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BEYOND CALLS: MODELING THE CONNECTION CENTER

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ABSTRACT

Call centers have been the subject of many simulation studies and the challenges and successes of modelling these environments have been widely published. Call centers have however evolved significantly in the last decade or so, as new communication technologies have become available, customer expectations have increased, and the value of customer experience has been recognized and prioritized. While the single-channel call centers proved complex to analyze and worthy of the advanced analytical power of simulation, the modern multi-channel connection centers bring new levels of complexity to managerial decision making. This paper presents research into the modelling challenges posed by these evolving environments and illustrates how simulation is now more beneficial than ever to organizations aiming to understand and quantify the impact of change in their customer support business.

1 INTRODUCTION

When businesses began to set up dedicated offices to handle customer queries in the 1950s and 1960s (Payne 2015), telephone was the only communication channel (other than postal and face-to-face) available to management and hence "Call Centers" were created. While the postal service was still widely used at this time, it did not pose the same capacity management challenges as telephone. This was primarily because the postal workload could be levelled across the working day but for telephone sufficient staff/agents had to be available at the right times and with the right skillsets to answer calls as they arrived. For management, this meant new challenges in finding the balance between the time a customer must wait for their call to be answered and the labor cost of running the call center (Whitt 1999).

To support and formalize this managerial objective, metrics and targets were established across call centers. Average Speed of Answer (ASA) gives insight on how well the center is meeting demand by recording the time customers wait for their call to be answered. Average Handling Time (AHT) is seen as a measure of agent efficiency as it measures the time an agent spends on a call with a customer. Quality of Service (QoS) or Grade of Service (GoS) measures overall performance against an agreed target by calculating the percentage of calls answered within a specific time. A typical QoS target is 80/20, whereby 80% of calls are answered in 20 seconds (Klungle 1999; Mathew and Nambiar 2013; Seada and Eltawil 2015). Interestingly, although this is a widely used target, there is some online debate over why this is the case when say 90/10 or 70/20 could be appropriate depending on the industry and customer expectation; Talkdesk (2014) trace the origins of 80/20 back to a 30 year old AT&T study that found that most callers would hang up after 20 seconds of waiting while Fonolo (2014) point out that it may get a false boost in validity because of the similarity to the unrelated 80:20 Pareto principal. This uncertainty highlights the general lack of analysis behind selecting, and managing a business to, this target.

Apart from the inclusion of facsimile (fax) in the 1980s (as an advancement on the postal channel), call centers continued to operate in the same fashion until the 1990s. At that time, some of the single-channel call centers evolved to include the new email and SMS channels in their service offerings following the development of the internet and cellular telephone networks, respectively. With significant technological advancement over the past 15 years, the evolution of “Call Centers” to “Contact Centers” has occurred in recognition of the fact that organizations now facilitate interactions with their customers over a number of channels (Avramidis and L’Ecuyer 2005; Mathew and Nambiar 2013), and in some cases this can now be up to nine different channels (Dimension Data 2016).

In addition to the technological changes that have occurred over time, there has also been significant change in how the customer support function is perceived within organizations. For many years a call center was perceived as an efficient way to deal with customer queries about the core competency of the business. This ancillary function was regarded as a cost center and, like any other cost center, every effort was made to reduce its operating costs. When the outsourcing of non-core business processes became commonplace in the late 1990s, many call center operations were moved to lower cost economies. However, language and cultural differences between the customers and the support agents led to poor customer experiences. Companies began to realize that the call center is in fact a valuable touch point with customers and consequently, the managerial perception of call centers shifted from being a rather operative tool to having a strategic role in terms of relationship management (Kantsperger and Kunz 2005).

