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Influence of the Contact Center Systems Development on Key Performance Indicators

MIROSŁAW PŁAZA[1], AND ŁUKASZ PAWLIK[2]
[1]ICT&IoT CyberLAB, Kielce University of Technology, 25-314 Kielce, Poland
[2]Altar Sp. z o.o., 25-528 Kielce, Poland

Corresponding author: Mirosław Płaza (m.plaza@tu.kielce.pl)

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ABSTRACT The role played by information and communication technologies in human life is growing by the year. During the current pandemic, communication systems have become an essential part of operations of many industries around the world. This has also brought a dynamic development of solutions implemented in Contact Center systems, which ensure quick contact with customers. This paper presents how the pace of the development of Contact Center systems affects optimization of selected Key Performance Indicators (KPIs). It contains a detailed analysis of how successive technologies deployed in the industry, including IVR, chat, WebRTC, Visual IVR, Social Media, MultiChannel, OmniChannel and bots, have affected KPIs. The authors selected essential indicators that are critical to customer service, namely Service Level, Cost per Contact, Customer Satisfaction, Average Handle Time, First Call Resolution, Abandon Rate, Average Waiting Time, and Occupancy Rate. The authors also presented possible trends in the development of the solutions discussed in this paper, including in particular broad possibilities of employing artificial intelligence. AI methods will soon enable equipping Contact Centers with mechanisms for multi-criteria content classification and smart emotion recognition and behavioral profiling methods, and will optimize the process of predicting both inbound and outbound traffic.

INDEX TERMS Communication systems, Contact Center, information and communication technology, key performance indicators.

I. INTRODUCTION

The current dynamic development of Contact Center (CC) systems puts increasing demands on companies that implement these types of products and on scientists who support the development of these technologies. CC system technologies have rapidly evolved from very simple Call Center type telecommunication concepts to multichannel, hybrid, largely automated, smart, and fully integrated Contact Center systems [1], [2]. The changes taking place in CC systems are due to continuous efforts to optimize their internal processes, which translates directly into profits. Efficiency of the present CC systems is described by strictly defined Key Performance Indicators (KPIs) which illustrate the achieved results [3]. A number of ICT technologies have been integrated with the CC industry, thus significantly affecting the respective KPIs. This paper characterizes indicators that are critical to analyzing Contact Center operations.

However, there has been no detailed literature analysis to date of the specific impact of individual technologies on the optimization of KPI levels. This was the authors' motivation to conduct research in this area. This paper analyzes the indicators that are of critical importance to the analysis of the performance of CC systems. The selection of the indicators to be analyzed was based on the authors' long experience in implementation of and research into CC systems. The indicators analyzed and the corresponding standard values are summarized in Table 1.

The thresholds described in the table for each indicator are determined in different ways. Some values are statistical data, others result from agreements/contracts concluded between companies providing Call/Contact Center services and requirements of their clients. The SL and AWT indicators depend directly on the CC outsourcing company and are driven by the requirements of the clients for each

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TABLE 1. Key performance indicators for CC systems.

Symbol	Name of indicator	Industry values	Reference
SL	Service Level	80%	[4]
CPC	Cost Per Contact	$8-13$	[5]
C-SAT	Customer Satisfaction	90%	[6]
AHT	Average Handle Time	6 minutes	[4]
FCR	First Call Resolution	70-75%	[4, 7]
AR	Abandon Rate	5-8%	[6]
AWT	Average Waiting Time	17.28 seconds	[8]
OR	Occupancy Rate	60-80%	[6]

service. The values of these indicators are usually published in industry journals or posted on websites of CC companies as reference indicators. FCR, AR and C-SAT are reported on a monthly basis to the clients who ordered the campaigns. They influence possible changes to customer service strategies. Depending on the type of campaign and its specific characteristics, different levels of the above indicators may be acceptable. Therefore, the values cited in the paper for this group of indicators are described in literature items [5]–[7] as the industry average. The last group are the CPC, AHT, and OR indicators. They are studied for internal purposes of CC companies, which are aimed at optimizing the organization of agents' work so that specific companies achieve maximum effectiveness with a given number of agents. CC companies try to optimize these indicators through better workflow and agent training. The values cited in the paper are the average values achieved for the call center industry..

Knowledge of KPIs is very important for optimizing CC system operations, as they facilitate easy identification of elements that either positively or negatively affect the achieved results, thus making it easy to define areas that require improvement [3]. Optimization is linked mainly to the need to ensure uninterrupted and quick availability of support and other services offered (SL) while minimizing the costs incurred (CPC) [9]. Moreover, efforts are constantly made to keep customer satisfaction and individual experience with the call (C-SAT) as positive as possible [10], [11]. Other important indicators include the time spent by qualified CC personnel to handle a customer's call (AHT) and the effectiveness of the service during the first contact (FCR). It is important to ensure that as few customers as possible abandon their calls (AR) which may be due to the average call waiting time (AWT). As regards the agent's productivity at work, the time spent on direct conversations with customers per hour (OR) is also an important indicator. Keeping the aforementioned indicators at high levels ensures efficient communication with customers. The dynamic development of new IT technologies makes it possible to eliminate solutions that have so far proved to be barriers, while allowing adoption of increasingly efficient alternatives.

