prozess von der Annahme einer Reparaturanfrage bis hin zur Lösung des Problems optimiert werden kann. Momentan gibt es viele zeitaufwendige Zwischenschritte die die Kundenerfahrung mit dem Unternehmen überschatten. In der vorliegenden Arbeit wird ein Prozess vorgeschlagen, welcher sich eines durch KI unterstützten Chatbots bedient, welcher auf Grundlage der bereits vorhandenen (und zukünftig generierten) Daten in der Lage sein wird häufig auftretende Probleme entweder bereits aus der Ferne zu lösen, ohne, dass eine menschliche Interaktion notwendig ist, oder andere zeitaufwendige Zwischenschritte zu automatisieren um auf diese Weise das Kundenerlebnis zu verbessern. Die im Rahmen von Befragungen ermittelten Ergebnisse der Arbeit zeigen, dass eine Implementierung eines derartigen Chatbots eine präventive Abfederung leicht lösbarer Probleme ermöglichen kann. In weiter Folge kann sich das technische Fachpersonal auf komplexe Problemstellungen konzentrieren, was eine erhöhte Effizienz des Einsatzes vorhandener Ressourcen zur Folge hätte. Die vorliegende Arbeit zeigt jedoch auch auf, dass bestehende Technologien für die vorliegende Anwendung gewisse Limitierungen aufweisen, die vor einer endgültigen Implementierung im Rahmen weiterer Entwicklungsschritte überwunden werden müssen.

Abstract

This thesis presents a preliminary study in relation to the implementation of an artificial intelligence (AI) supported chatbot in an existing customer support process.

Digital technologies have become increasingly important in recent years. This has been amplified by the effects of the Covid-19 pandemic, which has seen employees increasingly working from home. Covid-19 has changed both consumer and working behaviour in a way that has further accelerated the use of many digital tools (Du Toit et al. 2020). In general, this has also increased the desire for remote support and self-service in customer service in order to minimize personal contacts outside the company. In addition, the amount of available data in this area is almost unmanageable and is growing from year to year, whereby the stored data can be used profitably. Particularly in the area of customer service and support, findings from a historical analysis can make a lasting contribution to improving the customer experience (Gupta 2021).

This thesis deals with the question of how the process from the acceptance of a repair request to the resolution of the problem can be optimized. Currently, there are many time-consuming intermediate steps that overshadow the customer experience with the company. In this paper, a process is proposed that utilizes an AI supported chatbot that will be able to either solve common problems remotely without the need for human interaction or automate other time-consuming intermediate steps based on existing (and future generated) data in order to improve the customer experience.

The results of the survey performed within this thesis show that the implementation of such a chatbot can enable the preventive mitigation of easily solvable problems.

As a result, the technical staff can concentrate on complex problems, which would result in increased efficiency in the use of existing resources. However, this study also shows that existing technologies for this application have certain limitations that need to be overcome before final implementation as part of further development steps.

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1 Introduction

1.1 General background

In recent years, digital technologies have become increasingly important. Most recently, this development was accelerated by the impact of the pandemic. Covid-19 has changed both consumer and work behaviour in ways that further accelerate the use of an array of digital tools (Du Toit et al. 2020). In general, this has led to a greater desire for remote support and self-service in customer service in an attempt to reduce non-intra-company physical contacts to a minimum.

In addition, the amount of data created is almost unmanageable and grows from year to year. The problem in this context is that more than 90 percent of the data is unstructured and thus cannot be used (Panetta 2016). It is becoming increasingly important for companies to benefit from the stored data. Particularly in the area of customer service and support, insights from historical analysis can make a lasting contribution to improving the customer experience (Gupta 2021).

In the course of the digital transformation, artificial intelligence (AI) supported or AI based approaches such as Data Science, Big Data Analytics and Machine Learning (ML) are gaining in importance. Augmented Reality (AR), Virtual Reality (VR) or Extended Reality (XR) are also increasingly used.

AI-based technologies are also used in the field of customer support and customer service (Armistead & Clark 1992; Goffin & New 2001). According to a survey by Bain & Company, most organizations are already using AI-supported tools to improve the customer experience (CX) and to achieve a sustainable competitive advantage (Du Toit et al. 2020).

Especially in larger companies, customer questions and requests are often handled by third parties, such as call centers. Such solutions in many cases offer an unsatisfactory customer experience, for example due to weakly trained staff and language issues.

Artificial intelligence can provide relief: A number of sources recommend using artificial intelligence in call centers to reduce customer waiting time (Abu Daqar & Smoudy 2019). The use of chatbots for communication is considered a good way to deal with service outages and to avoid churn (De Keyser et al. 2019). Additionally, 24/7-availability of chatbots is considered an essential benefit of such systems

(Chong et al. 2021). However, it is still assumed that active collaboration between humans and machines is crucial to the success of this approach (Chakrabati & Luger 2015). Although AI-based systems are often unable to solve very complex tasks, the implementation of AI in existing processes can still allow human employees to spend more time on important tasks (Drift 2018).

In general, AI-based technologies are therefore envisaged to be a viable alternative – or rather addition – to conventional, purely human-based customer support solutions.

Generative artificial intelligence in particular has become increasingly well-known among the general population over the past year since ChatGPT has been made freely accessible by OpenAI in November 2022 (OpenAI 2022). Due to the large media presence, the willingness to try out this new innovative tool is increasing and equally the inhibition threshold that initially led to the rejection of artificial intelligence is decreasing.

Despite the fact that the use of digital technologies promises an increase in efficiency and also implies time savings for the customer, many customers appreciate the direct contact with customer service staff – an issue, which could hamper the widespread acceptance of these technologies. Multiple studies have shown that especially subjective factors hamper the acceptance of digital technologies among customers (Drift 2018; Press 2019; Srinivasan et al. 2018).

It therefore seems that it is not the mere fact that digital technologies are used, which affects the customers' acceptance. It rather appears that their wish for human (or human-like) interaction has to be fulfilled, as for example studies show that chatbots that mimic human emotions are better received by customers (Haugeland et al. 2022).

1.2 General research objective

The present work should provide preliminary answers to the question if AI-based tools have the potential to be a suitable alternative or supplement to human customer support staff in the field of technical support for analytical devices, which are used for chemical analysis. Light should be shed on possible advantages and disadvantages of the implementation of such solutions. Additionally, it should be evaluated, if currently available technologies could already be fit for practice. Finally, a process model will be presented, which incorporates the findings.

Due to the assumption that customers prefer a human-like interaction, the tool ChatGPT has been considered a suitable technology for the present research. Parts of this tool have been freely available to the public by OpenAI Inc. and during the past year, ChatGPT has attracted considerable interest among the general public.

ChatGPT uses so-called generative artificial intelligence with models that were trained on data from the internet written by humans, including conversations. This makes its responses sound human-like (OpenAI 2023a). Additionally, it is assumed that the large media presence will enhance people's willingness to try out this new tool and simultaneously decrease their inhibition threshold against the use of artificial intelligence in general.

1.3 Background of the research

The company under consideration is a globally operating, US-American technology conglomerate. The customers served are mostly laboratories and production facilities operating in the natural sciences, whereby these can be categorized into the fields: research & development, quality control, laboratory diagnostics, environmental analytics and industry, among others.

Independent of the particular field and above all, customers expect a fast response time, prompt problem solving and thus high availability of instruments. Time is money, especially when production comes to a standstill because raw materials or intermediate products cannot be supplied to their quality control or when a contract laboratory cannot generate sales due to an instrument failure.

The instruments under consideration are devices for analysis of trace elements, which are for example used for water analysis, namely inductively coupled plasma-mass spectrometry (ICP-MS) and inductively coupled plasma-optical emission spectroscopy (ICP-OES) devices.

The company in question has been using enterprise resource planning (ERP) software for years, which also includes customer relationship management (CRM). In addition to the general administration of customer data, the services provided are also recorded and billed on this system. Contracts and service level agreements are likewise stored on this platform, as are discounts agreed with individual key accounts.

It should also be mentioned that service technicians do not have direct access to the ERP platform and can therefore only access part of the information. For a long time,

it was thus not possible for field service engineers (FSEs) and Digital Remote Support (DRS) to identify which entitlements a particular customer had.

For several years now, a cloud-based service platform has existed as an add-on to this system, which is linked to the ERP in the background. Since then, the available information about devices, customers and the service history of individual devices has been available in real time to technicians and back-office staff equally. This has already eliminated external lists and other additional communication artifacts that could only be kept up-to-date with a great deal of extra effort.

Included in this service platform is also a link to an augmented reality (AR) tool, the use of which is still under development and which is primarily used by technical support. This is used in addition to older technologies such as TeamViewer to provide better remote support for customers and colleagues alike. Especially during lockdowns imposed by the pandemic, more than one technician was often not allowed to be on site with the customers, which made mentoring of new employees more difficult. Such difficulties could be overcome at least in part by using the above technologies.

Additionally, data analytics are already being applied within the company to monitor key performance indicators (KPIs). However, the majority of data currently remains unused, and Big Data Analytics is only in its nascent stages. Thanks to the cloud-based service platform, on which all customer service requests are assigned to a specific device by means of a unique serial number, a large amount of data is available from which an artificial intelligence could learn how to solve a specific problem. But still, there is no useful Knowledge Base available as articles still have to be created manually by human experts.

Support requests for the instruments described above are still completely handled by humans.

1.4 Detailed research approach

This work addresses the question of how the process of handling a customer inquiry from acceptance of the service request to resolution of the problem can be optimized with the help of AI-based technologies. Currently, numerous time-consuming intermediate steps are necessary within the chain of a support request that negatively affect the customer experience. Many of those steps include simple and repetitive tasks, which could also be handled by an AI rather than a human.

In a first part of the present thesis, literature review is performed. Goal of this part is to introduce, summarize and evaluate already available technologies, approaches, and opinions in relation to the topic of AI-based customer support. Apart from the opportunities, also possible pitfalls and drawbacks of the technology in question should be uncovered, to provide a deeper understanding of the core requirement for a possible implementation.

In the following, empirical research is described, which has been performed by means of a real-world support request scenario in the field of business described in point 1.3 above. This support request was fed into the ChatGPT AI-engine and the responses were evaluated afterwards. Evaluation of the response quality was performed by means of questionnaires that were sent to employees of the technical support department of a technology group operating in Europe, the Middle East and Africa (EMEA). The survey also included questions about previous or current personal usage and perceptions of artificial intelligence.

In order to additionally elucidate the general opinion of staff on the use of AI technologies, a qualitative analysis was carried out, for which interviews were conducted with members of management in the areas of technical support, field service, customer service and sponsors of the digital transformation.

Finally, on the basis of the results, a process is proposed which makes use of AI-based technology. In the context of this process, the AI-based technology could be able to solve frequently occurring technical and application problems either already remotely, without the need for human interaction, or it could help to automate other time-consuming intermediate steps in order to improve the customer experience in this way, such as an automatic forwarding to the correct department.

1.5 Research objectives

In the course of the research work, interviews were conducted in addition to literature research in order to make qualitative and quantitative statements as to whether the use of artificial intelligence, using ChatGPT as an example, is a suitable means of increasing efficiency in customer service.

For the quantitative analysis, questionnaires were sent out to employees of the technical support department of a globally operating technology group. To keep the amount of data manageable the focus was set on one product group. Microsoft Forms was used to create and send out the questionnaires. The employees filled out the

questionnaires in Microsoft Forms. The evaluation was carried out using Microsoft Forms and Microsoft Excel.

The following research questions were addressed in the present work:

- How do technical support employees perceive the quality and effectiveness of AI-generated answers?
- What are the potential risks associated with using AI-generated answers in technical support, and how can they be mitigated?
- How can AI technology be integrated into existing technical support systems to enhance the user experience and improve support outcomes?
- How can the implementation of AI-generated answers in technical support be effectively managed and supported through a comprehensive Change Management Plan, ensuring smooth adoption, minimal disruption, and maximum benefit realization for both employees and customers?

1.6 Significance of the study

The significance of this study lies in its exploration of the multifaceted perspectives surrounding the implementation of AI in technical support. In an era where AI technologies are increasingly integrated into numerous industries, it is crucial to understand how employees perceive and anticipate the impact of AI on their roles.

This study provides valuable insights for organizations looking to leverage the potential of AI while addressing the human and ethical considerations that come with its adoption. It sheds light on both the opportunities and concerns expressed by employees. Moreover, as AI's role in customer service and technical support continues to evolve, this research provides a foundation for crafting strategies that balance technological advancement with the preservation of personalized, trust-based interactions. This will ultimately shape the future of technical support in a way that is both effective and human-centred.

2 Literature Review

2.1 Introduction to Artificial Intelligence

The following part of this thesis will provide a concise introduction to artificial intelligence (AI), with its historical background and a summary of selected technologies. The understanding of the historical development of AI-based technologies will aid in the anticipation what the key requirements and limitations of AI are, and what needs to be considered when seeking to successfully implement AI-based solutions to existing workflows.

It will be shown that despite modern AI being a more than half a century-old technology, it has never yet gained as much momentum as it has been prophesized. However, it may be the latest developments in AI, which could fuel the AI-world with new spirit and open doors to many new fields of business, such as the sector of technical support, which is the spotlight of the present thesis.

Still, there are many important issues to consider, and a profound understanding of the background of the relevant technologies can help to avoid pitfalls and get the most out of the powerful tools, which have become available on the market.

2.1.1 History of Artificial Intelligence

The mechanization of thinking reaches back to the Ancient Greek, when Homer introduced automata from workshops of the Greek god Hephaestus into literature in his poem *The Iliad* (McCorduck 2004). Of course, these early sources do not relate to what is today understood as AI, but they provide proof that the concept of machine or artificial thinking has always fascinated and inspired humans.

The creators of the concept of what is nowadays called AI are considered John Von Neumann and Alan Turing, two of the founding fathers of modern computer science. However, they had not used the term AI back then (Council of Europe).

It was Turing, who first extensively explored the meaning of the term “thinking” in connection with machines. In his fundamental and highly influential essay *Computing Machinery and Intelligence*, he attempted to assess the difference between human thinking and machine thinking by means of a thought experiment (Turing 1950). It seems that Turing understood the fundamental differences of these two types of “thinking”, when he introduced his elaborations with the following passage:

“I PROPOSE to consider the question, ‘Can machines think?’ This should begin with definitions of the meaning of the terms ‘machine’ and ‘think’.” (Turing 1950, p. 433)

In the following pages of his work, Turing describes the experiment, which he called the *Imitation Game*, where a human should be able to make a distinction between having a conversation with another human or a machine. This approach, though also having experienced criticism (Saygin et al. 2000), is still considered a fundamental way to make a differentiation between human intelligence and machine “thinking”, today widely known as *Turing Test*.

It is assumed that the term "AI" has been established just a couple of years later, namely in 1956, by John McCarthy of Massachusetts Institute of Technology at the Dartmouth Conference (McCorduck 2004). McCarthy’s colleague and co-participant of the Dartmouth Conference, Marvin Minsky of Carnegie-Mellon University defines AI as *“the construction of computer programs that engage in tasks that are currently more satisfactorily performed by human beings because they require high-level mental processes such as: perceptual learning, memory organization and critical reasoning”* (Council of Europe).

The concept of AI then quickly started to gain interest and experts predicted that machines would outperform humans soon in many areas. For example, in 1957, Herbert Simon, an economist and sociologist, expected that an AI could beat a human at chess within the next 10 years (Council of Europe). In 1967, the Associate Director of the New York University’s Institute of Judicial Administration, Allen Harris, wrote an article entitled *Judicial Decision Making and Computers*, where he prophesied that computers would largely influence a judge’s daily life (Harris 1967).

During the following years and decades, AI had its achievements, such as D. Bobrow’s STUDENT, which could solve algebra word problems based on its understanding of natural language, J. Weizenbaum’s artificial psychotherapist ELIZA, or H. Cohen’s AARON, a self-sustained art-making program (McCorduck 2004), to name a few notable examples.

However, we know today that the development did not proceed as expected, reaching its low in the end of the 1980s with a period that was later called *AI winter* (McCorduck 2004). The lack of success can be mainly attributed to the lack of high-performance computing systems. For example, a doctoral student of McCarthy stated that *“computers were still millions of times too weak to exhibit intelligence”* (Anyoha 2017).

This quote perfectly summarizes the main requirements for “intelligent” machines – computational power and data storage.

Only a couple of years later, AI was on the rise again in the early 1990s. However, contrary to Simon’s expectation in 1957, it should take not just 10, but 40 years, until a machine could first defeat a human at chess – Russian chess grandmaster Garry Kasparov lost against Deep Blue, a chess-playing expert system run on a unique purpose-built IBM supercomputer, in 1997 (McCorduck 2004; Wikipedia contributors 2023).

Even though AI-based technologies experienced major achievements during the decades, it kept behind what had been forecasted. Driven by the availability of immense sets of data and low-priced computer processors AI flourished again in the early 2010s. These developments also drew new public attention to the topic, for example, when in 2011, Watson, IBM’s AI engine, defeated two Jeopardy champions, in 2012, Google X was able to recognize cats in a video, and in 2016, another one of Google’s AI engines defeated two champions at Go (Council of Europe).

These recent successes are attributed to the introduction of the concept of machine learning, where the engines do not have to rely on the information that is fed to them by coding, but they can independently draw conclusions from a given set of data (Council of Europe).

2.1.2 Types of Artificial Intelligence

While in the past having been restricted to specific capabilities, today’s AI is often versatile and often provided with a toolbox containing a multitude of skills. An AI’s capabilities can be classified into different categories, which specify the type of problem that is targeted (Russell & Norvig 2010). Among these types the following ones:

- generation of language,
- providing logical reasoning for a given problem,
- planning of future tasks,
- source of knowledge,
- social intelligence (Russell & Norvig 2010).

This is just one approach for providing a classification. Another one is based on an AI’s functionality.

In regard to their functionality, currently four types of artificial intelligence are described. Those are: Reactive AI, limited memory machines, theory of mind, and self-aware AI (Gillis & Petersson 2023).

These four types also represent different levels of functionality. The lowest-ranked type (reactive AI) only works with a given set of data without being able to interact with its environment. The highest one (self-aware AI) is of equal intelligence as compared to the human brain, not only with respect to pure knowledge, but also with respect to consciousness and self-awareness (Gillis & Petersson 2023).

Reactive AI uses a pre-determined set of data to work with, having its basis in statistical mathematics. It does not have the capability to learn from the outcome of previous results. Notable examples of this type of functionality are IBM's Deep Blue engine, which defeated Kasparov at chess and has already been described above, or the well-known Netflix recommendation engine (IBM Data and AI Team 2023).

Limited memory machines go one step further and add the capability of learning from their own history to the functionality of reactive AI. State-of-the-art limited memory machines implement the concept of deep learning, mimicking the functionality of the human brain and the linkage of neurons (Gillis & Petersson 2023). This functionality represents today's technological summit of publicly available AI engines, with some well-known examples being generative AI engines, such as ChatGPT, or virtual assistants such as Alexa, Siri, and Google Assistant (IBM Data and AI Team 2023).

Theory of mind AI and self-aware AI are still unrealized (IBM Data and AI Team 2023). The main aspect of theory of mind AI is that it additionally has the capability to realize emotions and to react on the basis of these emotions (IBM Data and AI Team 2023; Gillis & Petersson 2023). In addition to the theory of mind AI's understanding of emotions of others, self-aware AI would also possess its own feelings (IBM Data and AI Team 2023).

2.2 AI in Customer Support

The recent technological developments in AI have opened up new possibilities for different applications, including the sector of customer support and customer service. However, also the Covid-19 pandemic has elevated the desire to use digital technologies and to solve tasks remotely (Du Toit et al. 2020).