Despite the increased awareness of the importance of customer facing functions, such as call centers, a financial case for ‘onshoring’ or investing in resources was typically difficult to justify. Kantsperger and Kunz (2005) conducted research into service quality in customer care centers by interviewing top management and collecting 1,580 completed questionnaires from employees, and 2,010 completed questionnaires from customers across a total of 58 call centers. From this, they confirmed that employee satisfaction is the main factor in customer orientation. However, it was not until companies needed to find new ways to differentiate themselves in the marketplace, that they began to exploit the value of contact centers. While brands once predominantly competed on product functionality or cost there has been a recent refocus to include customer experience. Yaşlıoğlu, Çalışkan, and Şap (2013) reported that a study conducted by Purdue University found that 92% of US customers form their image of a company based on their experience using the company’s call center. To help meet customer expectations, innovative companies are offering more services across a range of channels. Reflecting high staff turnover rates in contact centers and the consequent effect on customer service, research is emerging into the effect that information technology plays on job satisfaction and contentment amongst call center employees (Abdullateef et al. 2014).

In the last year or so, the term “Connection Center” has emerged in recognition of the combined effect that the aforementioned focus on customer experience and the introduction of new technology, has had on customer support functions. As more and more customers interact with companies through branded apps and social media platforms, there has been a shift from once-off support interactions to continued “always on” conversations where past queries can be picked up and continued as required. The benefits for customers include reductions in duplicated data entry as they are already logged into a secure environment where the company has access to account details, previous queries and recent website activity (e.g. the customer has tried to add an item to their online cart or they have already browsed the online FAQ). These features provide benefit for the company too, as queries can be handled more quickly thus reducing the agent capacity requirement. Furthermore, the customer relationship is strengthened by the improved speed to resolution and the increased knowledge of customer history and requirements (BearingPoint 2012).

Although the terms Call Center, Contact Center and Connection Center do not have hard definitions and are often in practice (and in this research) used interchangeably, they do illustrate the evolution that has occurred in this business sector over the last sixty years and highlight the increased rate of change in recent years. Despite the disruption, telephone has however continued to be the predominant mode of communication over all this time – up until now that is. In the 2016 Global Contact Centre Benchmarking Report, it was noted that the number of phone transactions handled by contact centers fell another 12% in 2015 and it was predicted that by the end of 2016, digital volumes would overtake phone interactions (Dimension Data 2016). While the results are not yet in, it is clear that the transfer of dominance is imminent.

With customer support services being more complex than ever before, managers face more challenging decisions as they grapple with new channels with varied behaviors and requirements, all in the context of ever increasing customer expectations. Unfortunately, most of the analytical tools used in contact centers are still based on Erlang calculations (described later) and very much call oriented. This research aims to provide an evaluation of requirements for model based decision support in the modern connection center.

2 MODELLING CALL/CONTACT CENTERS

Since the formation of call centers, Erlang-C calculators have been widely used by managers to model their own particular situations and predict performance. By entering relatively basic system parameters (namely, the expected demand rate, mean call duration, the number of agents, and the target answer time), the user of an Erlang-C calculator can quickly get predictions on the key metrics of agent occupancy rates (time on calls / total available time), service level achievement (percentage of calls answered within target time) and the average speed of answer. These are all important pieces of information to consider when determining staff requirements, entering into contractual service level agreements or preparing for change; therefore the widespread use of these calculations is at first understandable. However, the Erlang-C model at the heart of these calculators is a multi-server queuing system (M/M/N) and therefore based on a number of fundamental assumptions which are questionable in the context of a call center environment (Robbins, Medeiros, and Harrison 2010). Firstly, it assumes that every incoming call is of the same type and that once a call enters a queue, it never abandons. Furthermore, it assumes that agents handle calls based on a first in, first out (FIFO) basis and that each agent handles every call in exactly the same way (Bapat and Pruitte 1998). The result of this is that Erlang-C calculators overestimate staffing needs (Kosiba and Wicaksono 2015) and, given that most of the operational costs in a call center are due to salary expenses (Munoz and Brutus 2013), this is a notable source of inaccuracy in call center decision making. Buuren et al. (2015) note that the extension to multiple call types and a heterogeneous pool of servers leads to complex and intractable queueing models. Yet despite all of this, most call center analysis and workforce management tools still rely on Erlang calculations (Kosiba and Wicaksono 2015).