This paper analyses the process of optimization of selected KPIs in the context of the technological development of CC systems. It describes the evolution of CC systems over the last years and discusses the impact of the newly implemented

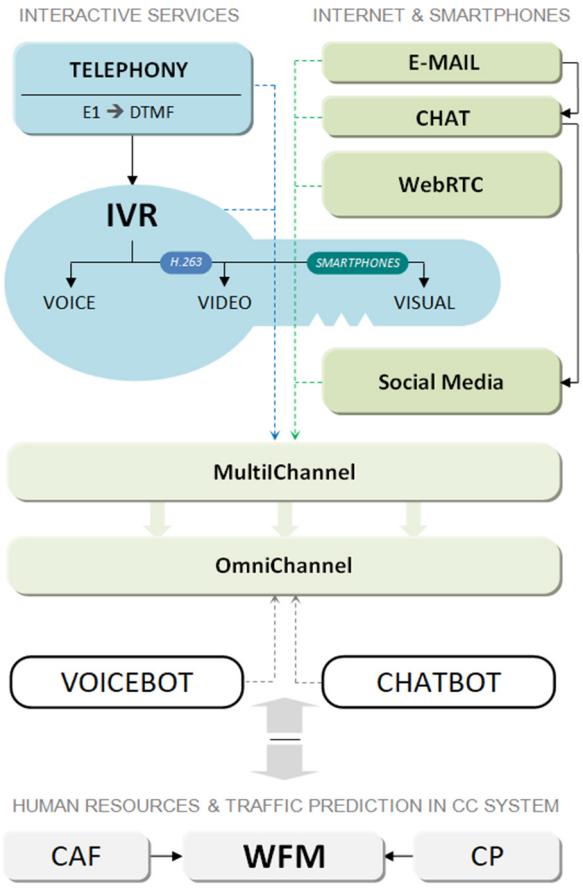

FIGURE 1. A block diagram of the evolution of technologies adopted in CC systems.

technologies on their efficiency. A block diagram showing the integration of successive technologies adopted in CCs is shown in Figure 1. The significance of these technologies is explained in detail further in this paper.

II. THE TECHNOLOGICAL PROGRESS AND OPTIMIZATION OF KPIs

An important role in CC development has been played by the need to optimize the KPIs that translate into profits and service costs. Successive technologies adopted over the years have contributed to a significant improvement in service standards and workforce management [1].

A. INTERACTIVE SERVICES

In the early days of CCs, the only communication channel was traditional telephone calls, analogue at first and digital later on (from E1 digital channel multiplication systems to VoIP-based technologies) [12]. Further stages of CC development saw widespread use of DTMF technologies (Dual Tone Multi Frequency) [13], which give rise to the promising IVR_{voice} (Interactive Voice Response) solution, the development of which became the key to the expansion of CC systems. The automation associated with IVR_{voice} made it possible to replace humans in several areas, including authentication, answering simple inquiries, and referring customers

to specialized agents. At that time, the multimedia communication area was dominated by the H.323 standard, together with the G.723 speech coding and the H.263 video coding standards [14]. This allowed IVR_{voice} systems to evolve towards IVR_{video} (Interactive Video Response). However, due to the low popularity of video calls and poor video quality, that solution failed to revolutionize the call center industry. The studies presented in [15] show that, depending on the campaign, only between 35% and 75% customers who used the IVR tone menu achieved their intended objectives. The complicated options of the navigation menu made some customers who had not achieved their intended objectives abandon their calls, which had a negative impact on the AR indicator [16]. Others would simply return to the start of the menu to attempt to speak with an agent. However, the time they spent on contacting the CC substantially deteriorated their satisfaction and personal experience levels (C-SAT) [17]. The advantages of automated IVR solutions included reduction of the customer identification time by 15 seconds. Moreover, the time required to refer the customer to an appropriate group of specialists and the time for collecting information and finalizing the transaction were reduced by 40 seconds [15]. This brought a substantial 12.5% improvement in the AHT indicator compared to traditional telephony [18] and helped reduce the service costs expressed by the CPC indicator, which indirectly translated into optimization of the SL.

B. INTERNET AND SMARTPHONES

A large leap in the development of CC systems was brought by the widespread deployment of the Internet technology, which gave rise to text-based communication with customers. At first, conversations were based only on e-mail protocols, which are standard today. However, there soon emerged chat, an entirely new contact channel that is being constantly developed [2]. According to studies of the C-SAT indicator [19], 73% of customers said they were satisfied with chat-based support. In the case of the e-mail channel, C-SAT stood at 61%, while for standard telephony, only 44% of the respondents expressed their satisfaction. Moreover, according to [20], as many as 53% of customers indicated chat as their preferred contact channel.

The widespread access to the Internet entailed a dynamic development of the WebRTC (Web Real Time Communication) technology, which allowed audio/video contacts via web browsers. That solution was very soon implemented in CC systems as a new communication channel, with remote desktop as an interesting and frequently used functionality [21]. Enriching the customer service process with a video channel came as a fundamental video transformation in many areas, as excellently exemplified by implementations related to the insurance industry, where it became possible to adjust losses with the use of smartphone cameras. With the resulting savings on the time needed to travel to event sites, that solution allowed insurers to expand their capacities regarding the number of cases handled per day. It was estimated that thanks to the integration of the video technology a single employee could solve 11 cases a day, i.e. 4.5 times more than previously. This leads to the conclusion that handling complaint processes through video calls contributed to a 50% increase in the C-SAT and reduced the CPC-related costs. The WebRTC technology had a positive impact also on the FCR indicator. For example, the banking industry saw a 50% increase in the FCR, compared with the traditional telephone channel. Furthermore, compared with telephony, the average handle time expressed by the AHT indicator decreased by 23%, with 44% of customers willing to recommend that type of communication. In banking, the video channel allowed increasing sales by 12% to 20% [22], [23].