Customer support is – broadly defined – the process to assure that a customer can make appropriate use of a product. It is considered an essential factor for customer

loyalty and satisfaction (Armistead & Clark 1992; Goffin & New 2001). Especially in the high-tech industry, customer support can be the key differentiating factor from competitors (Loomba 1998).

Due to the highly faceted field of customer support, it is self-evident that an AI's functionality needs to be tailored to the requirements of a specific task or question, and not all potentially available functionalities will be required for each task. For example, if an AI-based solution is only used for a quite narrow field of interest, it is assumed that it does not have to be able to answer questions that go beyond the limits of this field.

AI has already been widely applied to various business domains, including customer support, where it can help improve the quality, efficiency, and customer satisfaction of service delivery (Davenport & Ronanki 2018). One prominent and widely used application of AI in the retail and customer service segment are chatbots (Chong et al. 2021). According to a general definition, chatbots are computer-based conversation systems, which interact with human users through natural language. Such chatbots function in the form of conversational agents (Hill et al. 2015).

A classification system for conversational chatbots has been introduced by Grudin and Jacques (2019), which illustrates the different capabilities of this technology. Their classification scheme is based on the conversational objectives targeted by the chatbots and they differentiate between *virtual companions*, *intelligent assistants*, and *task-focused chatbots*. *Virtual companions* set a focus on the conversation itself and its continuity, with a less emphasis on the factual content. *Intelligent assistants* aim to keep conversations short and succinct, but alike virtual companions are capable of addressing different topics. In contrast, *task-focused chatbots* are subject-focussed and have a limited scope.

In the past years, chatbots have experienced such immense popularity, that the developments have been called a "chatbot-tsunami" in literature (Grudin & Jacques 2019). Predictions assume that by 2025, about 95% of online service inquiries will be handled by chatbots (Clark 2020).

Modern applications of chatbots are widespread and cover healthcare (Yu et al. 2018), banking (Kochhar et al. 2019), education (Zhai et al. 2021), fashion retail (Goti et al. 2023), food services, and check-in services in hotels (Chi et al. 2020; Li et al. 2017), just to name a few examples.

2.2.1 Benefits of AI in Customer Support

The use of AI-based technology in customer support offers many benefits. Two of the core advantages are the all-day-round availability of chatbots (Chong et al. 2021), even during service outages (De Keyser et al. 2019), as well as the potential to reduce a customer's waiting time during a request (Abu Daqar & Smoudy 2019). Both benefits are tremendous assets in the pursuit of the improvement of support quality and customer satisfaction.

This of course also has a financial facet: According to a McKinsey study, technologies aimed at enhancing customer experience are expected to have a multi-trillion USD impact on the global economy by 2025 (Manyika et al. 2013). A study by Bain & Company shows that many companies are already actively using AI-based tools to gain a competitive advantage over other players on the market (Du Toit et al. 2020).

Cost-effectiveness can be elevated through the use of chatbots as compared to human employees in traditional service centers. For instance, in the retail sector, businesses were projected to be able to decrease their costs by more than 400 billion USD per year until 2023 by using automation (Williams 2019). At the same time, human employees can use their free time to engage in high-value customer relations (Drift 2018), providing a further improvement in service quality and enabling them to concentrate on the crucial aspects of their work (Needle 2023). This especially has to be seen in the light of the fact that already in 2020, it has been estimated that about 80% of standard customer enquiries could be answered by chatbots (Suthar 2020) – a number that rather has increased than decreased since then.

Modern chatbots are easily implementable into existing platforms (Klopfenstein et al. 2017). This means that the knowledge required for the realization of such systems can be kept at a minimum, resulting in a low effort and a large return on investment (Srinivasan et al. 2018), which further fires the popularity of such technologies among businesses.

2.2.2 Acceptance of AI in Customer Support

Despite the enthusiastic market predictions, scepticism towards chatbot-based technologies is growing. It becomes thus paramount to have a clear overview of how chatbots are really experienced by humans, given also the fact that this technology is relatively new for the general population and their expectations may not be completely met (Rapp et al. 2021).

With all the benefits of AI-based technologies, it has to be kept in mind that the counterpart of the conversation is a human being with emotions and feelings that cannot be measured on a scale that is purely driven by efficiency, knowledge, and availability. In other words: Not only usability plays a major role in the acceptance of chatbots, but also the subjective aspect of user experience. The latter can be described as the experience a user has when interacting with a piece of technology (Lallemant et al. 2015).

Due to these subjective factors playing a major role, high levels of objective accurateness (Suthar 2020) are contrasted by surprisingly low levels of customer acceptance: In a study from 2018, 43% of customers indicated that they would prefer to talk to a human rather than to a chatbot (Drift 2018). Another study finds an even higher number, namely an estimated 86% of customers, which would prefer human interaction (Press 2019). This concern also seems to be considered by businesses. A study from the year 2020 revealed that 64% of companies refrained from the implementation of chatbots due the expected reluctance of customers to accept AI-based services (Srinivasan et al. 2018).

In order to achieve better customer acceptance, a combination of task-orientation and untargeted chitchat functionality has been proposed. For example, a chatbot providing factually correct information about an event could supplement the conversation by relevant chitchat to make the dialogue more engaging and lively, which in turn is expected to elevate user experience (Sun et al. 2020). Also another study suggests that customer reception of chatbots can be increased, if they show the ability to mimic human emotions (Haugeland et al. 2022).

In summary, this aspect also needs to be considered when aiming to implement a new AI-based tool. Even if the information provided by an AI system may be perfect from a factual point of view, this system may not be accepted by a customer due to subjective factors. Here, the Turing Test, which has already been mentioned in the summary of the history of AI comes into play: Until today, the general concept proposed by Turing (1950) is used to test the “intelligence” of AI systems, though in modified form (Suleyman & Bhaskar 2023).

2.2.3 Specifics of AI in Tech Support

Tech support, also referred to as technical support, is a specific type of customer support. It involves providing help to customers who have technical problems with products and/or services (Digital Minds BPO 2021), whereas customer support

summarizes all tasks which are aimed to help customers with any type of problem, also those of non-technical nature (Perez 2020).

Tech support is focussed on the technical questions and providing solutions rather than prioritising user experience (Perez 2020). Depending on the product involved, the problems to be solved may be of highly complex nature, requiring complicated deductions and explanations. However, due to the technical focus, the aspect of user experience may be of lesser importance in the field of tech support.

Nevertheless, it is important to consider additional factors that may be less significant or irrelevant in other contexts. For instance, safety concerns may arise, where wrong recommendations could not only result in low customer satisfaction, but could even involve product damage and health hazards.

All these aspects influence the requirements of an AI-based tool in tech support. While the lower requirements in relation to user experience could benefit the applicability of AI-based tools, the possible safety issues may represent a weak point of this technology.

2.3 Implementation of AI in a specific Tech Support Task

Within the present thesis, a proposal for the implementation of AI in a tech support task was developed.

The support task relates to a simulated technical issue with a mass spectrometer and an optical emission spectrometer. These devices are used in chemical laboratories for the analysis of trace elements in different types of samples with the company background described in chapter 1.3 above. Users are typically well-trained and have an above-average technical understanding. In many cases, they have a university degree in technical or natural sciences. Some aspects of the devices of interest are critical from a safety perspective. Faulty advice may lead to irreparable damage of the instruments or even evoke safety hazards.

Based on the available technologies and the learnings from current applications but also limitations of AI in customer support, an AI-based model with the capability of conversing in a human-like manner and having access to a wide range of training data was required.

OpenAI's ChatGPT was the tool of choice, due to being readily available to the public when the first evaluations for this thesis were started. Additionally, ChatGPT showed promising results in first pre-trials, especially with respect to the objective quality and

accurateness of the responses but also with respect to the subjective aspects of user interaction such as conversational engagement.

ChatGPT utilises natural language processing (NLP) to enable a conversation between human and AI engine. It is part of the class of so-called generative AI and can be considered a limited memory machine, according to the definitions given above (IBM Data and AI Team 2023).

2.3.1 Natural Language Processing

The idea of machines generating language is one of the oldest (or even *the* oldest) aspect of AI, which has already been introduced by Turing (1950). This concept is nowadays called natural language processing (NLP). It can be defined as “... a *theoretically motivated range of computational techniques for analyzing and representing naturally occurring texts at one or more levels of linguistic analysis for the purpose of achieving human-like language processing for a range of tasks or applications.*” (Liddy 2001, p. 2126).

NLP is one of the areas of AI, which have undoubtedly benefitted from the recent wealth of data sets in combination with the availability of computing performance. Modern NLP, also known as the third wave of NLP, is characterized by the utilization of deep learning, which is a specific aspect of machine learning. In contrast to other technologies of machine learning, deep learning does not require the manual engineering of features by humans (Deng & Liu (Eds.) 2018).

Deep learning has enabled NLP models to overcome the limitations of earlier approaches, which involved manual feature design and therefore could never cover all possible aspects of the complex nature of human language (Deng & Liu (Eds.) 2018).

During the 2010s, deep learning-based NLP not only took speech recognition to a new level (Yu & Deng 2015)., it also highly affected the performance of machine translation systems (Bahdanau et al. 2014) and led to the development of new applications, such as speech understanding (Mesnil et al. 2013) and dialogue systems (Deng & Liu (Eds.) 2018).

2.3.2 Generative AI

Within the present thesis, a special focus is set on AI-based dialogue systems, which have the ability to generate text, images, or other media (Lanxon et al. 2023). These capabilities are offered by generative models, which are considered to have potential

suitability for tech support tasks, as they are readily used in different areas of customer support (Yu et al. 2018; Kochhar et al. 2019; Zhai et al. 2021; Goti et al. 2023; Chi et al. 2020; Li et al. 2017).

Easy access to the information contained in large data sets is a core capability of generative AI. The idea behind it is simple:

“To train a generative model we first collect a large amount of data in some domain (e.g., think millions of images, sentences, or sounds, etc.) and then train a model to generate data like it.”
(Karpathy et al. 2016)

This way, already available information – often generated by humans – can serve as basis for new information and the generative AI model will rely on the “experience” that is stored in the underlying data set (Gui et al. 2023).

2.3.3 Fundamentals of ChatGPT’s Functionality

ChatGPT is a natural language model, which has been developed by the non-profit artificial intelligence research company OpenAI. OpenAI has been active in artificial intelligence research since 2015. Their official

“...goal is to advance digital intelligence in the way that is most likely to benefit humanity as a whole, unconstrained by a need to generate financial return.” (Brockman & Sutskever 2015)

OpenAI claims that *“since [their] research is free from financial obligations, [they] can better focus on a positive human impact”* (Brockman & Sutskever 2015).

In 2020, OpenAI released an API (Application Programming Interface), which gave access to AI models that had been developed by OpenAI. The API provided *“a general-purpose ‘text in, text out’ interface”* (Brockman et al. 2020).

The core functionality of the API was text completion: For every text input, the API gave a text completion as output, making the attempt to match the pattern of the input. Customizing the model could simply be achieved by providing some examples of the expected results. Additionally, training based on larger datasets or user feedback could be performed (Brockman et al. 2020).

A couple of months after launching the API, OpenAI presented the next development: GPT-3. Based on the principle of OpenAI API, GPT-3 was capable of providing a text completion to any input text (or “prompt”) (Pilipiszyn 2021). The GPT-3 set of

language models employs a dataset of text available on the internet to predict the next word of a text response to a prompt. This involves situations, where the response is unintended, which is called a *misalignment* of the model (Ouyang et al. 2022). Such misalignments should be avoided, as a language model should be *honest*, *helpful*, and *harmless* (Askell et al. 2021).

The next generation model InstructGPT aimed at overcoming the shortcomings of GPT-3 using reinforcement learning from human feedback (RLHF) for fine-tuning the GPT-3 models. Human “labelers” were used for this purpose to perform a so-called supervised fine-tuning (Ouyang et al. 2022; OpenAI 2022).

In a first step of this fine-tuning, the labelers provided a set of desired output data to a given prompt. The model was then trained using this data set. This way, the model should learn the way that a certain response was expected to look like. The results are referred to as “supervised learning baselines” (Ouyang et al. 2022; OpenAI 2022).

In the next step, comparison data was collected, where model-generated responses were recorded for the same prompts that were used in the first step. These responses were ranked by the labelers based on their quality. A reward model was trained using the results from the labelling, which aimed at predicting which type of response would be preferred by a human (Ouyang et al. 2022; OpenAI 2022).

In the last step of the training process, this reward model was used as a reward function to fine-tune the baselines aiming at maximizing the reward, thus obtaining an optimized model, which is specifically trained for the response “style” preferred by the labelers (Ouyang et al. 2022; OpenAI 2022).

Ouyang et al. reported that labelers significantly preferred the outputs given by InstructGPT to those given by GPT-3 (2022), proving the success of the RLHF-based fine tuning.

Additionally, InstructGPT showed generalization capabilities, which went beyond the borders of the scope of the fine-tuning. This specifically involved non-English language responses – despite the fact that the fine tuning was predominantly performed by English language inputs. This was even surprising for the creators of the fine-tuned model. Furthermore, InstructGPT could be used for text summarization and question-answering in relation to code. In summary, these observations indicate that the model could also be useful for inputs that have not been directly supervised by humans (Ouyang et al. 2022).

The ChatGPT-model is a sibling model of InstructGPT, which has been specifically trained to follow text instructions and provide a detailed text output on the basis of the instructions, having been fine-tuned from a model in the GPT-3.5 series (OpenAI 2022). It is assumed that the difference between ChatGPT and InstructGPT is the amount of training data. However, there is no detailed technical information available, which deals with the functioning of ChatGPT (Agarwal 2023).

2.3.4 Problems and Risks of ChatGPT

It is evident from the above that ChatGPT processes only language and not information (Walters and Wilder 2023). In more drastic words: ChatGPT is only concerned with optimizing the probabilistic aspects of the text response and not the factual information it contains. It does not assess the veracity of a response (Walters & Wilder 2023).

This fact is the basis of one of the greatest (or even *the* greatest) problems of ChatGPT: Incorrect responses, also referred to as “hallucinations” (Walters & Wilder 2023) – an aspect that is especially critical in fields, where the factual content of a response is of the essence.

A case in relation to this issue, which also caught the attention of the public, appeared in the legal field. An employee of a law firm used ChatGPT when filing a lawsuit against an airline. The generated text contained references to previous court cases, which had been invented by the AI model (Neumeister 2023). It is also known that ChatGPT has been used in scientific writing, where references have been made up by the model (Van Noorden & Webb 2023).

An additional problem of models, which have been trained by supervised fine-tuning, is bias due to the selection of the labelers. Ouyang et al. report that the labelers are “*clearly not representative of the full spectrum of people affected by these models*” (2022, p. 27738). Judgments during the alignment, which involve cultural background, beliefs, and personal background, will influence the model, potentially introducing such bias. Intentional misuse during the alignment process can also be problematic; the problems of intentional misuse come at the cost of simplifying the input of user intentions into models (Ouyang et al. 2022).

As the models use historical data for training, inaccuracies and prejudice contained in the training data will also be reproduced in ChatGPT’s responses (Walters & Wilder 2022).

Lastly, alignment failures may lead to safety issues. InstructGPT's makers explicitly highlight that special care should be taken if the models are employed in safety-critical situations – the large language models are capable of generating “*convincing misinformation*” (Ouyang et al. 2022). In such cases also the aspect of liability comes into play. As compared to human failure, it could be problematic to determine the cause of damage, if an AI model gave the instructions.

2.4 Basics of Change Management

Change is an aspect of life that has always preoccupied and fascinated humans. Already about 2,500 years ago, Greek philosopher Heraclitus, to whom the famous saying “*everything flows*” is attributed, said that

“There is nothing permanent except change.”

It seems that already back then, he understood the specialties of the concept of change.

Heraclitus obviously did not have a company in mind, when he said the above words, but it shows that the general concept of change can be applied to most specific areas – also the one of organizational change.

Now, in a business context, change can be referred to as a process that is able to adjust those factors that “*highly influence an enterprise in terms of its offers, strategy, and innovation*” (Fernandes et al. 2023, p. 79).

Change management – or in other words: the way to manage change – is a systematic approach, which is used by organizations to manage changes in their processes, technologies, or structures (Kotter & Schlesinger 2008).

The core of change management is a structured process that includes planning, designing, implementing, and evaluating changes to ensure they meet organizational goals and objectives. Ultimately, the goal of change management is to minimize disruptions and maximize the adoption of new changes by employees (Kotter & Schlesinger 2008). Continuous improvement can promote a higher level of change (Fernandes et al. 2023).

Beer & Nohria (2000) assume that the requirement for changes in enterprises has reached a peak and has never been higher since the Industrial Revolution. Many traditional enterprises find themselves in a “change or die” situation, such that they have to accept the need for performing changes or otherwise would cease to exist. The dynamics of competition lead to a continuous change in market rules, business

models and technologies. Companies only remain successful if they are able to adapt to new developments or proactively drive change to their advantage (Güttel et al. 2021). Of course, change initiatives can also be undertaken without an imminent need and in situations, which do not pose a direct threat to an enterprise's existence (Kotter 2007).

However, and in any case, change is a core task an enterprise has to be able to perform, may it be in a "life-threatening" situation, or to perform an improvement over the present state. History has shown that enterprises that were unwilling to undergo changes, were equally unsuccessful and could not adequately adapt to alterations in the market environment (Güttel et al. 2021).

Despite the essentiality of changes, the success rates when attempting to change are low and a number of transformation initiatives fail (Beer & Nohria 2000; Kotter 2007). Even if complete failure is rare, complete success is as well, and in the process complications occur often (Kotter & Schlesinger 2008).

It should be the ultimate goal to avoid such failures (or at least problems related to change attempts), as the presence of considerable risk can always hamper the willingness to initiate change, which in turn impairs the optimization of an enterprise's processes.

In literature, many causes for problems during the transformation of processes have been described. Those range from resistance by the staff (Kotter & Schlesinger 2008), over missing of structuration and time (Kotter 2007), or even lack of understanding for the fundamentals of a change process (Beer & Nohria 2000).

In an attempt to avoid such problems, different change management models have been proposed. Change management models are concepts, theories and methods with the aim to provide a comprehensive and structured approach to organizational change. They are designed to provide a guide for implementing change, navigating the transformational process and ensuring that change is finally accepted and implemented (Business Strategy 2022; Hicks 2022).

Change management models help companies prepare for change, overcome resistance, motivate employees and maximize the return on investment for business process changes. They enable organizations to draw on best practices, tactics and strategies when implementing change projects (Business Strategy 2022; Hicks 2022).

Some of the most popular models are:

- McKinsey 7-S Model: A model that analyzes seven factors affecting a company's ability to change and how they relate to each other.
- Nudge Theory: A model that uses subtle cues and incentives to influence people's behavior and decision-making in a positive way.
- Satir Change Model: A model that tracks the performance and emotional responses of employees during five stages of change.
- Lewin's Change Management Model: A simple model that breaks down the change process into three steps: unfreeze, change, and refreeze.
- ADKAR Model: A model that focuses on the individual outcomes necessary for successful change: awareness, desire, knowledge, ability, and reinforcement.
- Kotter's 8-Step Change Model: A model that guides leaders through the change process by outlining eight steps, from creating a sense of urgency to sustaining the changes.

As can be seen from the above, each model is designed to address a particular aspect of change and to target a specific point in the decision-making process. Despite this, some of the ideas overlap between different models.

The ADKAR Model was chosen as a framework to develop recommendations for a successful change process for the implementation of an AI-assisted technical support process, which is the core of the present thesis. The reasons for this will be discussed in detail further below.