The ability to represent the dynamic and variable characteristics of a busy call center means that simulation models are not restricted by the above assumptions and can therefore address the limitations of Erlang-C calculators. This is not a new revelation. Indeed, forty years ago, in the late 1970's, AT&T had already begun using simulation to analyse their business customers' call centers (Brigandi et al. 1994). So what has happened since then and why isn't "Simulation Everywhere" in call centers?

2.1 Call/Contact Center Simulation Modelling

While much research has also been published elsewhere, the Winter Simulation Conference (WSC) archives provide good insight into the level, and topics, of interest in call center modelling over the years. Almost twenty years ago, when considering "Why call centers need simulation?", Bapat and Pruitte (1998) noted the limitations of Erlang models and indentified how simulation can be used to represent the necessary elements of a call center. These elments include but are not limited to calls (and different call types), agents, trunk line capacities and call center technologies (e.g automatic call distributors (ACD) and interactive voice response (IVR) systems).

At the turn of the millenium, a number of research papers were published outlining case examples and providing insight into the benefits but also the challenges that a call center simulation modeller may face (Tanir and Booth 1999; Klungle 1999). While the challenges identified related predominately to data both in terms of gathering and consolidating, the deeper understanding of the system and the stronger team bonds that can be built by sharing and visualising this understanding were reported by Tanir and Booth (1999) as benefits of simulation that can be often overlooked. Other papers at this time aimed to highlight how simulation models could be used to support investment decisions in a call center (Chokshi 1999; Miller and Bapat 1999). These types of decisions were pertinent as call routing and network technologies represented significant capital investments (for instance, one of the examples presented was a multi-million dollar rollout across 25 sites). By representing the proposed 'to-be' scenario in a simulation model, it was possible to illustrate the performance of the intended system under a range of circumstances, gain stakeholder insight and recommendations, and support return on investment (ROI) calculations.

By the mid-2000's researchers were investigating specific contact center activities such as the handling of both inbound and outbound calls (Pichitlamken et al. 2003) and the consideration of mult-skilled agents and the associated routing (Koole, Pot, and Talim 2003; Mazzuchi and Wallace 2004). At this time, Mazzuchi and Wallace (2004) concluded that "Simulation-based analysis of skill-based routing call centers is expected to be the predominant tool of choice since even for relatively simple systems, available analytical solutions are rather restricted" and Avramidis and L'Ecuyer (2005) agreed that "Simulation appears to be the most viable option for accurate performance measurement and subsequent decision support". In recognition of the pivotal role that usability plays in the uptake of a new technology, Saltzman and Mehrotra (2004) presented a "manager-friendly" platform that used the ubiquitous and familiar MS Excel to act as an interface to an underlying discrete event simulation model. The authors suggest that by exposing only the inputs for system parameters and model results (and not the components of the model) they addressed the barrier that a lack of programming ability can pose for call center managers when using such models.

In the late 2000's simulation was used to evaluate and refine the algorithms that are coded into call center systems effectively gaining operational benefit through the insight from the advanced power of simulation based analysis (Ibrahim and Whitt 2008; Adetunji and Larijani 2008). The subject of Erlang model evaluation (and comparison to simulation models) was revisited at this time and once more their limitations were identified. Franzese et al. (2009) note that while the simulation results are more accurate (assuming one has the "right" real-world situation reflected in the model), the Erlang based methods are very quick and easy to obtain and do not require a simulation software package. They conclude that the Erlang calculators may remain popular until affordable simulators can be made widely available. Robbins, Medeiros, and Harrison (2010) point out that the Erlang model's continued popularity may in part be explained by its tendency to provide pessimistic (i.e. conservative) estimates which allow scope for the real system to perform better than predicted.