The widespread use of smartphones and developer environments for creating mobile applications and distribution platforms resulted in further development of the IVR technology. Thanks to the graphical user interface, the Visual IVR systems developed at the time increased the C-SAT indicator compared with initial IVR solutions. The most widely known products of this type are systems developed by Jacada, Five9, Plum Voice, and Radial [24]. They guarantee reduction of the call handle time by a minimum of 60 seconds. Moreover, the Visual IVR technology ensures the possibility of real-time sharing of files, links, and photos, which has a positive impact on the FCR, C-SAT, AHT, and CPC indicators [25]. According to the analyses described in [26], the FCR indicator was within the range of 20% to 30% for traditional IVR solutions. The introduction of the Visual IVR technology made it possible to increase that value to 70% [27].

With time, the original chat and video solutions were implemented in the area of Social Media. At present, most major companies use social media in their first contacts with customers. The Internet, mobile devices, and social media represent one of the main trends in the development of customer service in the current CC systems. 63% of CC customers tend to expect service based on social media. This is confirmed by the studies [28] which demonstrated that 90% of social media users relied on that technology in their contacts with CCs at least once. In this case, the CPC indicator is 6 times lower compared with services provided by traditional call centers. Effectiveness of campaigns carried out with the use of social media is 178% higher than for those utilizing traditional voice calls. Moreover, 71% of customers are willing to recommend that method of selling products and services. According to experts, optimization of the FCR indicator is among the most essential requirements related to social media-based customer service [29]. Additionally, the need to utilize this communication channel is supported by analyses [30], which show that by failing to use social media channels companies run a risk of losing as many as 15% of their current customers.

C. COMMUNICATION CHANNELS

New technologies implemented in CC systems in the form of additional communication channels have greatly improved their functionality and increased their attractiveness. Combining multiple channels in a CC that have never been integrated

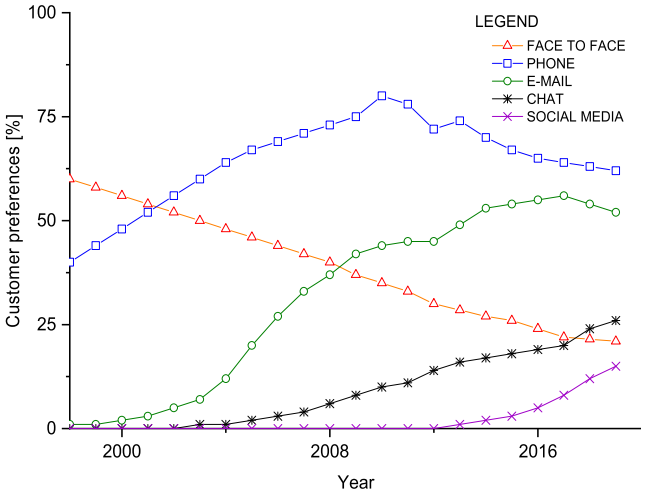

FIGURE 2. Percentage estimation of customer preferences in use of selected communication channels based on data gathered by Altar company.

with each other before and have been used only autonomously was ultimately termed as MultiChannel, and a natural transformation of that trend is the OmniChannel model [1]. The OmniChannel technology brought a completely new look at the concept of multiple channels in CCs. The main functionality of OmniChannel solutions involves ensuring simultaneous use of many communication channels during actual interaction with the customer [22]. The technology is a point of contact for respective communication channels, facilitating their management and making customer service easy and consistent. A customer normally contacts a CC to get assistance in solving a problem or to buy products or services, and what he or she expects is mainly professional, quick, and comprehensive support. This is why, depending on individual business relations, communication channels are selected to ensure adequate quality of interaction. As shown by studies [31], customers supported with the OmniChannel technology spent between 4% and 10% more than customers served through a single communication channel only. The significance of the OmniChannel solution grew notably in the era of widespread Internet access through mobile devices [32]. Additionally, a multiple-criteria analysis of information from individual communication channels enables much more precise customer profiling [1], which has a positive impact on a number of KPIs, including AHT, FCR, C-SAT, and CPC.

Figure 2 illustrates trends that define Clients' preferences related to the use of selected communication channels. The chart has been prepared based on an analysis of sales inquiries submitted by potential clients to Altar Sp. z o.o. The period prior to 2010 is mainly based on data collected by Altar, as no adequate information on this topic was found in the literature. For the period after 2010, the data presented are largely consistent with those cited in publications [33]–[40].

D. CALLER MATCHING

Requirements for CC systems grew with the continuing development of those systems. Campaigns were becoming increasingly difficult, requiring agents to have vast industry-specific knowledge to conduct their conversations. The original method of assigning agents to work in individual CC campaigns without using any selection criteria was no longer sufficient. The adequate level of agents' qualifications and competences started to play a very important role. That need contributed to adding a new functionality to CC systems which became known as SBR (Skill Based Routing) [40]. Moreover, analyses of data generated by CC systems allowed assessing individual agents in the context of their efficiency in handling specific types of cases, which in turn translated into the arrival of PBS (Performance Based Routing) [42]. The aforementioned solutions opened the way to agent-customer matching based on the agent's substantive competences in a given area and the data generated at the CC, which allowed creating basic profiles of agents and customers. That functionality increased customer satisfaction (C-SAT) with the service, leading to significant optimization of the AHT indicator and reduction of the average customer waiting time (AWT) [43]. All these advantages led to reduced CPC. Correlation of customers' and agents' behavioral profiles seems to be the further natural direction of development of this trend.

E. HUMAN RESOURCES AND TRAFFIC PREDICTION

Human resource management methods have always been a significant challenge in the Contact Center sector. Staffing of agent jobs should ensure that the customer service process is run at the required top-quality level, while maintaining optimized KPI values. At the same time, it must be noted that the agent's working time is one of the highest costs generated. The processes of prediction of the required staffing of agent jobs, implemented in the form of WFM (Work Force Management) algorithms, depend largely on the methods of predicting the inbound traffic - CAF (Call Arrival Forecast) and the outbound traffic - CP (Call Predictive).