2.5 The ADKAR Model

The ADKAR Model has been developed by the company Prosci, which has been founded in 1994 by a former Bell Labs engineer and manager. Today, Prosci is active in the development of processes and the support in change management, with a focus on customer success (Prosci 2023).

The homepage of Prosci (2023) states the following regarding this particular change model: "The Prosci ADKAR® Model is one of the two foundational models of the Prosci Methodology, in addition to the PCT Model. The word "ADKAR" is an acronym for the five outcomes an individual needs to achieve for a change to be successful: *Awareness, Desire, Knowledge, Ability and Reinforcement.*"

The ADKAR Model sets a focus on individual change, which targets the guidance of an individual through a change process and it is based on the assumption that change

on an organizational level can only be obtained if the individuals change (Prosci 2023).

Each of the five elements of the ADKAR Model is influenced by multiple factors. Table 1 identifies some of the factors that affect the success of the implementation of a specific change task. These factors are mostly psychological in nature and can have positive or negative effects on the whole change process.

Table 1: Factors influencing each element of the ADKAR model
(Hiatt 2006, p.45, Figure 7-1)

ADKAR elements	Factors influencing success
Awareness of the need for change	<ul style="list-style-type: none"> • a person’s view of the current state • how a person perceives problems • credibility of the sender of awareness messages • circulation of misinformation or rumors • contestability of the reasons for change
Desire to support and participate in the change	<ul style="list-style-type: none"> • the nature of the change (what the change is and how it will impact each person) • the organizational or environmental context for the change (his or her perception of the organization or environment that is subject to change) • each individual’s personal situation • what motivates a person (those intrinsic motivators that are unique to an individual)
Knowledge of how to change	<ul style="list-style-type: none"> • the current knowledge base of an individual • the capability of this person to gain additional knowledge • resources available for education and training • access to or existence of the required knowledge
Ability to implement required skills and behaviors	<ul style="list-style-type: none"> • psychological blocks • physical abilities • intellectual capability • the time available to develop the needed skills • the availability of resources to support the development of new abilities
Reinforcement to sustain the change	<ul style="list-style-type: none"> • the degree to which the reinforcement is meaningful and specific to the person impacted by the change • the association of the reinforcement with actual demonstrated progress or accomplishment • the absence of negative consequences • an accountability system that creates ongoing mechanism to reinforce the change

By using these five elements as a guidance, key barriers for successful implementation can be identified and the implementation process can be tracked along the way (Prosci 2023).

3 Methodology

3.1 Research Design

This empirical investigation sought to assess the feasibility of implementing ChatGPT in a technical support setting to address common customer inquiries. A survey was conducted to gather employee perceptions, experiences, concerns, and expectations regarding the use of AI in technical support, including an evaluation of ChatGPT-generated responses to technical support questions.

The aim was to gain insights into how AI, such as ChatGPT, can be leveraged to enhance technical support processes, as well as to understand the potential opportunities and challenges associated with its integration.

The questionnaire was composed of the following three sections: (1) preliminary questions with the goal to obtain insights about participants' familiarity with and attitude towards artificial intelligence in general and ChatGPT in particular, (2) evaluation of ChatGPT-generated responses to customer enquiries and (3) questions on the perception of future developments and their consequences on a personal level.

Chapter 3.1.1 describes which inputs were used to generate ChatGPT responses, whereas chapter 3.2.1 explains the survey approach in more detail.

Oral online interviews were conducted with leaders in technical support, customer service, application support, and digital transformation. The interviews were semi-structured and flexible to gain valuable insights into different implementation areas and plans that were not shared with the rest of the company at the time of the interviews.

3.1.1 Statement Generation from ChatGPT for evaluation purposes

In order to generate answers for participants to rate, ChatGPT was tasked with responding to four commonly asked questions posed by customers regarding the utilization of ICP-OES and ICP-MS instruments.

As customer enquiries are sometimes very short and not very descriptive or informative, the following simple inputs were chosen:

- "Sensitivity of my ICP-OES is low"
- "How can I clean the sample introduction of my ICP-OES instrument?"
- "Sensitivity of my ICP-MS is low"

- “How can I clean the cones of my ICP-MS?”

The generated responses were subsequently presented to technical support personnel for assessment based on the criteria of Accuracy, Relevance, Depth of Explanation, Clarity and Coherence, Potential Risk and Human Factor. Definitions of the rating criteria are listed in chapter 3.2.1 together with the provided rating scales.

The following number of suggestions were approved for evaluation for the above mentioned inputs:

- “Sensitivity of my ICP-OES is low”
 - 20 individual recommendations for checking possible causes
- “How can I clean the sample introduction of my ICP-OES instrument?”
 - 1 comprehensive instruction
- “Sensitivity of my ICP-MS is low”
 - 15 individual recommendations for checking possible causes
- “How can I clean the cones of my ICP-MS?”
 - 1 comprehensive instruction

Furthermore, the following German inputs were selected for comparison purposes, in order to analyse whether the input language has an impact on the quality of the response:

- „Wie kann ich die Probenzufuhr meines ICP-OES-Geräts reinigen?“
- „Wie kann ich die Konen meines ICP-MS reinigen?“

Chapter 4.7 compares the results from the English and German entries.

3.2 Data Collection Methods

3.2.1 Survey

For this exploratory study, frontline employees supporting inductively coupled plasma (ICP) instruments were surveyed. The target group included both remote support and field-based employees, in order to investigate potential differences based on their respective roles within the organisation. The survey aimed to gauge perceptions, experiences, and expectations of technical support employees regarding AI in general, followed by an evaluation of ChatGPT-generated responses to real technical support questions, and concluded with an outlook into the future of technical support with regard to (potential) changes related to the implementation of AI-tools.

The respondents for this case study were selected to represent the variety of professional and education profiles within 2 main groups of stakeholders: field service engineers (FSE) and engineers working as digital remote support (DRS). Among 12 respondents working in technical support, 5 were working as DRS and 7 were working on customer sites in the field.

In terms of their functional expertise, 10 respondents were supporting both, ICP-MS and ICP-OES instruments, whereas the remaining two participants exclusively handled requests on either ICP-MS or ICP-OES instruments, respectively.

As was to be expected, the majority of participants were aged between 30 and 50. The youngest participant was under 30 years old, while the oldest was over 60. The highest finished education of 7 participants was a university degree, with a background in either Electronics, Chemistry or Biology. The degrees ranged from BSc to PhD. The 5 other participants had completed high schools specialising in Electronics.

All participants were based in the EMEA region. 3 participants were based in Italy, 2 each in France and the United Kingdom, and 1 each in Austria, Belgium, Denmark, Spain, and Sweden. Both, FSE and DRS, primarily serve their country of residence, but may assist in other countries within the EMEA region as required by the business. Therefore, all employees must be capable of offering support in English.

Preliminary questions were designed to gather insights into various aspects related to artificial intelligence and specifically its application in the form of ChatGPT. Said questions served to elucidate participants' initial reflections and degree of familiarity regarding AI, as well as their appraisal of AI as either an opportunity or a threat, and their personal employment of AI-driven tools or systems. Furthermore, the survey aimed to determine how often and for what reasons respondents utilise AI-based technologies. Finally, participants were questioned on their familiarity with ChatGPT and, if applicable, were asked to indicate which terms they associate with ChatGPT, to reveal their perceptions of the system. By examining the answers to these inquiries, a comprehensive understanding of the participants' awareness, usage, and attitudes towards AI and ChatGPT can be obtained. The gathered responses shed light on the following topics:

- **Demographics:** Participants were asked to select their age range.
- **Perceptions of AI:** Participants were asked to share their initial thoughts when they read the term “artificial intelligence” and to rate their familiarity with the concept of AI. Participants were asked whether they perceived AI more as an opportunity or as a threat and to provide reasons for their selection. “*I’m unsure*” was also eligible.
- **AI Usage:** Participants were asked if they (knowingly) had personal experiences with AI-powered tools and whether these experiences were business-related or for private purposes. Additionally, they were questioned if they used AI on a daily basis and to specify how they employed AI.
- **Awareness of ChatGPT:** Participants were asked if they had heard of ChatGPT, and if affirmative, whether they had utilized it and what term they would associate with it, allowing a multiple selection of “*Opportunity*”, “*Fun*” and/or “*Risk*”.

The survey’s main section comprised the responses generated by ChatGPT. Participants were instructed to read and evaluate each recommendation according to the following rating criteria:

- **Accuracy:** Evaluate how correct and factually accurate the information is. Rate the statement on a scale of 1 to 5, with 1 indicating highly inaccurate and 5 indicating complete accuracy.
- **Relevance:** Determine how well the answer addresses the question or problem at hand. Rate the statement on a scale of 1 to 5, with 1 indicating irrelevant and 5 indicating highly relevant.
- **Depth of Explanation:** Assess the level of detail and thoroughness in the answer. Rate the statement on a scale of 1 to 5, with 1 indicating superficial and lacking depth, and 5 indicating comprehensive and insightful.
- **Clarity and Coherence:** Evaluate the overall clarity and coherence of the answer. Rate the statement on a scale of 1 to 5, with 1 indicating confusing and poorly structured, and 5 indicating clear and well-organized.
- **Potential Risk:** Assess the potential risk associated with the answer provided. Rate the statement on a scale of 1 to 5, with 1 indicating low potential risk and 5 indicating high potential risk.
- **Human Factor:** Do you think that this suggestion was written by a human? (1 = definitely not, 2 = probably not, 3 = unsure, 4 = probably, 5 = definitely written by a human)

By assessing the AI-generated answers based on the given criteria, the study aimed to obtain insights into the suitability and overall quality of those answers for technical support purposes. The findings could assist in decision-making regarding the integration of AI technology in technical support systems and identify potential areas for improvement to enhance the user experience and effectiveness of technical support.

After the evaluation phase, participants were asked a series of open-ended questions to gather qualitative insights. The concluding questions of the survey on the application of AI in technical support were designed to gather valuable insights and opinions from professionals operating within this domain.

The questions were intended to ascertain the participants' viewpoints on the impact of AI on the future of technical support, their personal encounters with AI-facilitated tools or systems in their respective roles so far, and their overall perception of AI's potential for enhancing technical support. Moreover, the survey had the objective of identifying the potential advantages and drawbacks linked to the integration of AI within technical support processes.

Specifically, by investigating individuals' perception of the risk of AI replacing jobs in technical support and examining participants' expectations about changes to their work and time allocation with the implementation of AI, the survey aimed to gauge the level of acceptance, apprehensions, and anticipations concerning AI in technical support. Furthermore, the survey explored whether participants consider the implementation of AI in technical support to generate novel prospects for career growth and skill development.

The results of this survey will provide valuable insights into the opinions and expectations of technical support professionals regarding AI usage, which can be used to inform future strategies and decision-making in this field.

3.2.2 Interviews

Semi-structured interviews were conducted with leaders in technical support, customer service, application support, and digital transformation. The interviews were designed to encourage open discussions rather than a structured survey. The majority of information was gathered during the chat phase at the beginning and end of the interviews, rather than the questioning phase itself. The leaders were hesitant to share information about unfinished projects and failures from previous projects, but still some valuable insights could be obtained. Topics that were addressed include

customer acceptance, privacy risks and challenges concerning the implementation and usage of AI-powered tools.

3.3 Data Analysis Techniques

Ratings were utilized to evaluate whether responses generated by the AI engine would be acceptable within an actual customer request setting.

For the purpose of this study, a 5-level rating scheme was employed to assess the quality of responses. The rating scheme ranged from 1 (lowest possible) to 5 (highest possible). Five different criteria were evaluated in relation to a total of 37 statements. The six evaluation criteria aimed to encompass various aspects of the quality of responses, which were already elaborated on in chapter 3.2.1.

Definitions of the distinct ranges are detailed in **Table 2** below.

Table 2: Rating criteria for evaluation of ChatGPT generated responses

Criterion	1	2	3	4	5
Accuracy	Highly inaccurate	Somewhat inaccurate	Neutral	Somewhat accurate	Completely accurate
Relevance	Irrelevant	Somewhat irrelevant	Neutral	Somewhat relevant	Highly relevant
Depth of Explanation	Superficial and lacking depth	Rather shallow and lacks thoroughness	Neutral	Rather comprehensive and insightful	Comprehensive and insightful
Clarity and Coherence	Confusing and poorly structured	Somewhat confusing	Neutral	Very clear	Clear and well-organized
Potential Risk	Low	Rather low	Medium	Rather high	High
Human Factor	Definitely not written by a human	Probably not written by a human	Unsure	Probably written by a human	Definitely written by a human

The collected responses were analyzed utilizing a quality assessment algorithm developed during the course of the present study.

In the initial step, median values were calculated for each statement based on feedback from 11 participants. This method was adopted to derive a representative rating for the “general” service expert in the relevant field. To ensure unbiased results, efforts were made to exclude outliers as much as possible. Median values were chosen over arithmetic means due to their larger resistance to the influence of statistical outliers.

Responses were deemed suitable for customer facing interaction if the median rating for each of the investigated criteria reached at least the second best possible rating. This threshold was established based on the fact that the responses were evaluated by experts, and it is reasonable to assume that a non-expert would be satisfied with a response that is not perfect, but still considered "good".

3.4 Limitations

ChatGPT was selected as the preferred tool due to its accessibility and widespread use in modern AI-assisted text generation tools. Chapter 2.3 already explained the details on why ChatGPT was the tool of choice despite having certain limitations.

However, as ChatGPT was not specifically trained on any organizational content like operating manuals, troubleshooting guides, or service ticket databases, its field of application was restricted to the most frequently asked questions by customers. Obtaining answers for these questions was only possible because the working principles of the devices is essentially identical for all products available from various manufacturers on the market.

Additionally, the investigation was limited to the technical support for ICP-OES and ICP-MS instruments. It is important to note that the results may vary for other product groups as not all principles are as widely known and comparable across different manufacturers. However, this limitation could be overcome by training the AI tool on specific manuals provided by the manufacturer.

4 Analysis and Findings

4.1 Preliminary questions – A Summary of perceptions about and experiences with AI

Overall, the attitude towards artificial intelligence among technical support employees is predominantly positive or neutral/undecided. Only one respondent expressed a negative opinion already in response to the first question (*What are your first thoughts when you hear the term "artificial intelligence"?*), whereas the other participants responded either with neutral or positive sentiments. Participants answering with definitions and both, positive and negative aspects, were categorised as neutral or undecided. The actual answers and corresponding categorisations can be found in Appendices A-C and can be summarized as follows:

- *What are your first thoughts when you hear the term "artificial intelligence"?*

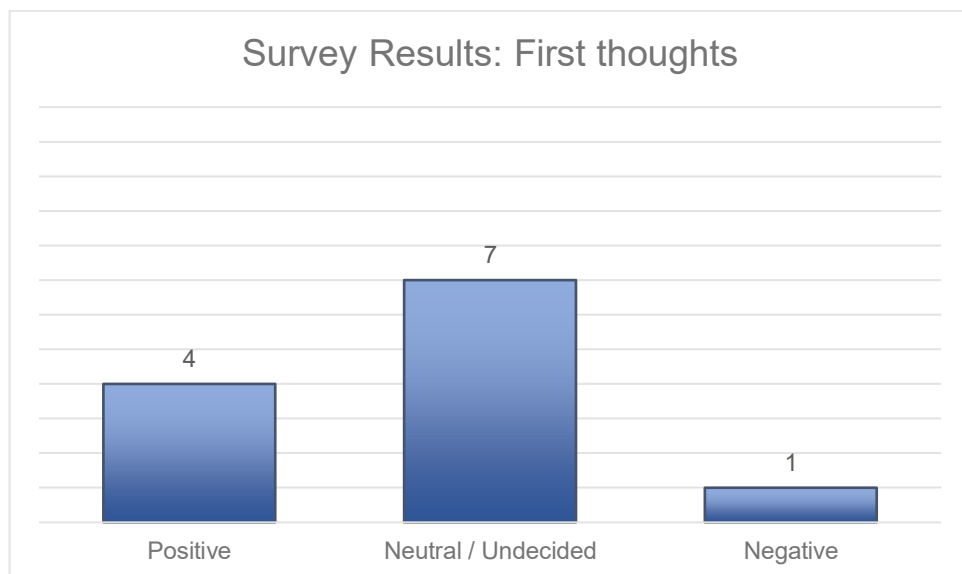


Figure 1: Survey Results: First thoughts about AI

Figure 1 displays the results of the categorisation of responses when participants were asked about their initial thoughts upon hearing the term “artificial intelligence”. One respondent expressed fear of job disruption. Seven respondents were categorised as neutral or undecided and four respondents associated positive impressions with AI.

- *Do you perceive AI more as an opportunity or as a threat?*

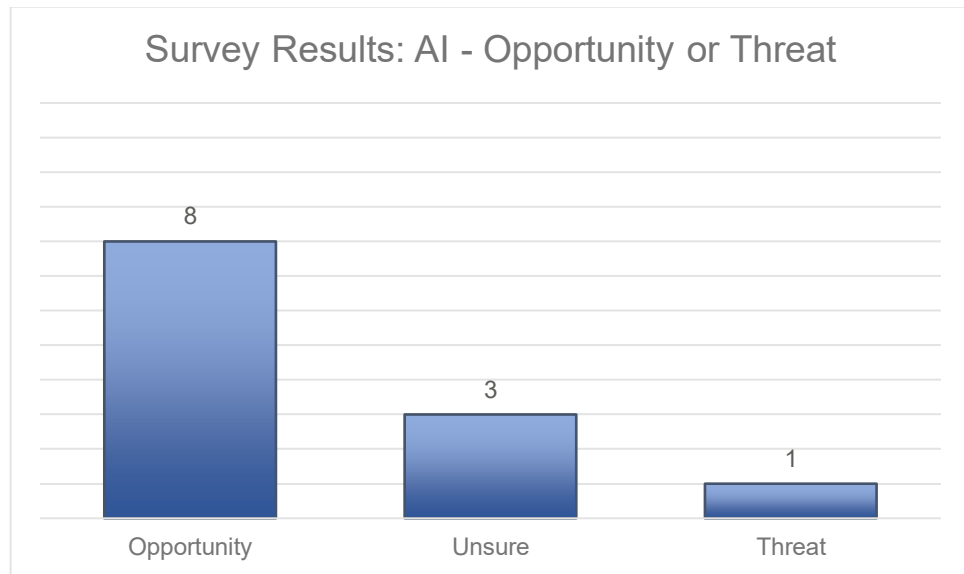


Figure 2: Survey Results: AI - Opportunity or Threat

Figure 2 shows the responses to the question of whether AI represents an opportunity or a threat. Eight participants perceived AI as an opportunity, three were uncertain, and one participant saw AI as a threat.

- *Have you personally been using AI-powered tools or systems?*
 - 5 Yes
 - 7 No
- *Where those occasions business related or for private purposes?*
 - 4 Private
 - 1 Both

The responses regarding participants' personal usage of AI are illustrated in Figure 3 below.

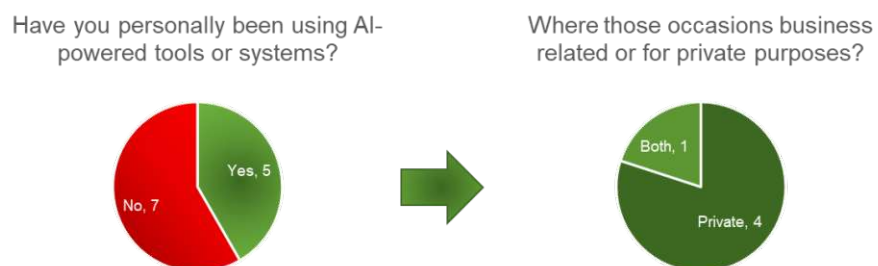


Figure 3: Survey Results: Personal usage of AI

It is noteworthy that FSE 1 stated that he had no personal experience with AI, but had tried ChatGPT. This finding suggests that not all individuals are aware that ChatGPT is in fact an application of artificial intelligence. Additionally, only DRS 2 was aware of the fact that the company already employs certain AI-assisted tools to enhance process efficiency.