From 2010 to 2015, while there was a lower level of call center related activity in WSC, researchers continued to study the nuances of this business function and build on previous research. Ibrahim et al. (2012) focus their attention on the arrival rate of calls and identify that commercial software and call center managers usually base their decisions on point forecasts whereas arrival rates are themselves "stochastic, time-dependent, dependent across time periods and across call types, and are often affected by external events". It is noted that in typical business-related call centers, there is a peak period just before lunch and another one just after lunch, with a lower arrival rate during lunch, and even lower in the early morning and late afternoon. However, depending on numerous factors including the business sector, the seasonality of the products/servics and billing cycles, the form of this call arrival pattern can vary depending on the time of the week, month or year and therefore has proven challenging to define as a model input parameter (Ibrahim et al. 2012). In addition to initial call attempts, there are many redials (re-attempts after abandonments) and reconnects (re-attempts after answered calls) in call centers. Neglecting redials and reconnects will inevitably lead to inaccurate forecasts, which eventually leads to inaccurate staffing decisions (Ding, Koole, and Van Der Mei 2013).

Steinmann and De Freitas Filho (2013) report that the basic problem in forecasting incoming call volumes can still be the availability and quality of data. They propose that generating synthetic data could be an interesting alternative possibility for constructing and testing simulation models of call center operations. The authors note that "countless different scenarios can be tested and random factors can be included with varying impacts thus providing managers with insight into the range of possible outcomes". Munoz and Brutus (2013) also pick up on the power of this sensitivity analysis and illustrate how simulation models can help management to understand the skillset versus cost trade-offs that can occur in a call center environment by testing a range of possible scenarios. Buuren et al. (2015) consider such trade-offs in the high stake emergency service context where the speed of handling calls and dispatching ambulances (or firefighting services) is of critical importance.

Interestingly, in the latest WSC proceedings, the journey comes full circle with Robbins (2016) offering an evaluation of the use of an Erlang model in a call center. In this case, the Erlang-A model is considered in high traffic environments, a situation where the Erlang-C model is not applicable. The Erlang-A model is an increasingly popular extension of the Erlang-C model that allows for caller abandonment. After a systematic analysis of the error associated with the model, it is concluded that "under realistic conditions even the more sophisticated Erlang A model is subject to significant error".

In summary, the above (while not even covering all of the WSC research with a call center facet) shows how simulation has long been identified as an appropriate tool for call center analysis and how this appropriateness has been reiterated over time as technological considerations have changed (e.g. the early focus on infrastructural constraints and investment decisions has become less of a concern as cloud computing technology allows call/contact centers to access resources and scale as required) and more detailed forecasting and skillset considerations have been explored. In the following section, the nuances of a modern contact/connection center, with the increasing focus on digital channels is explored and the case is made that simulation is still, and perhaps more than ever, an appropriate analysis tool in the domain, albeit with new modelling challenges.

3 THE FUTURE FOR MODELLING CONNECTION CENTERS

The traditional operational challenges of managing a call center have been well studied, as can be attested to by the extensive reference lists in prominent literature surveys in this field (Gans, Koole, and Mandelbaum 2003; Aksin, Armony, and Mehrotra 2007). These challenges still apply in connection centers (as a new representative term for modern customer support functions with a focus on digital channels and customer experience) and some of the key topics include but are not limited to the following.

- Call volume forecasting – as noted above call volumes can have difficulties in predicting daily and seasonal patterns which are often influenced by external factors.
- Personnel planning – the forward planning of staff levels can be critical as agent training can take anywhere from three weeks to three months and once active, it can take an agent several more months to become fully competent and productive (Robbins, Harrison, and Medeiros 2007).
- Cross-training – with product and service proliferation and multiple communication channels the levelling of cross-training to aim for (where agents are capable of handling multiple contact types) is still a topical challenge.
- Shift scheduling – on a daily basis the number of agents active in the call center must be managed so as to achieve target service levels in a cost effective manner. This task is widely handled by specialized Workforce Management (WFM) tools but the aforementioned reliance on Erlang

models and limited experimental capability mean that there are still opportunities for improvement in this space.

The ability to support these decision making topics with simulation modelling has been previously illustrated in Section 2.1. Therefore, the next section will focus specifically on how simulation can be applied to some of the challenges associated with representing newer digital channels.