Planning the right staff for agent jobs often starts with the CAF, which is normally very stochastic and can be modelled as a heterogeneous and distributed Poisson process. Furthermore, when taking into account the relationship between outbound calls during a single day (intra-day) and between successive working days (inter-day), standard time series models are applied, such as integrated autoregressive moving average models and exponential smoothing. In this respect, the literature also indicates dimensional reduction techniques or Bayesian techniques [44]. Optimal inbound traffic forecasting is the key to achieving the desired operational efficiency of a CC. Understated forecasts lead to underestimation of the number of necessary personnel, which entails long customer waiting time. As a result, this leads to a decrease in the SL, C-SAT, and AWT indicators, among other things. On the other hand, overestimated forecasts increase the CPC.

Optimal planning of agent staffing is affected also by outbound traffic prediction (CP). At the early stage of CC systems development, calls with successive customers in the outbound traffic were carried out as the agents

became available. That methodology had a negative impact on service objectives and had to be optimized. An important role is played here by the OR indicator, as it shows how much time in one hour an agent spends speaking with customers. According to available data [45], in traditional dialing methods, the OR indicator is on the level of only 20%. This means that agents spend a significant portion of their working time waiting for a target call to be established. This situation was very unfavorable and required implementation of new solutions. This brought about first predictive dialing algorithms implemented in the form of Call Dialer solutions. OR optimization involves dynamic dialing of additional calls (while the current calls are still going on), which reduces the agent's waiting time for the next call. Importantly, it also minimizes the customer waiting time (AWT). The main features of a predictive dialing system include the ability to filter out busy numbers, wrong numbers, and fax and voice mail tones. If the system detects any customer activity, it will route the call to an available agent. The objective here is the highest possible OR level. It was estimated that the introduction of CP solutions to Contact Center systems increased the OR level to 80%, and even up to 83% in some cases [46]. For many years, the main challenge is the achievement of the desired OR level without any significant increase in the number of abandoned calls [47]. Outbound call prediction now involves mainly standard statistical models which describe the reality with certain estimation without taking the dynamics of the CC environment into account [48].

Call arrival forecasting [49] and CP algorithms [50] are usually implemented in WFM solutions [2] which automate work scheduling. It should be emphasized that there is no universal WFM model that can be used regardless of the CC size or characteristics. Work scheduling algorithms should optimize the staffing costs as well as ensure the best possible quality of service. This is why agent job staffing is very likely to be a very important issue that, if optimized further, will help reduce CC operating costs. Modernization of CAF, CP and, in consequence, WFM mechanisms will certainly contribute to improving the KPIs described in this paper. As regards the development of this area, the greatest hopes are attached to widespread use of artificial intelligence methods.

F. ARTIFICIAL INTELLIGENCE

In parallel with the development of CC systems, the literature largely focused on studies into implementation of artificial intelligence (AI) solutions in a number of areas. At first, the capacities of computers did not permit any widespread application of those technologies in CC systems, where a large majority of calls are conducted in real time. To be sufficiently fast, the complicated AI algorithms required computational power at levels that were not available back then. A breakthrough was achieved with the advent of graphics processing units (GPUs), which led to the development of such new technologies as SLI, CUDA, GRID, and VOLTA. These solutions, as well as artificial intelligence methods, especially machine learning (ML) and natural language processing (NLP), are now revolutionizing the CC industry.

Implementation of the aforementioned solutions in the CC sector made it possible to develop the Automatic Speech Recognition (ASR) technology, and subsequent studies [13] showed that approximately 60% of customers felt comfortable when served by ASR systems. Transcription of the customer's verbal statements to text that could be processed by NLP algorithms was the starting point for the development of customer intention recognition systems. Correct determination of the customer's intentions by the system enables automatic generation and delivery of answers during ongoing calls. This became the basis for Chatbot and Voicebot, and application of these ensured instant help in solving a great majority of problems 24H/7D [3]. This is why bots are currently the first line of support, providing a low-cost source of help and information regarding frequently asked questions. Compared with traditional IVR solutions that require customers to navigate complicated menus and wait in queues, bots respond almost instantaneously, thus improving such parameters as AR and AWT, while increasing the C-SAT and reducing the CPC. A number of companies, for example AliExpress and Alibaba, have invested significant funds in the development of smart bots, where bots play the key role in customer service [51]. Solutions that support bots are offered also by the IBM Watson [52] and Google Dialogflow [53] platforms. Moreover, bots can be very often met in electronic trade, information systems, and solutions that support courier services [54]. For several years now, increasingly innovative solutions such as Chatbot and VoiceBot have been more and more often implemented across the entire CC industry. According to forecasts, by the year 2022, 80% of CC companies will be using chatbots and banks will be able to automate up to 90% of their customer-bot interactions. It is expected that the global chatbot market will reach USD 2 billion by 2024, growing at a CAGR (Compound Annual Growth Rate) of 29.7% [55]. Such a strong interest in this technology is driven by two main factors. One is the fast development of artificial intelligence methods (including ML and NLP) [56] and the other is the continuously growing popularity of such platforms as Facebook, Messenger, Slack, WhatsApp, and WeChat [57]. Typical and interesting Voicebot applications include the use of their functionalities to build a dashboard that will describe the objective of the customer-CC contact in the best possible manner. The information is provided to the agent before the call is established, which has a favorable impact on the service optimization process [58].