“Business: software-based assignment tool to determine the best match engineer to be assigned for a service job...” (DRS 2)

Out of 10 people having heard of ChatGPT, only 4 participants had actually used it at the time of the survey. Two participants solely associated *risk* with ChatGPT, whereas seven participants saw it as a *chance*. It should also be mentioned that the two respondents exclusively associating *risk* with ChatGPT were part of the group having tried it, whereas 3 other participants associating *risk* with ChatGPT in combination with either *chance* or *fun* had not tried ChatGPT or any other AI-powered tool or system. Therefore, it appears that individuals familiar with the tool and with prior experience using it, recognize both its limitations and its potential to replace human tasks.

Following the question *“Do you perceive AI more as an opportunity or as a threat?”*, participants were requested to provide an explanation for their choice. Three respondents stated that AI, like any technology, is neutral in itself, but can be used for good or bad purposes. Respondents see both possible chances and risks associated with ChatGPT, reflecting the critical approach to the subject. Two respondents pointed to job loss as a factor influencing their choice and one person voiced concerns regarding data privacy/security:

“...But i am unsure what happens to your data when you enter things in Chat GPT.” (FSE 5)

The following chapters, in particular chapters 4.3 and 4.4, discuss these topics in greater detail from an employee perspective. Chapter 4.6 will provide the view of upper management.

4.2 Assessment of ChatGPT-generated responses

According to the calculation technique explained in chapter 3.3 the following number of answers were deemed suitable:

- “Sensitivity of my ICP-OES is low”
 - 3 out of 20 individual recommendations
- “How can I clean the sample introduction of my ICP-OES instrument?”
 - 1 of 1 comprehensive instruction
- “Sensitivity of my ICP-MS is low”
 - 4 out of 15 individual recommendations
- “How can I clean the cones of my ICP-MS?”
 - 1 of 1 comprehensive instruction

Long, detailed instructions appear to be better received by participants than short answers with trouble-shooting suggestions. Though it should be noted that the input provided to ChatGPT was also more elaborate and detailed in those cases.

This observation highlights the importance of providing high-quality input to ChatGPT in order to obtain accurate answers. Inputs, also referred to as *prompts* (see chapter 2.3.3 for reference), require careful consideration to yield satisfactory results. As achieving good results can be quite challenging, several “How-to” guides for *prompting* are already being distributed on social media and other platforms for various topics. To receive the best possible results, it is crucial for users to provide well-crafted prompts.

Therefore, intensive training may be required for customers to achieve desirable outcomes. As this additional effort could potentially lead to customer rejection of an AI-based technical support tool, it became necessary to explore alternative use cases.

To investigate this further, a second review of the results was conducted. For this specific use case, we propose the implementation of ChatGPT as an internal tool for technical support employees, rather than making it available to customers. As the tool will be used by experts in the field, it is acceptable to be more tolerant regarding the rating scores. Therefore, responses were deemed suitable if the median rating for each of the investigated criteria was equal to 3 or lower. This threshold was established because experts are better equipped to determine which answers to accept and which to reject. Additionally, experts are expected to be able to gather the correct content from a partially incorrect advice.

Based on these guidelines, the following numbers of suitable answers were identified:

- “Sensitivity of my ICP-OES is low”
 - 18 out of 20 individual recommendations
- “How can I clean the sample introduction of my ICP-OES instrument?”
 - 1 of 1 comprehensive instruction
- “Sensitivity of my ICP-MS is low”
 - 12 out of 15 individual recommendations
- “How can I clean the cones of my ICP-MS?”
 - 1 of 1 comprehensive instruction

Figure 4 illustrates the notable increase in acceptable responses when engineers are selected as the target group.

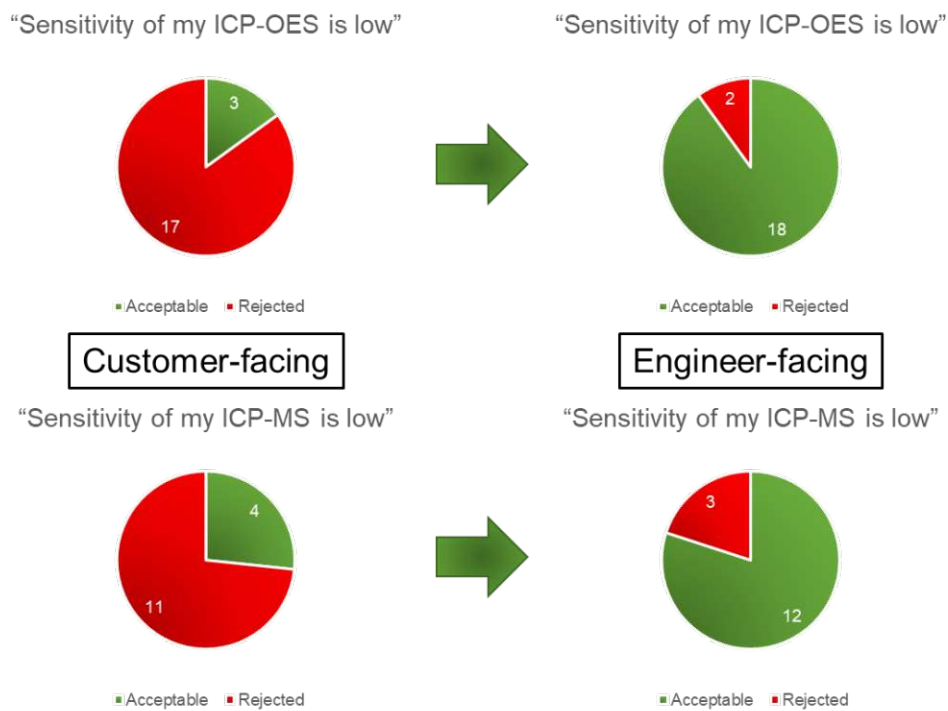


Figure 4: Survey Results: Acceptability of responses generated by ChatGPT based on the target group

Even for the simple prompts a significantly higher number of responses was found to be adequate. Furthermore, when initially introduced as an internal tool, human feedback can be fed back to the AI system to correct the *baseline* (refer to chapter 2.3.3 for details on *RLHF*), which in turn could help prepare the system for a customer-facing adoption.

4.3 Concluding questions – The future of technical support in the age of AI

In the last part of the survey, participants were asked to share their vision of a future of AI-assisted technical support. The actual answers can be found in Appendices D-F and are summarized as follows:

- *How do you perceive the impact of AI on the future of TechSupport?*
(1 Extremely positive | 5 Extremely negative)

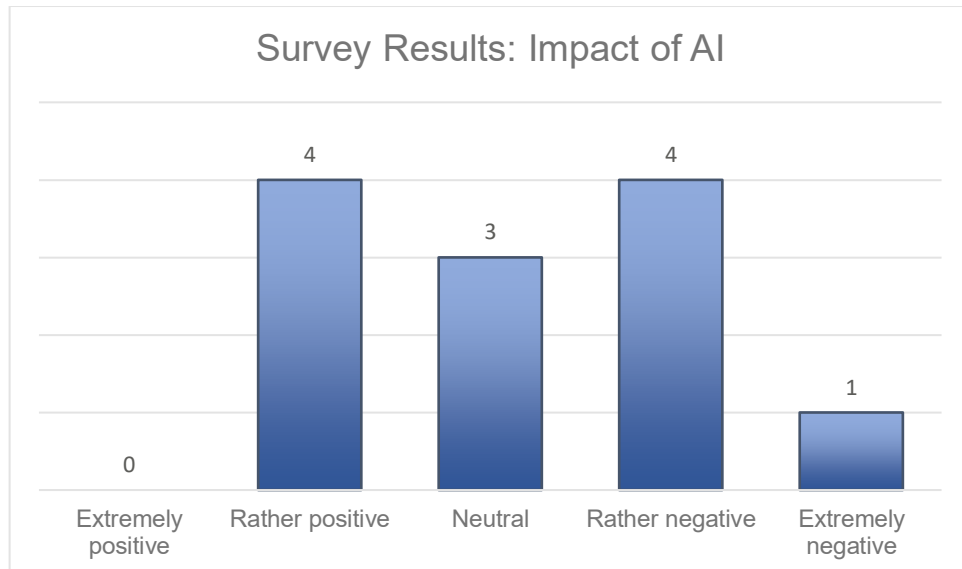


Figure 5: Survey Results: Impact of AI on the future of TechSupport

Figure 5 illustrates the distribution of responses, indicating a neutral overall perception.

- *Have you personally used AI-powered tools or systems in your TechSupport role?*
 - 12 No
- *How do you perceive the risk of AI replacing your job in technical support?*
(1 No risk at all | 5 Significant risk)

Figure 6 displays the responses, showing that two individuals saw no risk of their job being replaced by AI, while three individuals saw a significant risk.

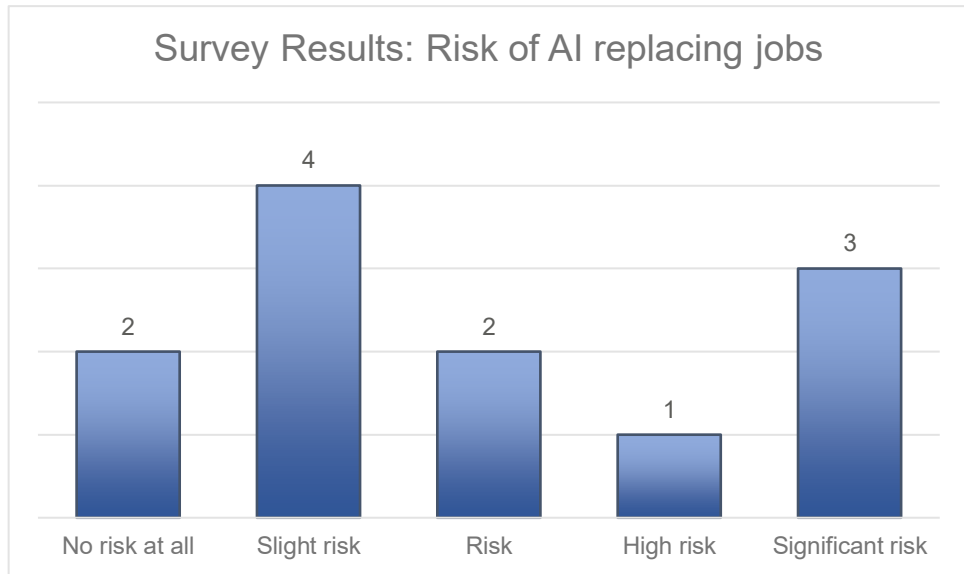


Figure 6: Survey Results: Risk of AI replacing TechSupport jobs

- *How do you anticipate your work would change with the implementation of AI in technical support?*
(1 No change at all | 5 Major changes)

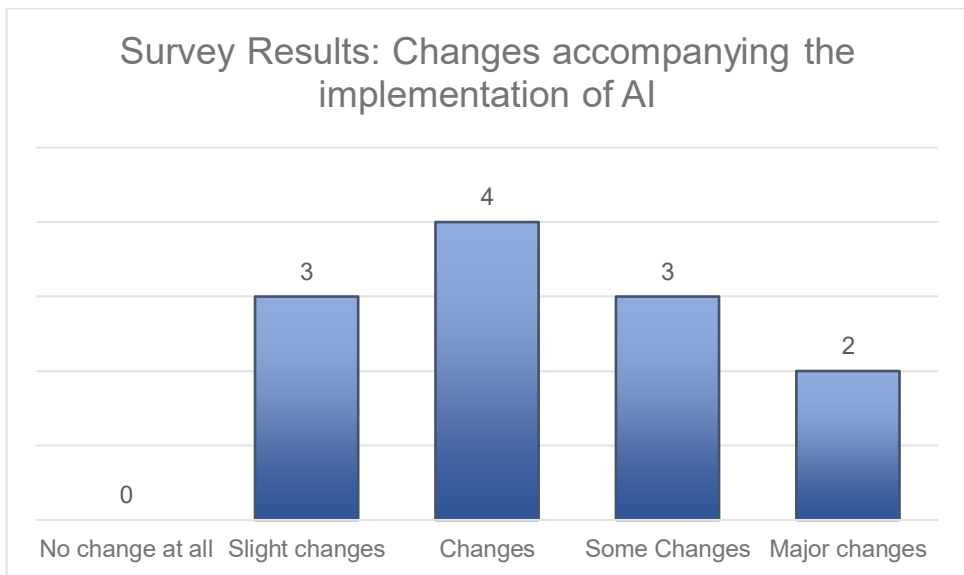


Figure 7: Survey Results: Anticipated changes associated with the implementation of AI

Figure 7 illustrates the distribution of responses, indicating a neutral overall perception.

- *How likely do you believe the implementation of AI in technical support would create new opportunities for career growth and skill development?*
(1 Not likely at all | 5 Very likely)

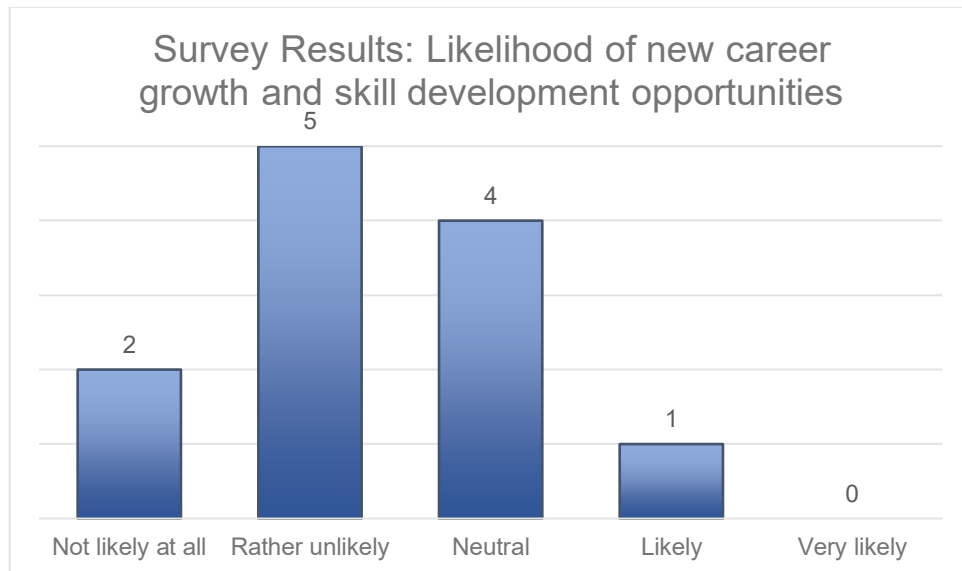


Figure 8: Survey Results: Likelihood of new growth and skill development opportunities

Participants expressed scepticism regarding the potential of new career growth and skill development opportunities being generated through the implementation of AI, as Figure 8 shows a rather negative sentiment.

As noted in chapter 4.1, technical support employees appear to be unaware of the AI-assisted tools already implemented in the company. All respondents stated that they had not used any AI-powered tools or systems in their role. Leadership failed to raise awareness and knowledge of the rising employment of AI-based applications to improve the usage of existing resources and, at the same time, customer experience.

Table 3 displays the rating averages and medians, which show generally neutral to slightly positive responses to the aforementioned questions. However, it seems that employees may not fully understand the future implications of AI employment, possibly due to a lack of information provided by management. There are doubts among employees regarding the potential for growth opportunities. It is important to ensure that employees are aware of the potential benefits of using AI as an assistant.

Table 3: Rating averages and medians of concluding questions

	Rating average	Rating median
<i>How do you perceive the impact of AI on the future of TechSupport?</i>	3.17	3
<i>How do you perceive the risk of AI replacing your job in technical support?</i>	2.92	2.5
<i>How do you anticipate your work would change with the implementation of AI in technical support?</i>	3.33	3
<i>How likely do you believe the implementation of AI in technical support would create new opportunities for career growth and skill development?</i>	2.33	2

Regarding the potential integration of AI into technical support processes, respondents mentioned various aspects. Table 4 provides a summary of the potential benefits and concerns mentioned.

Table 4: Advantages and disadvantages of AI employment in Technical Support

Benefits	Concerns
Automatic responses to customers	Work force reduction
Quicker answers to requests	Additional responsibilities
Reduced workload	Lower salaries
AI could check data for anomalies	Customer vocabulary not suitable to prompt ChatGPT
AI could take care of the minor issues	Loss of personal relationship / human communication
Consistent quality of answers	Loss of business
	Job disruption
	AI does not take customer experience into account
	Data quality of training data

The following chapters will discuss the aforementioned aspects in greater detail.

4.4 Fears and expectations of technical support employees

One of the participants already voiced his fear while answering the very first question in the survey, when employees were asked for their first thoughts when they hear the term "artificial intelligence".

FSE 3: "Job disruption"

The same participant was also the only one perceiving AI as a threat rather than an opportunity. Emphasizing his fears, when explaining why this option was selected:

FSE 3: "Job disruption is real"

While answering the concluding questions, two additional employees rated the risk of AI replacing their job in technical support as significant. In the free text section, additional concerns were raised about workforce reduction in general.

DRS 1: "...a concern, as the AI can reply to several customers questions without the need of a tech support specialist"

DRS 3: "Fewer and fewer specialized people and lower salaries."

Furthermore, there was unease about potential salary decreases and additional responsibilities after the implementation of an AI-assisted tool.

DRS 2: "Concern: risk that companies will cut personnel or add work to personnel as more automation is developed rather than facilitating the job or reducing the workload."

Individual expectations ranged from workload reduction to an increased workload due to the added responsibilities mentioned above. Additional responsibilities can have both negative and positive effects on employee development. While they can be a distraction from the core responsibilities, they can also provide important impetus for growth.

Technical support employees were hoping that an AI-enabled tool can intercept easily solvable problems, allowing them to focus on more complex issues.

FSE 4: "AI may be able to filter out the easier support calls, avoiding wasting resources on minor issues."

This could increase the efficiency of existing resources and reduce individual workload. However, in a business context, a decrease in workload often results in a

reduction in headcount, which leads to an increased workload when additional responsibilities are distributed amongst the remaining personnel. A reduced workload could fuel the aforementioned concerns regarding job security.

Two respondents envisaged AI checking instrument data for anomalies, which would save a considerable amount of time due to the amount of data that needs to be reviewed in the process.

DRS 4: "AI could maybe be really interesting going into log files, or instrument parameters in order to show us what could be wrong on the instrument."

To successfully implement a tool that can predict errors or malfunctioning parts from instrument log files, a vast amount of training data needs to be collected from instruments that are working fine. This could be challenging as this data is normally only transferred to the company upon request after an error occurred. However, such solution seems to be feasible from a technical point of view.

The quality of training data was also addressed by two participants and highlights one of the main concerns when implementing an AI-based tool, such as ChatGPT.

DRS 4: "everything depends on the initial data and the robustness of this data."

FSE 7: "The info thought to AI must be correct otherwise AI will give wrong info or suggestions."

The selected training data has the highest impact on the quality of the generated text responses. If the training data is inconsistent or incomplete, the AI may provide incorrect suggestions to resolve the issue. This topic was previously addressed in chapter 2.3.4, which discussed the risks and issues associated with ChatGPT.

4.5 View on potential changes in customer experience

As front-line employees, FSE and DRS are highly customer-focused. Therefore, many comments and concerns were received regarding the interaction with customers. One of the main benefits anticipated was a faster response rate.