3.1 New Operational Challenges

The new operational challenges in a connection center predominately emanate from the increasing commercial focus on customer experience (CX) while being fueled by rapid technological change. In order to improve brand accessibility and create convenience for customers, progressive organizations already provide support across an array of communication channels. The organizations that have to date only supported traditional channels (e.g. call and email) are now evaluating the benefit of investing in digital alternatives (e.g. web chat and in-app messaging, wherein web chat and in-app messaging refer to two similar but operationally different digital communication channels).

- Web chat is a service that allows customer questions to be answered whilst they are browsing a website and is typically initiated by a pop-up notification inviting the customer to chat. As such, web chat is made available when agents are available and the response times are typically short (in the order of seconds or minutes).
- In-app messaging refers the situation where a company offers a chat option within their branded smartphone application. In this case, the response time expectation is lower (can be hours) as the customer can begin a conversation whenever they wish, even outside of working hours.

In both of these cases the conversation can be asynchronous, i.e. requiring neither the agent nor customer to be engaged at all times (as is the case in a telephone conversation). For the connection center manager, this enables agents to handle more than one conversation at a time. In the industry, this is referred to as 'concurrency' and while beneficial from an overall efficiency perspective, it complicates managerial decision making.

To manage the overall time it takes to deal with an individual customer and to prevent agent burnout, concurrency limits are put in place to restrict the number of active chat sessions that an agent is engaged in at any one time. Agent proficiency is a significant factor in the number of sessions that they can effectively support and so trainee agents will begin with a limit of one and this rises with experience to two, three, four or even more depending on the sector and complexity of queries. Although a recent survey, suggests the service quality can be compromised beyond two or three concurrent web chat sessions per agent (Call Centre Helper 2016).

3.2 Case Examples

As part of the research presented here, interviews were conducted with managers in two companies that are representative of both scenarios outlined earlier (i.e. already using or proposing to use digital channels). In one case, the company currently only offer telephone support but recognizes that some of the routine queries that they deal with could be readily handled on web chat. The managerial challenge is the calculation of the ROI associated with adding a web chat service prior to presentation of the case to senior management. In the second case, the company already offers support across phone, email, social media, web chat, and in-app messaging but plans to transition from non-digital dominant communications to digital dominance in terms of total volume. To achieve this while maintaining service levels during the digital 'ramp-up' phase, the customer support manager needs to temporarily increase the workforce. In evaluating and planning for this transition, management is interested in experimenting with different projected scenarios and illustrating the financial impact associated with short term increases and longer term decreases in labor costs. In both cases, the rate of concurrency was noted as a source of confusion and complication in their calculations.

3.2.1 Modelling Concurrency

To examine the impact of concurrency on connection center capacity and performance metrics, a simulation study has been undertaken based on sample data from the case examples. The models were developed using the discrete event simulation engine in Centricity (http://centricity.ie/), a new decision support tool for connection center managers. Whilst developing simulation models of multi-channel connection centers, some specific requirements for representing web chat and in-app messaging have emerged. For instance, as illustrated in the simplified block diagram in Figure 1, chat sessions queue until an agent has capacity based on their concurrency limit. Once a customer has entered a web chat conversation with an agent, they continue to interact with that particular agent and therefore wait even if another agent is available. Each chat agent must consequently be modelled as a distinct instance rather than using a more generic resource pool (as can be done for call based agents). However for in-app messaging, the conversation can often be extended over a longer period of time (longer than a single work shift) and therefore, while the preference is to use the same agent, the possibility of another agent continuing the conversation must be provided for. The concurrency limit works in the same fashion in both cases wherein an agent is prevented from engaging with a new customer unless their number of active sessions is below their personal concurrency limit. However, the concurrency limit for in-app messaging is typically much higher than that for web chat as customer expectation for response time performance is significantly lower.