The implementation of intelligent bot solutions in Contact Center systems also leads to some risks and challenges. Some, especially older customers, do not do well interacting with automated assistants or have very limited confidence in such solutions. In this situation, they may stop the call or make insistent attempts to bypass the bot to contact the agent directly. Such situations can be greatly reduced by appropriately offering the customer different options of how to be served. For example, using the information collected

in the CC system, the suggested communication channel for a given customer can be indicated [59]. It is also worth encouraging customers to use the smart machine by warning them that the wait for a call from an agent may take a relatively long time. The goal of CC systems is to minimize situations that adversely affect their functionality and performance, but they must be easily identifiable in order to respond appropriately. To this end, in the era of implementation of artificial intelligence technologies in CC solutions, new types of KPIs are being introduced to identify problems associated with AI/ML mechanisms and to measure their effectiveness. For bots, the following KPIs are starting to play a key role: SSR (Self Service Rate), RR (Retention Rate), FBR (Fall Back Rate), and GCR (Goal Completion Rate). The SSR indicator determines the percentage of user contacts that did not end with a contact action after using the bot [60]. The RR indicates the percentage of users who revisit the bot within a given time frame, whether monthly, quarterly or annually [61]. The FBR determines the number of times the bot gets confused and replies "I don't understand," but the GCR indicator determines the number of all users who contact the bot and how many actually reach the goal [62]. It must be emphasized that in the literature [59]–[65] one can find many different proposals concerning KPIs related to artificial intelligence applications in CC systems. However, the vast majority of these proposals are completely new and often lack an established market and scientific position. Moreover, they only concern solutions supported by artificial intelligence, so they could not be taken into account in the context of the study of the impact of technological progress on selected KPIs that is presented in the paper. Nevertheless, it can be assumed that in the near future some of them may provide the foundation for assessing the quality of implemented artificial intelligence solutions.

The literature shows examples of application of artificial intelligence methods in tasks involving text message classification [66]. In CC solutions, an important role in text communication is played by messages from customers that are requests for contact (e.g. a complaint, a technical problem). Such a message should be routed to an agent with appropriate competences. In large CCs such routing is a problem due to the huge daily number of incoming messages (even up to several thousand) and the vast variety of topics. In the classical approach, this process was controlled by a group of several CC employees who would read the messages and send them to appropriate CC sections. However, that approach proved very inefficient. It can be estimated that one employee can handle some 450 messages per day (approx. 1 message/minute), which is a small number. On the other hand, increasing the number of employees to meet the demand results in increased costs. Strong support in this regard was offered by classification methods based on AI solutions, including neural networks, fuzzy logic, and rule-based systems. At present, CC systems are equipped with content classifiers that can classify messages into a single class, which largely contributes to reducing CPC customer service time expressed by the AHT. In this regard, it is advisable to develop a multiple-criteria method of text message classification that could classify text messages or documents simultaneously into several classes [67], [68], which would allow further optimization of the KPIs concerned. Artificial intelligence methods will undoubtedly dominate the CC industry in the coming years and their integration with e.g. methods of emotion recognition and behavioral profiling of customers and agents can significantly revolutionize the market.

Implementation of methods supported by artificial intelligence solutions in Contact Center systems has raised a number of questions as well as concerns and doubts related to privacy and confidentiality processes, as well as security issues. Systems built using AI methods impose many additional requirements both at the solution development stage and at the operation stage. When creating solutions using AI algorithms for CC systems, it is worth conducting a detailed assessment of their impact on legal aspects, particularly in areas where the impact could be negative. Such systems should be aligned with any authoritative standards (e.g.: ISO, IEEE) and widely accepted data management and oversight protocols. Oversight mechanisms for collection, storage, processing, and use of data should be established. Safeguards should be planned against over-reliance on the work of AI-supported systems in the processes performed by the CC, which requires an adequate level of human control over the AI system. Potential forms of attacks to which the AI system may be susceptible should be identified and measures should be planned to ensure integrity and resilience against identified vulnerabilities. In addition, users should be provided with simple mechanisms to manage sensitive data and to report privacy and data protection concerns. It is worthwhile to ensure increased security through encryption, anonymization, and aggregation of stored data. From the point of view of further development of an intelligent CC system, it is worth considering the possibility of training models with minimal or even no use of potentially sensitive data. Also important from the point of view of the customer's trust are transparent mechanisms for informing end users about the rules of the AI system and taking into account the users' opinions in the process of the target adaptation of the system. Creating dedicated mechanisms for users to report problems with bias, discrimination, or malfunctioning of the AI system will significantly improve trust in the implemented solution. It is also a good idea to plan independent mechanisms to facilitate audits of the system and recording of its processes and results, along with methods to prevent bias in the process of verification of the results obtained [69], [70].

G. IMPACT OF CC DEVELOPMENT ON KPI LEVEL

Analyses that have been carried out clearly show that technological developments have a significant impact on optimization of many CC processes, thus opening new opportunities. Work on developing CC systems is aimed at continuous efforts to ensure the best service possible while optimizing the associated costs. Table 2 shows the trends in KPI optimization

TABLE 2. Impact of development of CC channels on KPIs level.

KPI	TECHNOLOGY							
	IVR	Ch	Web	Vis	MCh	OCh	SM	Bot
SL	+	+	•	•	•	+	•	+
CPC	+	+	+	+	-	+	+	+
C-SAT	-	+	+	+	+	+	+	+
AHT	+	-	+	+	+	+	•	•
FCR	+	+	+	+	+	+	+	•
AR	-	+	•	+	+	+	+	+
AWT	+	+	•	•	•	+	+	+
OR	+	+	•	•	+	+	+	•

Ch = Chat, Web = WebRTC, Vis = Visual IVR, MCh = MultiChannel, OCh = OmniChannel, SM = Social Media

for selected technologies. A positive impact of a given technology on KPIs is marked by a (+) and a negative impact by a (−). Where a technology has no impact on a given KPI, the (•) symbol is used.