DRS 1: "Automatic and immediate replies to customer questions/concerns/problems"

The ability to receive answers quickly and the availability of 24/7 support are likely to be the main selling points for customers when implementing an AI-based customer-facing support tool.

One of the participants highlighted the possibility of consistent quality of responses, when a machine answers instead of a human.

FSE 5: "A Central knowledge that answers doesnt depend on the person you ask."

However, as described in chapter 2.3.4, the integration of a ChatGPT-powered tool does not necessarily result in consistent, or even correct, answers. Even though the input may be identical, ChatGPT 3.5 may not always produce the same output. However, the overall outcome should remain largely consistent. It is important to consider this aspect when developing an AI-assisted tool. Chapter 4.7 presents the findings of the investigations conducted on this topic for the present thesis.

One of the biggest concerns regarding the implementation of an AI-based tool in customer-facing technical support was the poor vocabulary of customers and the limited amount of given information as DRS 4, DRS 5 and FSE 1 stated in their answers.

DRS 4: "AI is really depending of the initial input, and at this time the vocabulary of customers is really poor, so it could be very difficult to understand them with few sentences. I always have to ask questions in order to fully understand what the customer would like to ask me."

DRS 5: "Moreover the data provided by the customer are often not precize."

FSE 1: "AI is great for stand technical support, but it only works good if the question or concern is explained very specific."

Especially in companies with high turnover rates, employees may receive limited training only and may not possess the necessary vocabulary to identify instrument parts correctly. This point is closely related to the following point:

FSE 6: "It doesn't (cannot) take into account individual Customer's knowledge or experience."

The level of customer knowledge varies from basic to advanced, with some customers possessing a greater understanding of their instruments than the support staff. A

knowledgeable customer does not want to receive basic recommendations when seeking support. This is one of the major benefits of human customer and technical support personnel: In general, employees know ‘their’ customers very well, because they have supported them for considerable time. They are therefore able to assess if an issue could be related rather to an operator error than a hardware issue. This personal relationship is one of the crucial factors in ensuring a satisfactory customer experience and leads to the following concerns being raised:

DRS 5: “The human communication with the customer must remain essential.”

FSE 7: “Customer may need the feeling to contacting a person not a machine, the feeling of attention and care by customer is different.”

Customers may even feel left alone with their problems, as they may perceive a lack of ownership for their issue. They may lose the personal relationship and possibly the trust that has been built up over years of service because they feel they have no one to talk to.

FSE 1: “The personal relation with the customer gets lost. If customers are to communicate with robots the service provider can be anyone. AI is clearly the future for a lot of things, but relations and direct communication as talking will still be the way of building trustful relations.”

If personal relationships are lost and customers are forced to communicate with machines instead of human support employees, they may not have a preference for which company provides the service. This could lead to a loss of business for the service department. This topic was discussed during interviews with leaders of the digital transformation. These discussions can be found in the next chapter.

4.6 Information gathered from oral interviews

Various initiatives in relation to AI-based solutions have been launched across the company, but few have focussed on the service department. The most recent tool that was successfully deployed in the service organisation was deactivated after only a few months of operation due to the high level of manual intervention it required.

Several employees have suggested ideas for use cases for AI to improve internal as well as external processes, with the aim of enhancing the experiences of both

employees and customers. The majority of employees working in the service organisation raised concerns about a lack of information about on-going initiatives. There are fears that the company could be left behind if it does not bring an AI-powered support tool to the market in the near future.

During the discussion with Interviewee 3, it was argued that top management is looking for the *next big thing*, instead of gathering ideas from customers and employees and trying to achieve quick wins with simpler AI-powered tools, such as a bot that can answer part number queries or generate quotes. The emphasis is on creating a jack of all trades, rather than trying to continuously improve current processes.

Additionally, the possibility of significant differences in the acceptance of AI-powered support tools between EMEA and NAM customers was discussed. In North America, chatbots and similar applications are already widely used by the general public, whereas in Europe, personal interaction between humans still holds a high value.

The threat of loss of business, already shortly discussed in the previous chapter, was also subject of discussion in the conversation with Interviewee 2.

“But, yeah, we’re looking into this. We are also looking into how to protect ourselves because the moment internal know-how is shared publicly, someone could build an AI Chatbot on your stuff and that is also a risk. So we are looking both at the opportunity and the risk of this new technology and see how we can best implement it in our space.” (Interviewee 2)

Providing internal data to train the AI is necessary. However, a risk assessment should be conducted beforehand. There are reported cases where the AI tool has been tricked into revealing sensitive information such as the training data (Nasr et al. 2023).

Furthermore, the quality of the training data, which was previously addressed in chapter 4.4, was also a subject of discussion. There currently is no proper process or standard operating procedure (SOP) in place that specifies how to document the work performed and the preceding diagnosis path. In addition, a high amount of information gets lost during the processing of a service ticket, comparable to the children game “Chinese whispers”.

Following the current process, the customer calls the customer call center, they enter information in the ticket and this in turn is fed to Digital Remote Support (DRS). The

majority of DRS colleagues still communicate with customers through direct mail rather than utilising the mailing plug-in provided in the cloud-based service program. Only the outcome, if even, is entered in the Ticket before it is passed on to the Field Service Engineer (FSE).

Therefore, the information entered into the database is unsuitable for AI training. To enable a sustainable learning experience, special *knowledge base* articles would need to be produced manually. In combination with updated instrument operating manuals, troubleshooting guides, and part number catalogues, these resources would form a good basis for training the AI.

4.7 Language differences and repeatability

Another challenge faced by all global companies is providing support in multiple languages. While ChatGPT offers help in many languages, it is most proficient in English.

Prompt:

Does it make a difference if I ask my question in other languages?

ChatGPT:

As an AI language model, I'm trained on a diverse range of languages, including but not limited to English. While English is the language I'm most proficient in, I can also understand and generate text in several other languages such as Spanish, French, German, Italian, Dutch, Portuguese, Russian, Chinese, Japanese, Korean, and many more.

If you ask a question in a language other than English, I'll do my best to understand and respond to it. However, please note that my proficiency may vary across different languages, and my responses may be more accurate and fluent in English.

Feel free to ask your question in the language you're most comfortable with, and I'll do my best to assist you.

(ChatGPT 3.5 – Generated on May 20, 2023)

Although translation programs have become very proficient, most customers still prefer support in their local language. To investigate if there are differences in output quality when using different languages, German prompts were used to generate data for comparison. Chapter 3.1.1 explains which German inputs were selected to generate responses for comparison purposes, in order to analyse whether the input language has an impact on the quality of the response. The actual responses are located in Appendices G-I.

Upon comparing the answers for Scenario 1 (refer to Appendix G for complete text answers), the following was observed:

- Introductions are similar and *safety precautions* are mentioned in the first step in both answers.
- Some steps are only included in one of the instructions, such as *turning off the instrument* and *drying the cleaned components* (in the German version). The English version recommends *to perform a Blank run*, whereas the German version points to a *performance check* instead.
- The structure of the German instruction is more user friendly with the bullet points.
- The closing statements are again similar and both advise *to follow the specific cleaning instructions provided by the manufacturer*.

Both texts adhere to conventional structure, clear and objective language, and grammatical correctness. However, there are some factual errors present. Cleaning the sample introduction does not require switching off the instrument, and ultrasonic cleaning is not advised as it can damage the sample introduction parts. Furthermore, some of the German wording used for sample introduction parts is inaccurate, such as “*Injektionsnadeln*”.

To check for consistency of the provided answers, the same input was used to generate instructions in another chat window. The results can be found in Appendix H. It is worth noting that:

- Introductions are similar and, this time, *no* safety precautions are mentioned in the introductions of both answers. However, both versions refer to *safety protocols* in the section explaining a step for acid wash, and the English version additionally recommends to *follow appropriate safety precautions* in the closing words.

- The German version of the instructions includes a note to *follow the manufacturer's manual* before detailing the different steps, whereas the English version only refers to the manual in two of the bullet points where it could easily be overlooked.
- Some steps are only included in one of the instructions, such as *using a thin wire or a suitable needle to release any blockages* (in the German version). This time only the English version specifically points to *reassembling the sample introduction and regular maintenance*, whereas the German version recommends to *perform Blank runs* before starting any measurements.
- The structure of the instructions is similar this time and the closing words are also similar.

This time the English version advises to *follow the manufacturer's guidelines for using an ultrasonic cleaner and ensure that the components are compatible with this cleaning method*. Both instructions recommend to *perform Performance Verifications and/or calibrations* before starting any measurements.

The results of this investigation clearly demonstrate that answers from ChatGPT are inconsistent. It appears that this inconsistency is not language-related, as some recommendations are present in the English version at one time and then appear in the German version in the next instance. Furthermore, as previously mentioned, the instructions contain potentially harmful factual errors. For instance, if a glass nebulizer is cleaned with a wire or ultra-sonicated, it is highly likely to break, resulting in instrument downtime, unless the customer has a spare nebulizer on site. Therefore, such recommendations need to be avoided.

Upon comparing the answers for Scenario 2 (refer to Appendix I for complete text answers), similar observations were made.

- Introductions are similar and *safety precautions* are mentioned in the first step in both answers.
- The German version of the instructions includes a note to *follow the manufacturer's manual* before detailing the different steps, whereas the English version only refers to the manual with the second bullet point and within subsequent cleaning steps.
- Some steps are only included in one of the instructions, such as *turning off the instrument* and even *disconnecting the instrument from the gas supply* (in the German version).

- Both versions suggest drying the cones, but the German version allows the use of *compressed air*, while the English version advises against it.
- The English version ends with the reassembly of the Cones, whereas the German version includes further recommendations to run a *performance check* before starting any measurements. Furthermore, the German version advises to keep a log book for the instrument maintenance tasks.
- The German instruction is more user friendly as it uses bold titles for the bullet points, which gives the instructions more structure and makes it easier to reference.
- The closing statements both advise *to consult the instructions provided by the manufacturer*. However, the English version puts a higher emphasis on *following the manufacturer's guidelines for the proper cleaning procedure*.

Again, there are some factual errors present in this scenario. Cleaning the sample introduction does not require the instrument to be turned off. In the case of a mass spectrometer, switching off the power to the instrument may result in a vented system, causing instrument downtime as the instrument cannot be used until it has been evacuated again. Once the instrument is vented, a waiting period of at least overnight needs to be adhered to. Turning off the gas supply may exacerbate the situation as the gas pressure is the sole force keeping the vacuum door closed, even if the power is off and the fore-vacuum pump is no longer in operation.

As correctly stated in the English instruction, *using compressed air to dry* the cones, should be avoided, as compressed air may *introduce contaminants* to the freshly cleaned cones.

After cleaning the cones, they need to be conditioned for at least one hour. The entire system should then be tuned, followed by a *performance check* as recommended in the German instructions. Omitting these steps may cause signal drift over time, resulting in inaccurate measurements and the need to repeat them. This in turn leads to wasted time, standard solutions and samples. For certain applications, the available sample amount is limited, making repetition impossible. Even in cases where enough sample is available, the effects are still significant. Gases and chemicals of the necessary purity are expensive, and wastage should be avoided. Lost time in a production scenario can quickly lead to a significant financial loss. Customers rely on the quality of technical support to achieve reliable results, and an AI-based tool used in technical support must meet those high expectations.

4.8 Limitations and Considerations

This chapter summarises the main findings of the research, which can serve as a basis for forming recommendations in the following chapter. In relation to output quality, the main findings are:

1. The majority of ChatGPT produced output when prompted with customer inquiries was deemed suitable for internal use.
2. To provide useful output, ChatGPT requires high-quality prompts and high-quality training data.
3. Answers provided by ChatGPT are inconsistent and may contain factual errors, regardless of the used language.

ChatGPT provided answers to technical support inquiries despite not being specifically trained on instrument manuals or any other manufacturer-supplied material. However, the responses were inconsistent and contained factual errors that could potentially lead to lost money and time, part damage, instrument damage or even worse outcomes. Regarding the employees' point of view, two of the main findings are:

4. The possibility of losing one's job is an employee concern.
5. There is a lack of communication and information flow from upper management to employees.

There is a communication gap between upper management and employees regarding ongoing initiatives and the tools that are already in place or under development. Employees may feel neglected as they believe that their ideas are not being heard or valued. The survey responses included some ideas from employees, demonstrating their willingness to participate in change and continuous improvement. Another main finding is the relevance and the present awareness of data privacy:

6. Data privacy concerns must be addressed.

Typically, the privacy policy can be easily found on the landing page of an application. Accessing ChatGPT's privacy policy was not as straightforward as it is for most applications. To access OpenAI's Privacy Policy, the user must navigate from the ChatGPT window back to the main homepage of OpenAI.

Once obtained, the following sections can be found in the Privacy Policy:

“Personal Information You Provide: We may collect Personal Information if you create an account to use our Services or communicate with us as follows:

...

User Content: When you use our Services, we may collect Personal Information that is included in the input, file uploads, or feedback that you provide to our Services (“Content”).

...

Personal Information We Receive Automatically From Your Use of the Services: When you visit, use, and interact with the Services, we may receive the following information about your visit, use, or interactions (“Technical Information”):

...

Usage Data: We may automatically collect information about your use of the Services, such as the types of content that you view or engage with, the features you use and the actions you take, as well as your time zone, country, the dates and times of access, user agent and version, type of computer or mobile device, computer connection, IP address, and the like.

Device Information: Includes name of the device, operating system, and browser you are using. Information collected may depend on the type of device you use and its settings.

...

We may use Personal Information for the following purposes:

- To provide, administer, maintain and/or analyze the Services;
- To improve our Services and conduct research;
- ...
- To develop new programs and services;...”

(OpenAI 2023b)

Data privacy is clearly an important issue. The collection and use of personal information included in the input and file uploads for the stated purposes is a significant concern. Confidential, internal knowledge or sensitive customer data may

be disclosed and this must be prevented. In respect to the customer, relevant findings of the present study are:

7. The relationship between the customer and technical support relies on trust, therefore an AI-assisted tool has to fulfil high expectations.
8. Human-human interaction is still the preferred way of customer support.
9. Customer inquiries are often imprecise, or customers may use inadequate terminology to describe their problems.

Customers may feel unsupported and lose trust in the service provider if they perceive a lack of ownership for their problem. It is important to maintain a personal relationship with customers to avoid this.

5 Implications and recommendations

5.1 Best Practices – Change Management

To successfully implement any change, communication is of the utmost importance. Unfortunately, it was observed that there is a lack of communication between leaders and employees regarding initiatives focused on implementing new technologies inside the company.

In relation to the ADKAR Model, introduced in chapter 2.5, the following observations were made and action plans derived therefrom.

It appears that there is a general *Awareness* for change. Technical support employees know that there is a need for change. The media coverage of ChatGPT over the past year has contributed to this perception. Numerous ideas have been submitted through various channels within the company, including the survey for this thesis. Emphasis should be placed on creating a communication plan to inform employees about current initiatives and ways of contributing. Not providing any information can result in the spread of misinformation through rumours and word of mouth. Eliminating this misinformation and changing people's perceptions, once they have formed, requires significant effort. Therefore, it would be beneficial for management to provide targeted communication that addresses and involves employees.

Employees also *Desire* change, as everyone wants to reduce their individual workload and better serve customers. Additionally, the implementation of AI tools promises more time to deal with complex problems, which in turn increases the learning curve of technical support employees.

The level of *Knowledge* among colleagues can vary greatly. Providing resources for education and training is crucial. Conducting small training sessions with follow-up quizzes can be a fun and engaging way to introduce new concepts. There are two types of knowledge that require attention during a change process: Knowledge on how to act during the transition and knowledge on how to perform once the change has been implemented. Again, communication and information are key to providing employees with the information they need to ensure that they are not left behind.

For employees to have the *Ability* to change, giving them a psychologically safe space to work is essential. Knowledge is understanding the new process. Ability means putting that knowledge into practice. It may require a significant amount of time before knowledge can be effectively applied. This can be accelerated through consistent

practice, receiving coaching, and obtaining feedback. It is best practice to select subject matter experts who are interested in the topic and have intrinsic motivation to participate in the change process. Passionate individuals can have a leading personality without necessarily being in a leading role in the company. Employees often prefer to learn from a colleague rather than a supervisor because they feel they are learning from someone who understands their perspective and experiences. The implementation of office hours to ask questions can facilitate the transition from knowledge to ability as well by reducing barriers to ask for help.

Reinforcement is an ongoing process and crucial to sustain the change. This final stage of the model focusses on efforts to maintain the changes made. Positive feedback, rewards, recognition, performance measurement, and corrective actions can help ensure that changes remain in place and individuals do not revert to old ways. This stage of change management can be challenging as organizations are often already moving towards the next change. However, to achieve successful change, reinforcement is essential.

5.2 Recommendations for next steps

Results derived from the assessment of ChatGPT-generated responses in chapter 4.2 in combination with the findings in chapter 4.6 make it clear that a customer facing implementation of an AI-tool, such as ChatGPT or similar, will require extensive preparation and training for both customers and the AI itself. ChatGPT, or a similar tool, would need to be trained on manuals, troubleshooting guides, knowledge base articles, and all available data regarding service interventions. However, as most manuals are only available in English, it is important to carefully consider the appropriateness of answers in different languages.

The implementation of an AI tool that leverages the GPT 3.5 Large Language Model or a similar model is proposed. A risk assessment should be undertaken with regard to data privacy before a specific tool is chosen. Starting with a pilot that supports only the English language is recommended, because of the availability of training data. Since all employees are expected to be proficient in English, this approach ensures the widest possible audience.

Furthermore, it is recommended to start with an internal assistant that is only accessible to technical support employees. A RLHF-based learning approach is advised. Through this approach, technical support employees can familiarize themselves with the tool in a secure environment, because the tool is only internally

used in the beginning. This ensures that the employees can safely learn how to use the tool in an effective way and provide valuable feedback. Employees can acquire knowledge in the new technology while the AI undergoes reinforcement learning through human feedback.

Regulations must be implemented to prevent ChatGPT from generating “*convincing misinformation*” (Ouyang et al. 2022). If ChatGPT cannot give an informed answer, it must respond with “*I’m sorry, I cannot provide an answer*” and transfer the request to a human.

During the initial piloting phase, it is recommended to gather feedback from the employees on the most effective prompts and other observations to start preparing training data for users. This will save time once the AI is trained and ready to be deployed in the field.

5.3 Strategies to address challenges and limitations

To even be able to train an AI-based model, certain prerequisites must be in place. Firstly, a clear process for documenting technical support cases needs to be established to ensure the quality of the documentation of actual support cases. Secondly, manufacturer manuals and troubleshooting guides need to be reviewed and updated as necessary.

Before implementing an AI-assisted tool in the field, it is important to prepare customers for the upcoming change. A transition phase should be put in place, during which customers can choose to use the AI tool, but are not required to. Training courses should be offered to guide customer through the transition. Customer communication should be sent out to highlight the benefits of a 24/7-support tool and success stories should be shared to reduce the inhibition threshold. In addition, it would be valuable to store customer preferences and experiences in a way that the AI can access and take into account special needs and conditions.

One of the needs of employees is job security. Addressing employee fears of job loss is essential to prevent regrettable turnover. While it is projected that implementing an AI-based tool can reduce workload by solving known problems quickly, it needs to be communicated that this does not necessarily mean job disruption. If a tool like the proposed one is implemented, it will allow for better allocation of existing resources to serve customers. When simpler cases can be handled by an AI, higher qualified personnel will be required to maintain and train the AI tool and to take care of more

complex cases. It is important to note that the remaining staff should be highly qualified in order to create knowledge base articles that the AI can learn from.