In the early days of the development of Contact Center systems, when communication took place by means of traditional telephony, the high SL value required by clients was very difficult to meet while maintaining satisfactory CPC and AWT levels. The automation that came with the IVR technology allowed, to a certain degree, reducing the dependence of certain parameters on the human factor. This is why, with this technology becoming widespread, one can notice optimization of the SL, the CPC, and the AHT. The impact of the IVR on such indicators as the FCR, the AWT, and the OR has not been significant, although positive. Information on customer cases, automatically retrieved and delivered to an agent before the call, and routing of customers directly to adequately qualified personnel has made it possible to improve the FCR indicator. Moreover, reducing the call time enabled better management of customer queues, helping to optimize the workload between agents and leading to OR improvements. The introduction of IVR solutions has also had some negative outcomes related to a decrease in C-SAT and AR. These indicators improved only after text communication was deployed in CC systems. Agents could conduct multiple calls simultaneously, which contributed to improvements also in the SL and the CPC. Moreover, calls based on the chat technology started filling the agent's time between calls, thus optimizing the OR level. In addition, the FCR level grew as well thanks to certain time-related flexibility of text conversations. A conversation did not have to be conducted continuously, and possible breaks could be used by both parties to prepare the necessary data, thus contributing to successful problem resolution during the first contact. Meanwhile, the conversation time grew longer, but this did not have any negative impact on other indicators. Adding video communication to voice and text channels in the form of WebRTC and Visual IVR enabled effective use of new solutions and further KPI optimization. It became possible to improve the CPC, the AHT, the C-SAT, and the FCR while usually maintaining others at their current levels. Although video channels became immensely successful at first, particularly in the insurance industry, they were soon absorbed by the oncoming era of multichannel communication. However, the impact of first video solutions on critical KPIs should be assessed as positive. At the beginning of the era of multichannel solutions, the costs of service grew while other indicators either showed a slight improvement or remained neutral to the changes. It was only after MultiChannel services started to be gradually and consistently developed towards the OmniChannel solution that a significant improvement in all critical KPIs could be observed. Not only did it show a growing maturity of CC systems, but it also demonstrated a high level of awareness on the part of managers of those systems. In this regard, owing to the integration of new solutions, the OR parameter saw a tremendous improvement. OmniChannel allowed noticeable optimization of the work of human resources who handled the existing technologies, which had a positive impact on the SL, the CPC, the AWT, and the AHT. The FCR level grew thanks to the enhanced possibilities of using adequate communication channels that matched the customer's needs during calls. In addition, the maturity of OmniChannel tools had a positive impact on C-SAT and AR. The possibilities offered by integrating Contact Center systems with social media solutions were complemented by the existing technologies. Social media quickly conquered the IT service market among young people, becoming a part of their everyday lives. This, naturally, entailed the need for further improvements in some of the indicators. The next significant step in the KPI optimization should involve solutions supported by AI mechanisms, including the increasingly popular smart bots. Although these technologies are still in the phase of very dynamic development, their impact on the KPIs is already largely positive.

Implementation of more and more technologically advanced solutions in Contact Center systems significantly affects the operational benefits and social aspects. As can be seen from the research presented in this paper, each of the technologies introduced over the years has had a positive impact on most of the KPIs under consideration, as confirmed by the results achieved for them. Publication [71] indicates that customer service gains the highest return on its costs with new technologies that optimize the performance of CC systems. CC companies are now strongly interested in adopting innovative solutions, especially those related to AI. However, budget constraints are often a barrier to this. In terms of social aspects, however, there is much room for improvement. The current working conditions in Contact Center hotlines are very demanding and, from the agents' point of view, require many improvements. The possibility to improve the working conditions for agents are mainly associated with extensive applications of bots, which will largely be able to assist agents in their work. The research in this area [72] shows that 68% of the world's leading CC service providers indicate that bots will become a key service in CC over the next few years, providing very valuable support tools [73]. It is estimated that by 2022, 70% of white-collar workers will interact with bot conversation platforms [74]. Direct assistance to agents is also to be provided by new applications of machine learning methods which, combined with bots, will allow

TABLE 3. Main advantages and disadvantages of technologies introduced to CC.

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
IVR	- automatic authentication and identification - automation of the customer's answers to the system's questions - redirecting the customer to the appropriate specialist - reduced customer service time	- the usually complex navigation menu structure - longtime of listening to IVR messages - frequent need to return to the start of the menu - high call abandonment rate
Chat	- possibility of simultaneous service of many clients - reduced call waiting times - greater comfort in decision-making - lower costs and a form of communication that requires less attention	- limited range of cases that can be resolved - more difficult authentication and identification process - does not work with complicated cases
WebRTC	- video communication for remote site visits - audio/video calls free of charge for telephone operators - remote desktop sharing capabilities	- technical problems with browser compatibility - higher workstation preparation cost - proper business clothing and style required of agents
Visual IVR	- improved ergonomics of the menu in relation to IVR - reduced call handling time - reduced call abandonment rates - real-time access to/exchange of documents	- problems with dissemination of the solution - often associated with the classic IVR system
MultiChannel	- significantly better functionality and greater attractiveness of the CC system - communication with the customer using multiple channels - interaction through the channel preferred by the customer - increase customer engagement and reduce service abandons	- no possibility to change the channel during the call - agents have difficult access to single customer interactions history - customers being forced to repeat themselves in different channels
OmniChannel	- possibility to change the channel during the call - further increase in efficiency of customer service - better use of agents' working time	- complex interface of the application used by the agents - multitasking can adversely affect the quality of service
Social Media	- use of systems that customers are familiar with - easier identification of customer needs - ability to quickly respond to comments and feedback	- required involvement of more agents - additional competences required from agents
Bots	- automation of many repetitive processes and activities - available 24/7 - immediate service/support	- problems in solving difficult cases - social barriers to the use of such tools

intelligent management of acquired knowledge and customer service content [75]. It has also been indicated that skill-based customer-agent caller matching helps alleviate agents' stress related to customer service, thereby improving their comfort level. The customer's first interaction with the service department should always be a positive experience, so it is necessary to avoid situations where the agent's potential negative emotions influence the customer's experience [76]. In this regard, it may be important to match callers using their behavioral profiles which, in the opinion of experts, will significantly increase customer satisfaction with the service.

Table 3 shows a summary of the main advantages and disadvantages of the technologies introduced in Contact Center systems over the years of their development.

III. CONTACT CENTER SYSTEMS IN THE FUTURE

The future of Contact Center systems is associated mainly with the vast possibilities of deploying artificial intelligence methods. Figure 3 shows a general block diagram of the proposed Contact Center system. New implementations of methods of multiple-criteria classification of text messages will undoubtedly have a strong impact on the service quality and the cost optimization. Furthermore, a combination of emotion recognition methods with intention recognition methods, which are now the foundation for developing chatbots and voicebots, may improve the quality of customer service and customer satisfaction. One can expect that the fast technological progress will soon bring widespread use of videobots, adding facial recognition techniques to emotion identification tools.

Smart methods of emotion recognition can also become the core element of customer and agent behavioral profiling systems. Character profiling will help match callers based not only on the agent's hard technical skills, but also on the callers' personality traits. Smart algorithms will not only allow the agent's performance to be assessed in a trustworthy manner, but will also identify his or her individual training needs and create a personalized career path, preventing professional burnout and high turnover observed in this profession today. This socially beneficial aspect related to the hard work performed by agents plays a very important role in the further development of CC systems. This aspect has been almost completely underestimated so far, which continues to have a negative impact on KPIs. This should change soon.

CC systems are also bound to undergo big changes regarding the methods of customer authentication, which are now at a very poor technological level. Voice analysis and video biometrics methods will ensure a high level of reliability and security in this area. It is also predicted [77], [78] that the key definition of the term ''customer'' will change by 2025. This will be driven by the rapid development of the Internet of Things (IoT) in many areas [79]–[81] thanks to which items equipped with smart sensors capable of mutual communication will also be able to contact CC hotlines on their own. Hotlines of this type will be served mainly by smart bots which will ensure an adequate level of support (e.g. by carrying out diagnostics and upgrades), thus eliminating any human involvement in mutual interactions in CCs. Huge amounts of data generated by IoT devices will take on a completely new

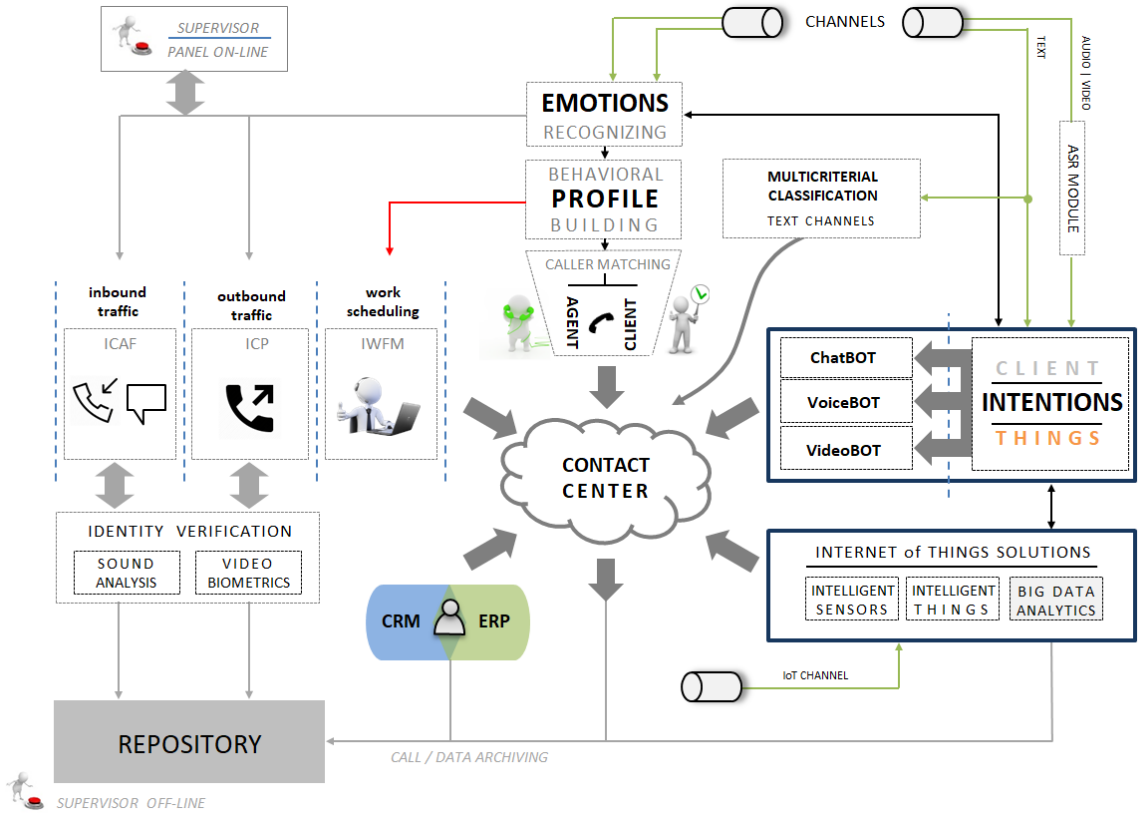

FIGURE 3. A contact center system in the near future.