To maintain a high skill level among employees, it is recommended to introduce a buddy system for newly hired FSE employees. This system would utilize the available time of DRS colleagues to assist FSE colleagues during their mentoring phase, allowing more experienced FSE colleagues to work more efficiently. This approach would enable DRS to remain up-to-date on newly occurring issues, while also freeing up resources in the field.

5.4 Proposed future process

5.4.1 Process of handling a customer request - NOW

Currently, fulfilling a customer's request entails several manual steps, including creation of a ticket (by entering all pertinent information such as contact information and a problem description), allocating a technician, providing a quote, and inputting the purchase order number received from the customer. Figure 9 shows a process flow chart of the current process.

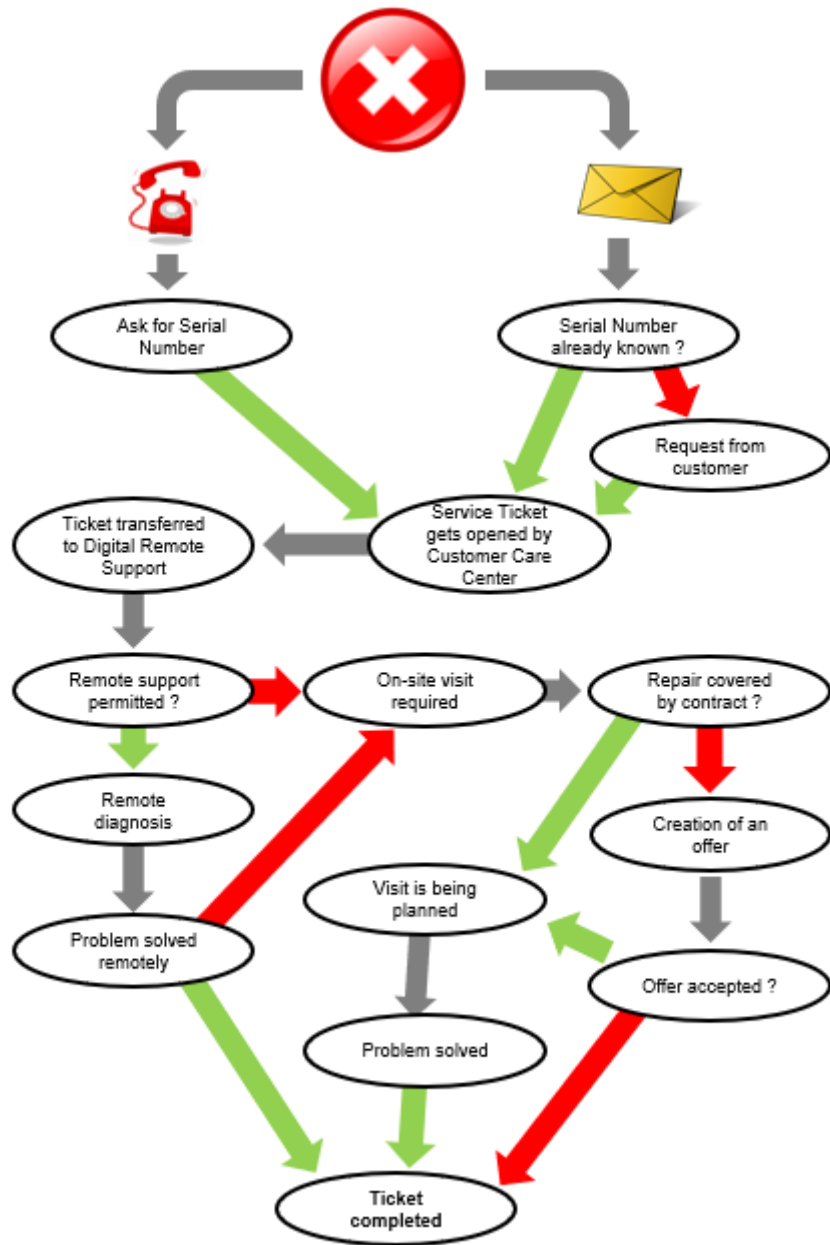


Figure 9: Process of handling a customer request - NOW (own illustration)

An instrument malfunction occurs and the customer contacts the customer call center either by phone or by email. The customer is automatically assigned to a customer service employee who speaks the national language of the instrument location. It is important to note, that all customer service employees also speak English, which is particularly useful in the academic sector where scientists from different countries often work at universities and may require support in English.

When customers use the hotline, they are asked for the serial number of their device during the call. However, customers may not always know where to find this information, which can cause delays in ticket creation. If customer service is contacted by email, this already can result in a considerable loss of time, as customer service must first consult with the customer to obtain the serial number.

If the device can be clearly identified, a service request ticket is created and assigned to a Digital Remote Support (DRS) employee who supports this product group in the local language. It is always possible to switch to English if needed.

The following step is to determine whether the customer permits remote access or if it is feasible according to the customer's company guidelines. If remote access is not permitted, the DRS employee will attempt to narrow down the issue by asking questions.

If the issue can be resolved remotely, the ticket will be marked as complete. If this is not possible, there are two possible scenarios:

- When the problem and solution are known, the DRS colleague will identify the necessary parts and estimate the repair time.
- If the problem is unknown, a FSE will need to perform a diagnostic visit.

It must be differentiated between contract customers and customers who are served on a time and material basis. Depending on the contract, the repair may be fully covered, or the customer may receive an agreed discount on a repair offer. If there is no contract, special discounts may apply. All discounts agreed with customers are stored in the CRM tool.

If there is existing contract coverage, a service call with a technician on site will be arranged immediately. However, if the required repair or diagnostic visit is not covered, the DRS employee will send a request to create the corresponding offer to the customer call center and they in turn will prepare the quote and send it to the customer. Since both steps currently require manual actions this further delays the repair process.

Once the offer has been accepted in writing, an on-site service visit can be scheduled. If the offer is not accepted, there are several options:

- The customer would like a (higher) discount:
A discount can only be granted after consultation with the service manager.

- The customer no longer wishes to have their device repaired due to its age, but requests an offer for a comparable new device:
This request will need to be forwarded to the sales representative.
- The customer expresses their desire to not proceed with the repair:
An employee should contact the customer to explore alternative options, such as purchasing a new device or finding an amicable solution.

All three options require human intervention on both ends. The customer call center needs to forward the tasks to the responsible employees, and they in turn need to perform specific tasks.

After an on-site service call has been carried out and the device has been restored, the ticket can be set to complete. Depending on the existing coverage, the customer may be billed for the call or this step may be omitted. Invoicing is still a manual process.

5.4.2 Process of handling a customer request - FUTURE

Chatbots can eliminate long waiting times caused by delays in manual customer support activities. Additionally, chatbots provide 24/7 support, by being available to customers at all times.

Figure 10 presents the process flow chart of the envisaged process to optimize customer service through the use of AI-powered chatbots and other AI-powered tools.

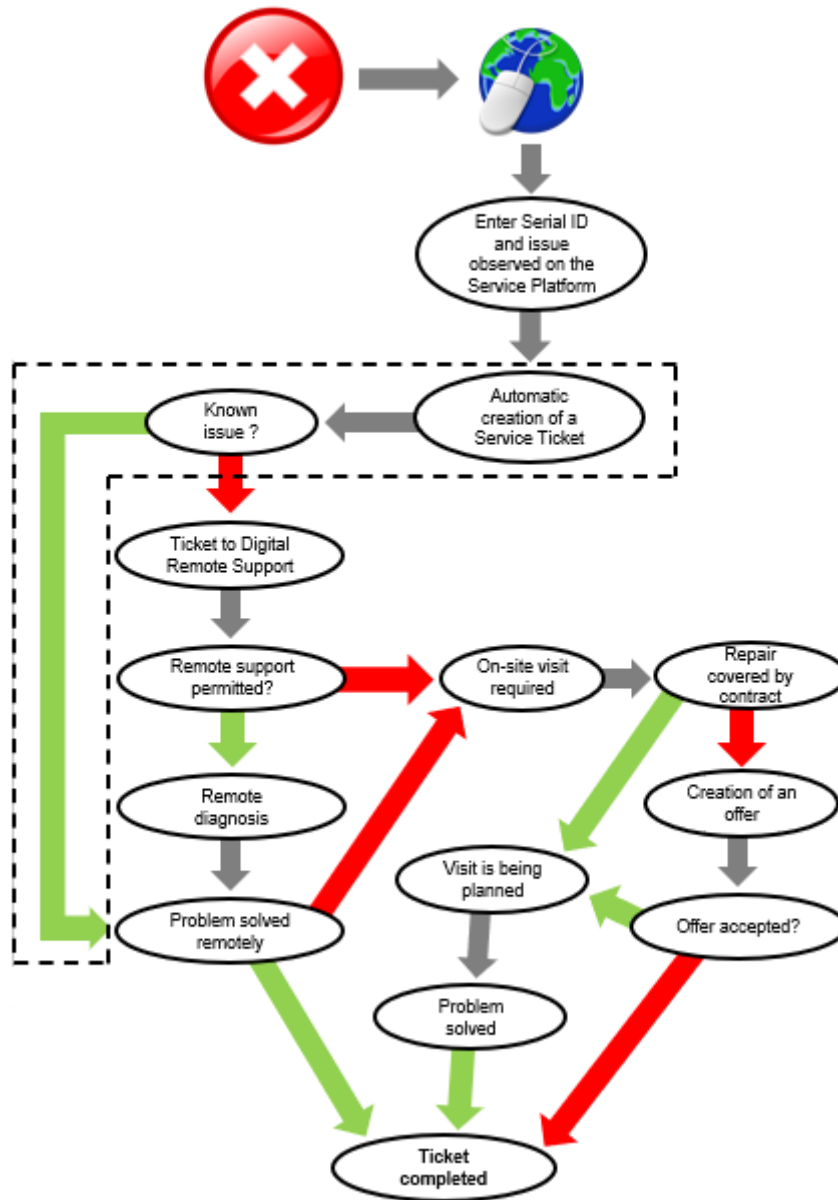


Figure 10: Process of handling a customer request - FUTURE (own illustration)

Instead of calling or emailing the customer call center, the customer accesses a service hub.

An automated query for the serial number eliminates the need for further queries from the call center. A service request ticket is automatically created to document the customer inquiry in the device history.

Ideally, an AI-powered chatbot can assist in resolving the problem by asking specific questions. If it is a known issue that the customer can solve themselves, the ticket can be set to complete after customer confirmation. If the issue is known but cannot

be resolved without on-site service, the chatbot can assign the request directly to a local service technician if there is contractual coverage. If there is no coverage, the chatbot can create an offer with the necessary spare parts and the estimated working time, applying the applicable discounts stored in the CRM.

If the chatbot is unable to find the solution on its own, the existing ticket is assigned to a DRS employee. The subsequent process follows the same steps as outlined in the previous chapter, with the difference that the previously mentioned manual processes are taken over by artificial intelligence.

Additional discount requests are handled through algorithms in the backend. If the customer declines the repair over the case is automatically transferred to a sales representative to contact the customer to discuss the option of a new instrument.

The use of AI will result in significant time savings and increased customer satisfaction.

5.4.3 Outlook

To enable *predicted corrective maintenances*, instruments would need to share data with the factories, in order for the readbacks and log files to be checked for anomalies. This way failures could be predicted and instrument downtime could be minimized. Additionally, this approach would result in seamless accessibility of data of healthy instruments, which currently is a challenge as stated in chapter 4.4 during discussion of an employee idea.

6 Conclusion

The present study has shown that the implementation of AI in technical support offers opportunities for cost reduction, improved efficiency, enhanced customer experiences, and greater scalability, due to the removal of time-consuming steps. However, it is of critical importance to strike a balance between automation and human touch, as certain complex or sensitive issues may still require human intervention and empathy.

Within the present thesis, a number of research questions have been addressed, which relate to quality and effectiveness of AI-generated responses, potential risks in relation to the use of AI-based technologies, integration possibilities, as well as potential change management approaches.

In relation to quality and effectiveness, the quantitative ratings derived from questionnaires suggest that the answers can be potentially helpful.

However, several risks need to be taken into consideration, such as data privacy and convincing misinformation.

These observations are in line with what has been reported earlier in literature, implying that the general information available about AI-based technologies can widely be applied to the specific task under investigation in this thesis.

During the research interviews conducted with ChatGPT, an intriguing observation was made regarding its tendency to provide distinct responses on each occasion. ChatGPT consistently offers subtly varied answers, occasionally even introducing novel suggestions. While this adaptability can be perceived as an advantageous aspect, as it might suggest that the answers improve over time, it may potentially pose challenges, particularly when customers – or users in general – seek consistency. The potential for customer confusion is increased by the variance in responses, particularly when a repeated question generates new or different options from the ChatGPT-powered Chatbot.

Additionally, ChatGPT appears to operate within a conversation-isolated framework, lacking the ability to retain prior interactions with customers. After a specific conversation concludes, ChatGPT seemingly erases any recollection of the previous exchange. This characteristic may have implications for maintaining context and continuity in customer interactions. Therefore, it requires further investigation and consideration in AI-driven customer support scenarios.

Tailoring the AI model to the specific purpose therefore seems to be an essential aspect to increase reliability and output quality.

In relation to the potential implementation into existing systems, the findings suggest that there are promising opportunities for AI-based language models to improve the efficiency and effectiveness of technical support services. The implementation into existing processes seems feasible and available solutions have the potential to seamlessly integrate into current frameworks.

However, especially the regards in relation to accuracy and reliability of AI-generated responses, as well as the potential for job displacement deserve thorough consideration.

The addition of AI-assistance to current process steps needs to be wisely chosen and thorough further research is needed to address present concerns as well as to fully understand the impact of AI on technical support services.

6.1 Final remarks

Although Schumpeter cannot have foreseen these recent developments, his concept of *creative destruction* fits quite well for the current developments in this field.

Diamond (2006) stated that *“the process of creative destruction, in both Schumpeter’s original, and in the more recent account, is a process in which technological advance is the main source of economic growth and improvements in the quality of life.”*

Currently, the integration of AI is one of the prime examples of *creative destruction*. It is important to keep up with this rapidly advancing technology in order to avoid being left behind.

However, with all its benefits, also the downsides have to be kept in mind. While AI *will* change the future of work, it is the task of humans to set the boundaries for how artificial intelligence can be used responsibly. Companies should therefore avoid trying to create the next unicorn and instead focus on keeping up with the latest trends.

Bibliography

- Abu Daqar, M.A.M. / Smoudy, A.K.A. (2019): The Role of Artificial Intelligence on Enhancing Customer Experience. In: *International Review of Management and Marketing*. 9 (4), pp. 22-31.
- Agarwal, A. (2023): The Origins of ChatGPT and InstructGPT. <https://dzone.com/articles/the-origins-of-chatgpt-and-instructgpt> – last verified on December 17, 2023)
- Anyoha, R. (2017): Can Machines Think?. <https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/> – last verified on December 12, 2023)
- Armistead, C.G. / Clark, G. (1992). Customer Service and Support: Implementing Effective Strategies. Financial Times Series – Pitman
- Askill, A. / Bai, Y. / Chen, A. / Drain, D. / Ganguli, D. / Henighan, T.J. / Jones, A. / Joseph, N. / Mann, B. / DasSarma, N. / Elhage, N. / Hatfield-Dodds, Z. / Hernandez, D. / Kernion, J. / Ndousse, K. / Olsson, C. / Amodei, D. / Brown, T.B. / Clark, J. / McCandlish, S. / Olah, C. / Kaplan, J. (2021). A General Language Assistant as a Laboratory for Alignment. <https://doi.org/10.48550/arXiv.2112.00861>
- Bahdanau, D. / Cho, K. / Bengio, Y. (2014): Neural Machine Translation by Jointly Learning to Align and Translate. <https://arxiv.org/abs/1409.0473> – last verified on December 12, 2023)
- Beer, M. / Nohria, N. (2000): Cracking the code of change. In: *Harvard Business Review*. 78 (3), pp.133-141.
- Brockman, G. / Sutskever, I. (2015): Introducing OpenAI. <https://openai.com/blog/introducing-openai> – last verified on December 16, 2023
- Brockman, G. / Murati, M. / Welinder, P. (2020): OpenAI API. <https://openai.com/blog/openai-api> – last verified on December 16, 2023
- Business Strategy (2022): The 6 Best Change Management Models for Your Company. <https://councils.forbes.com/blog/top-change-management-models> – last verified on December 29, 2023

- Chakrabarti, C. / Luger, G.F. (2015): Artificial conversations for customer service chatter bots: Architecture, algorithms, and evaluation metrics. In: *Expert Systems with Applications*. 42, pp. 6878-6897.
- Chi, O.H. / Denton, G. / Gursoy, D. (2020): Artificially intelligent device use in service delivery: A systematic review, synthesis, and research agenda. In: *Journal of Hospitality Marketing & Management*, 29 (7), pp. 757-786.
- Chong, T. / Yu, T. / Keeling, D.I. / de Ruyter, K. (2021): AI-chatbots on the services frontline addressing the challenges and opportunities of agency. In: *Journal of Retailing and Consumer Services*. 63, 102735.
- Clark, S. (2020): 5 Ways Chatbots Improve Employee Experience. <https://www.reworked.co/employee-experience/5-ways-chatbots-improve-employee-experience/> – last verified on December 11, 2023
- Council of Europe: History of Artificial Intelligence. <https://www.coe.int/en/web/artificial-intelligence/history-of-ai> – last verified on December 12, 2023
- Davenport, T.H. / Ronanki, R. (2018): Artificial Intelligence for the Real World. In: *Harvard Business Review*. 96 (1), pp. 108-116.
- De Keyser, A. / Köcher, S. / Alkire (néé Nasr), L. / Verbeeck, C. / Kandampully, J. (2019): Frontline Service Technology infusion: conceptual archetypes and future research directions. In: *Journal of Service Management*. 30 (1), pp. 156-183.
- Deng, L. / Liu, Y. (Eds.) (2018): *Deep Learning in Natural Language Processing*. Springer, Singapore.
- Diamond, A.M. (2006): Schumpeter's Creative Destruction: A Review of the Evidence. In: *Journal of Private Enterprise*. 22 (1), pp. 120-146.
- Digital Minds BPO (2021): Technical Support (Tech Support). <https://digitalmindsbpo.com/glossary/technical-support-tech-support/> – last verified on December 12, 2023
- Drift (2018): The 2018 state of chatbots report: How chatbots are reshaping online experiences. <https://www.drift.com/blog/Chatbots-report/> – last verified on December 11, 2023
- Du Toit, G. / Anderson, J. / Hatherall, R. (2020): Customer Experience Tools and Trends: Let No Tool Stand Alone. <https://www.bain.com/insights/customer->

experience-tools-and-trends-2020-let-no-tool-stand-alone/ – last verified on March 16, 2023

Fernandes, S. / Carvalho, F. / Neves, D. (2023): The Change Potential of Social Media: Learning From Digital Business Cases. In K.L. Tennin (Ed.), *Change Management During Unprecedented Times*. IGI Global, Pennsylvania, USA. p.79.

Gillis, A.S. / Petersson, D. (2023): 4 main types of artificial intelligence: Explained. <https://www.techtarget.com/searchenterpriseai/tip/4-main-types-of-AI-explained> – last verified on December 12, 2023

Goffin, K. / New, C. (2001): Customer support and new product development: An exploratory study. In: *International Journal of Operations & Production Management*. 21 (3), pp. 275-301.

Goti, A. / Querejeta-Lomas, L. / Almeida, A. / de la Puerta, J.G. / López-de-Ipiña, D. (2023): Artificial Intelligence in Business-to-Customer Fashion Retail: A Literature Review. In: *Mathematics*, 11 (13), 2943.