meaning and will certainly be utilized by the CC industry. The data will be used for comprehensive market analytics, determination of marketing strategies, product development, and customer experience monitoring. Methods such as Big Data will play an increasingly important role in CC data analytics, because standard statistical methods will be unable to handle large amounts of data [82]. In addition, the development of ICAF (Intelligent Call Arrival Forecast) and ICP (Intelligent Call Predictive) algorithms in combination with IWFM (Intelligent Work Force Management) algorithms will allow for a significant optimization of the human resource management process. An innovative challenge in this area is the use of adaptive machine learning methods in place of well-known statistical methods. Building of prediction algorithms (ICAF or ICP) with the use of deep neural networks or real-time learning reinforcement methods will enable quick strategy changes in a CC environment. Meanwhile, new smart IWFM algorithms will take into account both the skills and the behavioral profiles of agents. Moreover, smart CRM (Customer Relationship Management) and ERP (Enterprise Resource Planning) systems will help process the data collected in Contact Centers. The data gathered in these systems can help better reproduce customer and agent behavioral models.

The anticipated further dynamic development of Contact Center systems mainly based on artificial intelligence solutions will not eliminate the need for human involvement in their operation. The tool being developed will only provide great support for the work of staff. For example, bots in customer communications will certainly not be able to solve all problems. In calls that are complicated and too difficult for bots, the case will have to be smoothly referred to an agent. However, it should be noted that the agent will receive all the information collected by the bot, which will greatly improve his or her work. Looked at from another angle, the emotion recognition methods planned for implementation in bots will result in a need to switch calls to agents when the customer's negative emotions are detected. further development of Contact Center systems, especially with the use of artificial intelligence methods, will certainly contribute to further optimization of the KPIs presented in this paper.

IV. CONCLUSION

The processes of optimization of the KPIs discussed in this paper show trends that are consistent with the industry's expectations. Both the average waiting time and the average conversation time are shorter today. Introduction of new solutions has ensured more optimal utilization of agents' working time. These changes are beneficial, because they directly contribute to a reduction of the service costs. The share of abandoned calls is also decreasing, which leads to higher profits from campaigns. The level of other indicators analyzed in this paper has also gradually improved over time, with customer satisfaction with the service showing the most

noticeable increase in the recent years. The level of this indicator grows with every new solution introduced, which also results in a higher proportion of cases resolved at first contact. New technologies make it possible to ensure that more and more calls arriving within a defined time interval will be handled properly.

Introduction of an insufficiently mature technology is a threat that may accompany implementation of further solutions in CC systems. This can have a negative impact on the KPIs. Moreover, new technologies are increasingly complex and require difficult implementation and configuration processes, which increases the costs and requires training of the staff to learn new skills. However, the biggest challenge will come from the growing customers' requirements. Customers have become more aware and confident at using new technologies. Customers expect uninterrupted and reliable availability of services. Therefore, the CC industry cannot afford to neglect the development of technology. Taking into account the analyses presented herein and the continuously growing public awareness regarding remote communication (as recently triggered by the COVID-19 pandemic), one can assume that the Contact Center industry is bound to experience further dynamic development. Introduction of successive new technologies to CC systems in the coming years will undoubtedly entail continued optimization of the KPIs discusses in this paper.

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MIROSŁAW PŁAZA was born in 1977. He is currently pursuing the degree in telecommunications and computer engineering with the Kielce University of Technology. Since 2002, he has been a member of the academic staff with the Kielce University of Technology, where he obtained the title of Doctor of Technical Sciences in 2005. He is the Head of ICT&IoT CyberLAB, and the Head and Instructor of Cisco Networking Academy. He was awarded the Status of Expert Instructor in 2015, 2017, and 2020; the Above and Beyond Award in 2018; and the Letter of recommendation from the C++ Institute, in 2018, in recognition of increasing the quality of the C++ course offered to more than 9,500 instructors around the world. He held certificate, including CCNA, CCNP, CCNA Security / Cybersecurity, IoT, and Big Data and Analytics. He has conducted numerous Research and Development Studies for EU-financed projects. He is currently the Head of the project titled EMOTICA AI—The Intelligent Contact Center System. As a result of his long cooperation with Cisco, the Kielce University of Technology opened a joined specialization and major named ICT. The results of his research include two patents—as the main author (both received awards in the Świętokrzyski Racjonalizator Contest); one monograph, and over 50 scientific publications. From 2003 to 2009, he was a Vice President of AMICUS Foundation operating for the Kielce University of Technology. Since 2007, he has been a member of the Management Board of the Kielce Branch of the Polish Society of Theoretical and Applied Electrical Engineering (PTETiS). He is a winner of the international European Kangaroo Mathematics Contest, where he won the main prize. The curriculum for this specialization was recognized at the national level and won the title of Leader of Cooperation with the IT Business, in 2018.

ŁUKASZ PAWLIK was born in 1978. He received the M.S. degree in computer science from the Kielce University of Technology, in 2002. He is currently leading the first stage of a research project on speech transcription and intention recognition in the field of contact center systems. The project is carried out jointly with Altar Sp. z o.o. and the Kielce University of Technology, Kielce, Poland. Since 2000, he has been working at Altar Sp. z o.o. as a Programmer and Technical Leader. During his work, he has been involved in the design and programming of Contact Center, Workflow, and Billing systems. He is involved in research on the impact of new technologies on the optimization of Key Performance Indicators in contact centers. He has participated in many conferences in Poland, where he promoted new technologies in the call center industry, including Mobile applications in Contact Center services, Visual IVR in Contact Centers, and New possibilities in customer communication with a company. His interests include development of voicebots and chatbots using artificial intelligence.