Grudin, J. / Jacques, R. (2019): Chatbots, Humbots, and the Quest for Artificial General Intelligence. In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*, Association for Computing Machinery, New York, NY, USA. 209, pp. 1-11. <https://doi.org/10.1145/3290605.3300439>

Güttel, W.H. / Link, K. / Leitner, G. (2021): Führung in Veränderungsprozessen: Sinn, Motivation und Selbststeuerung. In W.H. Güttel (Ed.), *Erfolgreich in turbulenten Zeiten* (3rd ed., pp. 265-287). Nomos, Baden-Baden, Deutschland.

Gui, J. / Sun, Z. / Wen, Y. / Tao, D. / Ye, J. (2023): A Review on Generative Adversarial Networks: Algorithms, Theory, and Applications. In: *IEEE Transactions on Knowledge & Data Engineering*. 35 (4), pp. 3313-3332.

Gupta, A. (2021): 5 Key Trends from 2021's Hype Cycle for Customer Service and Support Technologies. <https://www.gartner.com/en/articles/5-key-trends-from-2021-s-hype-cycle-for-customer-service-and-support-technologies> – last verified on March 16, 2023

Harris, A. (1967): Judicial Decision Making and Computers. In: *Villanova Law Review*. 12, pp. 272-312.

Haugeland, I.K.F. / Følstad, A. / Taylor, C. / Bjørkli, C.A. (2022): Understanding the user experience of customer service chatbots: An experimental study of chatbot

interaction design. In: *International Journal of Human - Computer Studies*. 161, 102788.

Hiatt, J.M. (2006): *ADKAR: a model for change in business, government and our community*. 1st ed., Prosci Learning Center Publications, Loveland, CO, USA.

Hicks, K. (2022): Top 8 change management models: A comparison guide. <https://www.zendesk.com/blog/change-management-models/> – last verified on December 29, 2023

Hill, J. / Ford, W.R. / Farreras, I.G. (2015): Real conversations with artificial intelligence: A comparison between human–human online conversations and human–chatbot conversations. In: *Computers in Human Behavior*. 49, pp. 245-250.

IBM Data and AI Team (2023): Understanding the different types of artificial intelligence. <https://www.ibm.com/blog/understanding-the-different-types-of-artificial-intelligence/> – last verified on December 12, 2023

Karpathy, A. / Abbeel, P. / Brockman, G. / Chen, P. / Cheung, V. / Duan, Y. / Goodfellow, I. / Kingma, D. / Ho, J. / Houthoof, R. / Salimans, T. / Schulman, J. / Sutskever, I. / Zaremba, W. (2016): Generative models. <https://openai.com/research/generative-models> – last verified on December 12, 2023

Klopfenstein, L.C. / Delpriori, S. / Malatini, S. / Bogliolo, A. (2017): The Rise of Bots: A Survey of Conversational Interfaces, Patterns, and Paradigms. In: *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS 2017)*, Association for Computing Machinery, New York, NY, USA, pp. 555-565. <https://doi.org/10.1145/3064663.3064672>

Kochhar, K. / Purohit, H. / Chutani, R. (2019): The rise of artificial intelligence in banking sector. In: *The 5th International Conference on Educational Research and Practice (ICERP) 2019*, pp. 127-135.

Kotter, J.P. (2007): *Leading change: Why transformation efforts fail*. Routledge, Milton Park, Oxfordshire, England.

Kotter, J. P. / Schlesinger, L. A. (2008): Choosing Strategies for Change. In: *Harvard Business Review*. 86 (3), pp. 95-103.

- Lallemand, C. / Gronier, G. / Koenig, V. (2015): User Experience: A concept without consensus? Exploring practitioners' perspectives through an international survey. In: *Computers in Human Behavior*, 43, pp. 35-48.
- Lanxon, N. / Bass, D. / Davalos, J. (2023): A Cheat Sheet to AI Buzzwords and Their Meanings. https://www.washingtonpost.com/business/2023/03/10/glossary-of-ai-terms-meaning-of-gpt-openai-machine-learning-chatbots/3c8a59d8-bf44-11ed-9350-7c5fccd598ad_story.html – last verified on December 12, 2023
- Li, Y. / Hu, C. / Huang, C. / Duan, L. (2017): The concept of smart tourism in the context of tourism information services. In: *Tourism Management*. 58, 293-300.
- Liddy, E.D. (2001): Natural Language Processing. In: *Encyclopedia of Library and Information Science*, 2nd ed., Marcel Decker, New York, NY, USA.
- Loomba, A.P.S. (1998): Product distribution and service support strategy linkages: An empirical validation. In: *International Journal of Physical Distribution & Logistics Management*. 28 (2), pp. 143-161.
- Manyika, J. / Chui, M. / Bughin, J. / Dobbs, R. / Bisson, P. / Marrs, A. (2013): Disruptive technologies: Advances that will transform life, business, and the global economy.
https://www.mckinsey.com/~media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/disruptive%20technologies/mgi_disruptive_technologies_full_report_may2013.ashx – last verified on December 18, 2023
- McCorduck, P. (2004): *Machines Who Think*. 2nd ed., A K Peters, Natick, MA, USA
- Mesnil, G. / He, X. / Deng, L. / Bengio, Y. (2013): Investigation of recurrent-neural-network architectures and learning methods for spoken language understanding. In: *Interspeech*. 2013, pp. 3771-3775.
- Nasr, M. / Carlini, N. / Hayase, J. / Jagielski, M. / Cooper, A.F. / Ippolito, D. / Choquette-Choo, C.A. / Wallace, E. / Tramèr, F. / Lee, K. (2023): Scalable Extraction of Training Data from (Production) Language Models. arXiv preprint <https://arxiv.org/abs/2311.17035> – last verified on December 29, 2023
- Needle, F. (2023): The State of AI in Customer Service [New Data]. https://blog.hubspot.com/service/state-of-ai-in-service?__hstc=62733299.c1ff9dd83d80148d7dba7d482c15b5b3.1702331702387.1702331702387.1702331702387.1&__hssc=62733299.2.1702331702387&__hsfp=2754922396&hubs_content=blog.hubspot.com%2Fservice%2Fstat

e-of-ai-in-service&hubs_content-cta=-medium – last verified on December 11, 2023

Neumeister, L. (2023): Lawyers blame ChatGPT for tricking them into citing bogus case law. <https://apnews.com/article/artificial-intelligence-chatgpt-courts-e15023d7e6fdf4f099aa122437dbb59b> – last verified on December 16, 2023

OpenAI (2022): Introducing ChatGPT. <https://openai.com/blog/chatgpt> – last verified on December 16, 2023

OpenAI (2023a): What is ChatGPT?. <https://help.openai.com/en/articles/6783457-what-is-chatgpt> – last verified on December 18, 2023

OpenAI (2023b): Privacy Policy. <https://openai.com/policies/privacy-policy> – retrieved on May 20, 2023

Ouyang, L. / Wu, J. / Jiang, X. / Almeida, D. / Wainwright, C.L. / Mishkin, P. / Zhang, C. / Agarwal, S. / Slama, K. / Ray, A. / Schulman, J. / Hilton, J. / Kelton, F. / Miller, L. / Simens, M. / Askell, A. / Welinder, P. / Christiano, P. / Leike, J. / Lowe, R. (2022): Training language models to follow instructions with human feedback. In: *Advances in Neural Information Processing Systems*, 35, pp. 27730-27744.

Panetta, K. (2016): The ABC Technologies Will Change Future Customer Experience. <https://www.gartner.com/smarterwithgartner/the-abc-technologies-will-change-future-customer-experience> – last verified on March 16, 2023

Perez, M. (2020): Technical Support vs Customer Service: What's the Difference?. <https://www.momentcrm.com/blog/technical-support-vs-customer-service/> – last verified on December 12, 2023

Pilipiszyn, A. (2021): GPT-3 powers the next generation of apps. <https://openai.com/blog/gpt-3-apps> – last verified on December 16, 2023

Press, G. (2019): AI Stats News: 86% Of Consumers Prefer Humans To Chatbots. <https://www.forbes.com/sites/gilpress/2019/10/02/ai-stats-news-86-of-consumers-prefer-to-interact-with-a-human-agent-rather-than-a-chatbot/> – last verified on December 11, 2023

Prosci (2023): Methodology: The Prosci ADKAR Model: Organizational change requires individual change. <https://www.prosci.com/methodology/adkar> – last verified on December 29, 2023

- Rapp, A. / Curti, L. / Boldi, A. (2021): The human side of human-chatbot interaction: A systematic literature review of ten years of research on text-based chatbots. In: *International Journal of Human-Computer Studies*, 151 (3), 102630.
- Russell, S.J. / Norvig, P. (2010): *Artificial Intelligence: A Modern Approach*. 3rd ed., Pearson, Upper Saddle River, New Jersey, USA.
- Saygin, A.P. / Cicekli, I. / Akman, V. (2000): Turing Test: 50 Years Later In: *Minds and Machines*. 10 (4), pp. 463-518.
- Srinivasan, K. / Nguyen, C. / Tanguturi, P. (2018): Chatbots are here to stay. Accenture Digital. <https://www.oxfordeconomics.com/publication/open/300032> – last verified on December 12, 2023
- Suleyman, M. / Bhaskar, M. (2023). *The Coming Wave: Technology, Power, and the Twenty-first Century's Greatest Dilemma*. Crown, New York, NY, USA.
- Sun, K. / Moon, S. / Crook, P. / Roller, S. / Silvert, B. / Liu, B. / Wang, Z. / Liu, H. / Cho, E. / Cardie, C. (2021): Adding Chit-Chat to Enhance Task-Oriented Dialogues. In: *Proceedings of the 2021 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pp. 1570–1583.
- Suthar, S. (2020): 13 Best AI-Powered Chatbots to Skyrocket Your Sales. <https://thenextscoop.com/ai-powered-chatbots-to-skyrocket-sales/> – last verified on December 11, 2023
- Turing, A.M. (1950): Computing Machinery and Intelligence. In: *Mind*. 59 (236), pp. 433-460.
- Van Noorden, R. / Webb, R. (2023): ChatGPT: Boon and burden?. In: *Nature*. 624, p. 509. <https://doi.org/10.1038/d41586-023-03930-6>
- Walters, W.H. / Wilder, E.I. (2023): Fabrication and errors in the bibliographic citations generated by ChatGPT. In: *Scientific Reports*. 13, 14045.
- Wikipedia contributors (2023): Deep Blue (chess computer). [https://en.wikipedia.org/w/index.php?title=Deep_Blue_\(chess_computer\)&oldid=1182544026](https://en.wikipedia.org/w/index.php?title=Deep_Blue_(chess_computer)&oldid=1182544026) – last verified on December 12, 2023
- Williams, R. (2019): Study: Chatbots to drive \$112B in retail sales by 2023. <https://www.marketingdive.com/news/study-chatbots-to-drive-112b-in-retail-sales-by-2023/554416/> – last verified on December 11, 2023

- Yu, KH. / Beam, A.L. / Kohane, I.S. (2018): Artificial intelligence in healthcare. In: *Nature Biomedical Engineering*, 2(10), pp. 719-731.
- Yu, D. / Deng, L. (2015): *Automatic Speech Recognition: A Deep Learning Approach*. Springer, London, UK.
- Zhai, X. / Chu, X. / Chai, C.S. / Jong, M.S.Y. / Istenic, A. / Spector, M. / Liu, JB. / Yuan, J. / Li, Y. (2021): A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. In: *Complexity*, 2021, pp. 1-18.

List of abbreviations

AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
CRM	Customer Relationship Management
CX	Customer Experience
DRS	Digital Remote Support
EMEA	Europe, the Middle East and Africa
ERP	Enterprise Resource Planning
FSE	Field Service Engineer
GPT	Generative Pre-trained Transformer
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICP-OES	Inductively Coupled Plasma Optical Emission Spectroscopy
KPI	Key Performance Indicators
ML	Machine Learning
NLP	Natural Language Processing
RLHF	Reinforcement Learning from Human Feedback
SOP	Standard Operating Procedure
VR	Virtual Reality
XR	Extended Reality

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Appendices

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Appendix A – Answers to Survey Part 1 – Questions 1, 2 & 3

Participant	1. Age-range	2. What are your first thoughts when you hear the term "artificial intelligence"?	Assigned Category	3. Familiarity with AI (1 = Not familiar at all 4 = Very familiar)
DRS 1	40 - 50 years	Future, science fiction movies....	Neutral	3
DRS 2	30 - 40 years	Something that can replace human activities	Neutral	2
DRS 3	40 - 50 years	using computers to do things that traditionally require human intelligence	Neutral	2
DRS 4	40 - 50 years	content creation : texts, images, art, softwares in autonomy	Neutral	2
DRS 5	30 - 40 years	Improvement of the actual processes all around us. Deep learning.	Positive	4
FSE 1	50 - 60 years	Opportunities and scary unknown stuff	Undecided	3
FSE 2	40 - 50 years	Great !	Positive	3
FSE 3	30 - 40 years	Job disruption	Negative	3
FSE 4	30 - 40 years	The future! Computerised systems performing tasks that humans once did/still do, at a faster rate	Positive	3
FSE 5	younger than 30 years	Chat GPT	Neutral	2
FSE 6	older than 60 years	A potentially powerful tool that could be used in advanced research.	Positive	2
FSE 7	40 - 50 years	Some sort of mix between mechanical and informatics entity that is able to learn form their experience, and that has been created by a human intelligence	Neutral	2

Appendix B – Answers to Survey Part 1 – Questions 4 & 5

Participant	4. Do you perceive AI more as an opportunity or as a threat? → 5. Why did you select this option?	
DRS 1	Opportunity	Don't believe AI itself can be dangerous, of course some people can use it in the wrong way, but we can't blame the AI
DRS 2	I'm unsure	I see it as an opportunity when used wisely and when it helps simplifying some procedures or activities in the human society. I see it as a threat if human beings will be replaced (eg. losing their jobs) as no longer needed for certain tasks or if we have no control on the AI results that might be wrong.
DRS 3	Opportunity	better speed in doing accounts, stats, finding, predicting things
DRS 4	I'm unsure	nothing is Good or Bad. it always depend the way you use it for you or relatively to the others.
DRS 5	Opportunity	I think we can do a lot of things faster and better with AI in a lot of different fields (medical, social, agriculture, science etc)
FSE 1	Opportunity	AI is clear the future if used correctly
FSE 2	Opportunity	It helps me to get the basics of something unknown. Then I can improve it
FSE 3	Threat	Job disruption is real
FSE 4	Opportunity	I see it as progress, a part of evolution as we have continued to do over the centuries humans have been the dominant species on the planet
FSE 5	I'm unsure	I saw people using Chat GPT and it seem to be very helpful. But i am unsure what happens to your data when you enter things in Chat GPT.
FSE 6	Opportunity	As above, I feel it could be used to assist in research to achieve goals more efficiently.
FSE 7	Opportunity	This is something new and powerful that as all the things may be used in a positive way and a negative way, I see this topic as an opportunity to create positive things.

Appendix C – Answers to Survey Part 1 – Questions 6 to 12

Participant	6. Personal usage	7. Business or private	8. Daily use?	9. How are you using AI and what for?	10. Heard of "ChatGPT"?	11. Tried "ChatGPT"?	12. Associated words
DRS 1	No	-	-	-	Yes	No	Fun Chance
DRS 2	Yes	Both	Yes	Business: software-based assignment tool to determine the best match engineer to be assigned for a service job Personal: navigation, facial recognition, digital assistants (eg. alexa, chatboxes..)	No	-	-
DRS 3	No	-	-	-	Yes	No	Chance Risk
DRS 4	No	-	-	-	Yes	No	Risk Chance
DRS 5	Yes	Private	Yes	Photo retouching, picture edition, text creation (chat GPT)	Yes	Yes	Chance Fun
FSE 1	No	-	-	-	Yes	Yes	Fun Chance
FSE 2	Yes	Private	Yes	Programming imaging security	Yes	Yes	Chance Fun
FSE 3	Yes	Private	No	N/A	Yes	Yes	Risk
FSE 4	Yes	Private	No	This is becoming a common feature on online chat "bots" when customer service is required	Yes	No	Risk
FSE 5	No	-	-	-	Yes	No	Fun Risk
FSE 6	No	-	-	-	Yes	No	Chance
FSE 7	No	-	-	-	No	-	-

Appendix D – Answers to Survey Part 2 – Questions 22, 23, 25, 26 and 28

Participant	22. How do you perceive the impact of AI on the future of TechSupport? (1 Extremely positive 5 Extremely negative)	23. Have you personally used AI-powered tools or systems in your TechSupport role? (Yes No Maybe)	25. How do you perceive the risk of AI replacing your job in technical support? (1 No risk at all 5 Significant risk)	26. How do you anticipate your work would change with the implementation of AI in technical support? (1 No change at all 5 Major changes)	28. How likely do you believe the implementation of AI in technical support would create new opportunities for career growth and skill development? (1 Not likely at all 5 Very likely)
DRS 1	3	No	3	4	2
DRS 2	4	No	4	5	2
DRS 3	2	No	5	3	4
DRS 4	4	No	2	4	3
DRS 5	2	No	2	3	3
FSE 1	2	No	1	4	2
FSE 2	4	No	5	5	1
FSE 3	5	No	5	2	1
FSE 4	3	No	1	3	2
FSE 5	4	No	2	2	2
FSE 6	3	No	2	2	3
FSE 7	2	No	3	3	3

Appendix E – Answers to Survey Part 2 – Question 24

Participant	24. What is your overall perception of AI's potential in improving technical support? In your opinion, what are the potential benefits of incorporating AI into TechSupport processes? What concerns, if any, do you have about the use of AI in TechSupport? Feel free to share your thoughts!
DRS 1	Automatic and immediate replies to customer questions/concerns/problems, and this can be both a benefit to help the tech support colleague and also a concern, as the AI can reply to several customers questions without the need of a tech support specialist
DRS 2	Benefit: AI can certainly help with workload but there should always be a person double checking and correcting the results generated. Concern: risk that companies will cut personnel or add work to personnel as more automation is developed rather than facilitating the job or reducing the workload.
DRS 3	it will certainly help technical support at the expense of employees who will be less and less useful. Fewer and fewer specialized people and lower salaries. The benefits will be better response in terms of timing, a huge data database... such as C4S and part predict... and better development of ideas and concepts given the speed in processing data.
DRS 4	AI is really depending of the initial input, and at this time the vocabulary of customers is really poor, so it could be very difficult to understand them with few sentences. I always have to ask questions in order to fully understand what the customer would like to ask me. i doubt a computer will able to take care of customer's words. in another way, AI could maybe be really interesting going into log files, or instrument parameters in order to show us what could be wrong on the instrument. everything depends on the initial data and the robustness of this data. you can not say to a doctor : i'm ill and expect an answer, you'll get questions in order to determine what you really feel !!
DRS 5	I think it could save us a lot of time with minor issue but we have to keep AI for document processing or editing, for tickets handling and administrative stuff. The human communication with the customer must remains essential. Moreover the data provided by the customer are often not precise.

FSE 1	AI is great for stand technical support, but it only works good if the question or concern is explained very specific. If the error could be due to several things in combination, the customer might be send down the wrong track. Personally I hate AI robots trying to assist with IT, phone or travel assistance. It takes to much time if not all clear explained - and sometimes it is difficult to explain in writing. The personal relation with the customer gets lost. If customers are to communicate with robots the service provider can be anyone. AI is clearly the future for a lot of things, but relations and direct communication as talking will still be the way of building trustful relations
FSE 2	Ai can rapidly check the system for contamination
FSE 3	Job disruption
FSE 4	AI may be able to filter out the easier support calls, avoiding wasting resources on minor issues. However, properly trained customers should be checking most of the things that an AI would suggest as they should theoretically be limited to quite "basic" support
FSE 5	Positive: A Central knowledge that answers doesnt depend on the person you ask. Negative Replacing Jobs by AI
FSE 6	It's a good start for answering Customers queries. It may give suggestions that a Customer hasn't considered and so save time or the involvement of a FSE. It doesn't (cannot) take into account individual Customer's knowledge or experience.
FSE 7	I'm not happy to implement AI in Tech support, they may do our job and our presence in company may not be needed anymore. Customer may need the feeling to contacting a person not a machine, the feeling of attention and care by customer is different. Potential benefit, reduce the not correct info diffusion. The info thought to AI must be correct otherwise AI will give wrong info or suggestions.

Appendix F – Answers to Survey Part 2 – Question 27

Participant	27. How do you expect your time allocation in technical support to change with the implementation of AI? (Multiple selection allowed: I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements. There would be no significant change in my time allocation. I would have less time due to additional responsibilities related to AI implementation. Other (free text))
DRS 1	I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements.
DRS 2	There would be no significant change in my time allocation. <i>see above answer 24</i>
DRS 3	I would have more time to concentrate on complex cases. <i>in the beginning, I would have more time to concentrate on complex cases, after that I would have less time due to additional responsibilities related to AI implementation.</i> I would have less time due to additional responsibilities related to AI implementation.
DRS 4	There would be no significant change in my time allocation.
DRS 5	I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements.
FSE 1	I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements.
FSE 2	<i>It will completely take over tech support</i>
FSE 3	<i>Other</i>
FSE 4	I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements
FSE 5	<i>Hard to say, maybe more time because the simple cases are handled by AI, but if i have to assist with the implementation i would have less time for my work</i>
FSE 6	I would have more time to concentrate on complex cases. I would have more time for strategic initiatives and process improvements.
FSE 7	I would have less time due to additional responsibilities related to AI implementation. I would have more time to concentrate on complex cases.

Appendix G – Comparison English vs. German – Scenario 1 – Take 1

<p>Input: How can I clean the sample introduction of my ICP-OES instrument?</p>	<p>Eingabe: Wie kann ich die Probenzufuhr meines ICP-OES-Geräts reinigen?</p>
<p>Cleaning the sample introduction system of an ICP-OES (Inductively Coupled Plasma Optical Emission Spectroscopy) instrument is an important maintenance task to ensure accurate and reliable results. Here's a step-by-step guide on how you can clean the sample introduction system:</p> <ol style="list-style-type: none"> 1. Safety precautions: Before starting the cleaning process, make sure to wear appropriate personal protective equipment (PPE), including gloves, safety glasses, and a lab coat, to protect yourself from any hazardous chemicals. 2. Rinse with deionized water: Begin by rinsing the sample introduction system with deionized water to remove any residual sample or contaminants. This step helps prevent cross-contamination between samples. 3. Acid cleaning: Prepare a cleaning solution by diluting a suitable acid, such as nitric acid (HNO₃) or hydrochloric acid (HCl), with deionized water. The specific acid and concentration may depend on the nature of your samples. Consult the instrument manual or your laboratory's standard operating procedures (SOPs) for guidance. 4. Disconnect the sample introduction components: Depending on the design of your ICP-OES instrument, disconnect the relevant components of the sample introduction system. This typically includes the nebulizer, spray chamber, and torch injector. Consult the instrument manual for specific instructions on how to remove these components. 5. Soak the components: Place the disconnected components into a container or beaker containing the prepared acid cleaning solution. Ensure that the components are fully submerged. 	<p>Die Reinigung der Probenzufuhr eines ICP-OES-Geräts (Inductively Coupled Plasma Optical Emission Spectrometer) ist wichtig, um die Genauigkeit der Analyse und die Lebensdauer des Instruments sicherzustellen. Hier sind einige Schritte, die Sie befolgen können, um die Probenzufuhr zu reinigen:</p> <ol style="list-style-type: none"> 1. Sicherheitsvorkehrungen treffen: <ul style="list-style-type: none"> • Tragen Sie geeignete persönliche Schutzausrüstung, einschließlich Handschuhe und Laborkittel. • Stellen Sie sicher, dass das ICP-OES-Gerät ausgeschaltet und abgekühlt ist, bevor Sie mit der Reinigung beginnen. 2. Probenahmeeinrichtungen entfernen: <ul style="list-style-type: none"> • Entfernen Sie alle Teile der Probenahmeeinrichtung, einschließlich der Probenkammern, Injektionsnadeln, Schläuche und anderer Zubehörteile. Achten Sie darauf, diese Teile vorsichtig zu behandeln, da sie empfindlich sein können. 3. Reinigungslösung vorbereiten: <ul style="list-style-type: none"> • Bereiten Sie eine geeignete Reinigungslösung vor. Dies kann eine verdünnte Säure wie Salpetersäure sein. Die genaue Zusammensetzung hängt von den zu analysierenden Proben ab. Konsultieren Sie die Instrumentenanleitung oder Ihren Vorgesetzten für spezifische Empfehlungen. 4. Reinigen der Probenzufuhr: <ul style="list-style-type: none"> • Tauchen Sie die Probenahmeeinrichtungen in die vorbereitete Reinigungslösung ein und lassen Sie sie für eine angemessene

6. Ultrasonic cleaning (optional): If available, you can enhance the cleaning process by using an ultrasonic bath. Submerge the components in the ultrasonic bath filled with the acid cleaning solution and operate it according to the manufacturer's instructions. The ultrasonic waves help dislodge stubborn deposits and contaminants.
7. Rinse with deionized water: After soaking the components in the acid cleaning solution, thoroughly rinse them with deionized water to remove any remaining acid and contaminants. Repeat this rinsing step multiple times to ensure complete removal of the cleaning solution.
8. Reassemble the sample introduction system: Once the components are clean and rinsed, reassemble the sample introduction system carefully, ensuring proper connections and alignment.
9. Perform a blank run: Before analyzing any samples, run a blank solution (typically deionized water) through the sample introduction system to ensure that it is free from any residual contaminants or cleaning agents. This step helps establish a baseline and ensures accurate measurements.
10. Regular maintenance: To maintain the cleanliness of the sample introduction system, it is recommended to perform routine cleaning at regular intervals or as specified in your laboratory's SOPs. Regularly inspect the components for any signs of wear or damage and replace them as necessary.

Remember to always consult the instrument manual and follow the specific cleaning instructions provided by the manufacturer. Additionally, adhere to your laboratory's safety protocols and guidelines when handling hazardous chemicals and operating the ICP-OES instrument.

Zeit (normalerweise einige Stunden) einweichen, um Ablagerungen und Verunreinigungen zu lösen.

- Verwenden Sie eine weiche Bürste oder einen Ultraschallreiniger, um hartnäckige Ablagerungen zu entfernen.
- Spülen Sie die gereinigten Teile gründlich mit deionisiertem Wasser, um alle Reste der Reinigungslösung zu entfernen.

5. Trocknen und Montieren:

- Lassen Sie die gereinigten Teile vollständig trocknen, bevor Sie sie wieder zusammenbauen und in das ICP-OES-Gerät einsetzen.

6. Funktionstest:

- Führen Sie nach der Montage einen Funktionstest durch, um sicherzustellen, dass die Probenzufuhr korrekt funktioniert.

7. Regelmäßige Wartung:

- Führen Sie regelmäßig Reinigungs- und Wartungsarbeiten gemäß den Empfehlungen des Herstellers durch, um die langfristige Leistung des ICP-OES-Geräts sicherzustellen.

Es ist wichtig, die spezifischen Anweisungen und Empfehlungen des Herstellers für Ihr ICP-OES-Gerät zu beachten, da sich die Reinigungsanforderungen je nach Modell und Anwendungsfall unterscheiden können. Darüber hinaus sollten Sie die Sicherheitsrichtlinien und Vorschriften in Ihrem Labor befolgen, um sich und andere vor Gefahren zu schützen.

Appendix H – Comparison English vs. German – Scenario 1 – Take 2

<p>Input: How can I clean the sample introduction of my ICP-OES instrument?</p>	<p>Eingabe: Wie kann ich die Probenzufuhr meines ICP-OES-Geräts reinigen?</p>
<p>Cleaning the sample introduction system of your ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry) instrument is crucial for maintaining its performance and accuracy. Here are general steps you can follow to clean the sample introduction system:</p> <ol style="list-style-type: none"> 1. Rinse with Solvent: <ul style="list-style-type: none"> • Start by rinsing the system with a suitable solvent, such as deionized water or a solvent recommended by the instrument manufacturer. • Ensure that the solvent is free from any contaminants that could interfere with your analysis. 2. Soak in Detergent Solution: <ul style="list-style-type: none"> • Prepare a mild detergent solution and soak the components of the sample introduction system, such as the nebulizer, spray chamber, and tubing. • Let them soak for an appropriate amount of time to allow the detergent to break down any residue. 3. Ultrasonic Cleaning: <ul style="list-style-type: none"> • If available, use an ultrasonic cleaner to further remove any stubborn deposits. This can be particularly effective for small, intricate parts. • Follow the manufacturer's guidelines for using an ultrasonic cleaner and ensure that the components are compatible with this cleaning method. 4. Rinse Thoroughly: <ul style="list-style-type: none"> • After soaking or ultrasonic cleaning, rinse all components thoroughly with deionized water or the recommended solvent to remove any remaining detergent or contaminants. 	<p>Die Reinigung der Probeneinführung bei einem ICP-OES (Inductively Coupled Plasma Optical Emission Spectroscopy) Gerät ist wichtig, um eine präzise und zuverlässige Analyse sicherzustellen. Hier sind einige allgemeine Schritte, die du befolgen kannst, um die Probeneinführung zu reinigen:</p> <p>Hinweis: Stelle sicher, dass du die spezifischen Anweisungen des Herstellers für dein ICP-OES-Gerät beachtest, da die genauen Verfahren variieren können.</p> <ol style="list-style-type: none"> 1. Ausspülen mit Lösungsmitteln: <ul style="list-style-type: none"> • Spüle die Probeneinführung mit hochreinem Lösungsmittel wie deionisiertem Wasser oder einer speziellen Reinigungslösung, um Verunreinigungen zu entfernen. 2. Ultraschallreinigung: <ul style="list-style-type: none"> • Verwende bei Bedarf einen Ultraschallreiniger, um Ablagerungen und Partikel zu lösen. Dies kann besonders effektiv sein, um schwer zu erreichende Stellen zu reinigen. 3. Säurewäsche: <ul style="list-style-type: none"> • Führe eine Säurewäsche durch, um anorganische Ablagerungen zu entfernen. Verwende eine verdünnte Lösung einer geeigneten Säure wie Salpetersäure oder Salzsäure. Beachte dabei die Sicherheitsrichtlinien für den Umgang mit Säuren. 4. Spülen mit Reinstwasser: <ul style="list-style-type: none"> • Spüle die Probeneinführung mehrmals mit hochreinem Wasser, um alle Rückstände der Reinigungslösungen zu entfernen. 5. Kontrolle auf Verstopfungen:

<p>5. Acid Soak (if necessary):</p> <ul style="list-style-type: none">• For stubborn deposits or mineral build-ups, an acid soak may be required. Use a weak acid solution, such as a dilute nitric acid solution.• Be cautious when using acids, and ensure that you follow safety protocols and the instrument manufacturer's recommendations. <p>6. Final Rinse with Deionized Water:</p> <ul style="list-style-type: none">• Finish the cleaning process with a final rinse using deionized water to ensure that no residues or contaminants are left in the system. <p>7. Inspect and Assemble:</p> <ul style="list-style-type: none">• Inspect each component for cleanliness and any signs of damage. Replace any parts that are worn or damaged.• Reassemble the sample introduction system according to the instrument manufacturer's instructions. <p>8. Performance Verification:</p> <ul style="list-style-type: none">• Before resuming analysis, perform a performance verification or calibration to ensure that the instrument is functioning correctly after cleaning. <p>9. Regular Maintenance:</p> <ul style="list-style-type: none">• Implement a regular maintenance schedule to prevent the accumulation of contaminants. Follow the instrument manufacturer's guidelines for routine cleaning and maintenance. <p>Always refer to the specific instructions provided by the manufacturer of your ICP-OES instrument, as cleaning procedures may vary depending on the model and design. Additionally, follow appropriate safety precautions, including the use of personal protective equipment, when working with cleaning agents and chemicals.</p>	<ul style="list-style-type: none">• Überprüfe die Probeneinführung auf eventuelle Verstopfungen. Verwende gegebenenfalls dünnen Draht oder eine geeignete Nadel, um eventuelle Blockaden zu lösen. <p>6. Prüfe Dichtungen und Schläuche:</p> <ul style="list-style-type: none">• Überprüfe regelmäßig Dichtungen und Schläuche auf Abnutzung oder Undichtigkeiten. Ersetze beschädigte Teile sofort. <p>7. Optimiere die Plasmabedingungen:</p> <ul style="list-style-type: none">• Stelle sicher, dass die Plasmabedingungen optimal sind, um Ablagerungen und Kontaminationen zu minimieren. <p>8. Durchführung von Leerläufen:</p> <ul style="list-style-type: none">• Führe nach der Reinigung mehrere Leerläufe durch, um sicherzustellen, dass das System vollständig gespült ist und keine Reste von Reinigungslösungen vorhanden sind. <p>9. Kalibrierung und Validierung:</p> <ul style="list-style-type: none">• Kalibriere das ICP-OES-Gerät erneut und führe Validierungsprüfungen durch, um sicherzustellen, dass die Leistung nach der Reinigung weiterhin den Anforderungen entspricht. <p>Es ist wichtig zu beachten, dass die oben genannten Schritte allgemeiner Natur sind. Du solltest immer die spezifischen Empfehlungen und Anweisungen des Herstellers deines ICP-OES-Geräts befolgen, um die besten Ergebnisse zu erzielen und die Lebensdauer deines Instruments zu erhalten.</p>
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Appendix I – Comparison English vs. German – Scenario 2

<p>Input: How can I clean the cones of my ICP-MS?</p>	<p>Eingabe: Wie kann ich die Konen meines ICP-MS reinigen?</p>
<p>Cleaning the cones of an Inductively Coupled Plasma Mass Spectrometry (ICP-MS) instrument is an important maintenance task to ensure optimal performance. Here's a general guide on how to clean the cones of an ICP-MS:</p> <ol style="list-style-type: none"> 1. Safety precautions: Before proceeding with any cleaning, ensure you are following all necessary safety precautions, including wearing appropriate personal protective equipment (PPE) such as gloves, safety glasses, and lab coat. 2. Consult the instrument manual: Different ICP-MS instruments may have specific instructions for cleaning the cones. It's essential to consult the instrument manual or contact the manufacturer to obtain the recommended cleaning procedure for your specific model. 3. Remove the cones: Typically, there are two cones in an ICP-MS: the sampler cone and the skimmer cone. Follow the instructions provided in the manual to safely remove the cones from the instrument. Some instruments may require specialized tools for cone removal. 4. Soak in cleaning solution: Prepare a suitable cleaning solution as recommended by the instrument manufacturer or based on established protocols. Commonly used cleaning solutions include a mixture of nitric acid (HNO₃) and deionized water. Fill a suitable container with the cleaning solution and immerse the cones into it. Let them soak for the recommended duration, which could range from a few minutes to several hours. 5. Ultrasonic cleaning (optional): For stubborn deposits or contaminants, you may choose to employ ultrasonic cleaning. Transfer the cones to an 	<p>Die Reinigung der Kegel (auch Kegelstücke genannt) in einem ICP-MS (Induktiv gekoppeltes Plasma-Massenspektrometer) ist eine wichtige Aufgabe, um sicherzustellen, dass Ihr Instrument effizient und genau arbeitet. Hier sind die Schritte zur Reinigung der Kegel in Ihrem ICP-MS:</p> <p>Hinweis: Stellen Sie sicher, dass Sie die spezifischen Anweisungen des Herstellers Ihres ICP-MS und die Sicherheitsrichtlinien genau befolgen.</p> <ol style="list-style-type: none"> 1. Persönliche Schutzausrüstung: Tragen Sie die erforderliche persönliche Schutzausrüstung, einschließlich Labormantel, Handschuhe und Schutzbrille. 2. Ausschalten des ICP-MS: Schalten Sie das ICP-MS aus und trennen Sie es gegebenenfalls von allen Gasversorgungen. 3. Entfernen des Kegels: Je nachdem, wie Ihr ICP-MS konstruiert ist, müssen Sie den Kegel vorsichtig entfernen. Dies kann das Lösen von Schrauben oder das Lösen anderer Befestigungen umfassen. 4. Reinigungslösung vorbereiten: Bereiten Sie eine geeignete Reinigungslösung vor. Dies kann je nach den Anforderungen Ihres Instruments variieren, aber normalerweise wird eine Lösung aus 1-2%iger Salpetersäure (HNO₃) verwendet. Achten Sie darauf, dass die Lösung für die Materialien, aus denen Ihr Kegel besteht, geeignet ist. 5. Einweichen des Kegels: Tauchen Sie den Kegel in die vorbereitete Reinigungslösung ein. Lassen Sie ihn für eine angemessene Zeit einweichen, normalerweise mindestens 30 Minuten. Dies hilft, Ablagerungen und Verunreinigungen zu lösen.

ultrasonic bath filled with the cleaning solution and operate it according to the manufacturer's instructions. This step can enhance the cleaning process by removing particulate matter or stubborn deposits.

6. Rinse with deionized water: After the soaking or ultrasonic cleaning, carefully remove the cones from the cleaning solution and rinse them thoroughly with deionized water. Ensure that no traces of the cleaning solution remain on the cones.
7. Dry the cones: Allow the cones to air-dry in a clean environment. Avoid using compressed air to dry them, as it may introduce contaminants.
8. Reinstall the cones: Once the cones are completely dry, follow the instrument manual's instructions to reinstall them into the ICP-MS. Make sure they are properly aligned and secured according to the manufacturer's guidelines.

Remember, these are general guidelines, and it's crucial to refer to your instrument's specific manual and guidelines for the proper cleaning procedure. Additionally, always consult with the manufacturer or an experienced technician if you have any doubts or concerns regarding the cleaning process for your particular ICP-MS instrument.

6. **Spülen:** Nach dem Einweichen spülen Sie den Kegel gründlich mit deionisiertem Wasser, um die Reste der Reinigungslösung zu entfernen.
7. **Trocknen:** Lassen Sie den Kegel an der Luft trocknen oder verwenden Sie gegebenenfalls Druckluft, um sicherzustellen, dass keine Feuchtigkeit zurückbleibt.
8. **Wiedereinsetzen des Kegels:** Setzen Sie den gereinigten Kegel in Ihr ICP-MS zurück und befolgen Sie dabei die Herstelleranweisungen zur ordnungsgemäßen Montage.
9. **Prüfung und Inbetriebnahme:** Stellen Sie sicher, dass der Kegel ordnungsgemäß wiedereingesetzt ist, schalten Sie das ICP-MS wieder ein und führen Sie gegebenenfalls Leistungstests oder Kalibrierungen durch, um sicherzustellen, dass alles ordnungsgemäß funktioniert.
10. **Wartungsaufzeichnungen:** Führen Sie detaillierte Aufzeichnungen über den Reinigungsprozess, einschließlich der Verwendung von Reinigungslösungen und der Zeitpunkte der Reinigung, um die Wartungshistorie Ihres ICP-MS zu dokumentieren.

Es ist wichtig, die Kegel regelmäßig zu reinigen, um eine gute Leistung Ihres ICP-MS zu gewährleisten und die Kontamination der Proben zu minimieren. Beachten Sie auch die Empfehlungen des Herstellers und die Vorschriften für den Umgang mit Chemikalien und Abfällen in Ihrem Labor.