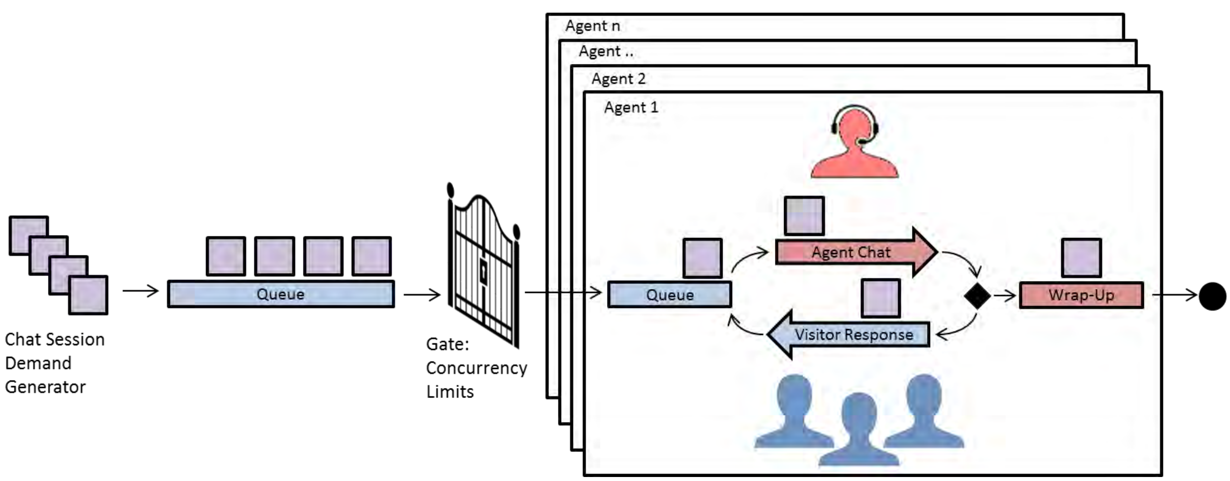

Figure 1: Graphical overview of modelling concurrent chat/messaging

To model asynchronous channels and concurrency, it is necessary to break a session down to the individual responses so that the agent resource is released and available to other active sessions while the customer is responding. This generates the requirement for the following model inputs (specified as probability distributions).

- The number of interactions per session;
- The time taken for an agent to process a message response (time spent reading and considering the customer's last response and then typing a response);

- The time taken for a customer to respond (time spent reading, considering, typing plus any other delays in responding);
- The renege times (time to abandon) associated with the initial response and in-chat/message waiting times.

Of note here is the distinction between the response times for agents and customers. For the agent, only the time spent directly engaged on a response should be specified with any additional delays (handling other sessions, breaks, etc.) being generated by resource constraints and queueing during the simulation model execution. For the customer, however, any delays are driven by factors outside of the scope of the model and must therefore be incorporated in the model input. In the digital channel reporting information reviewed to date, only overall time to respond (for both agent and customer) was available as this is how management evaluate performance. While this provides what is required to model customer responses it lacks the granularity needed to model agent behavior and therefore assumptions have been necessary (based on the response times when agents are working on a single session).

3.2.2 Sample Trade-off Analysis

As an example of the insight achieved by modelling concurrency in a simulation model, Figure 2 shows the results of a test analysis exploring the trade-off between AHT and ASA as concurrency limits are increased. The input data for the model was based on information from the second case example outlined above, as they already had a web chat channel in place and could therefore provide historical data. In this case, the chat channel is operated by two agents and receives an average of 180 contacts per day. Each chat session has an average of seven response lines (i.e. the back and forth interactions between the agent and customer) with each response taking a maximum of 135 seconds and an average of 47 seconds. An experiment was designed whereby the concurrency limit was incremented from a single conversation at a time up to five concurrent conversations. The results for mean ASA and AHT for each scenario are presented in Figure 2. As would be intuitively expected, but difficult to quantify, the ASA decreases with increasing concurrency limits because there is more potential for agents to accept newly arriving requests. The trade-off for this improvement is that it takes longer to complete the conversation as the agent must tend to more conversations at the one time. However, as concurrency allows for agent time to be used more efficiently, the impact on AHT is not as pronounced.

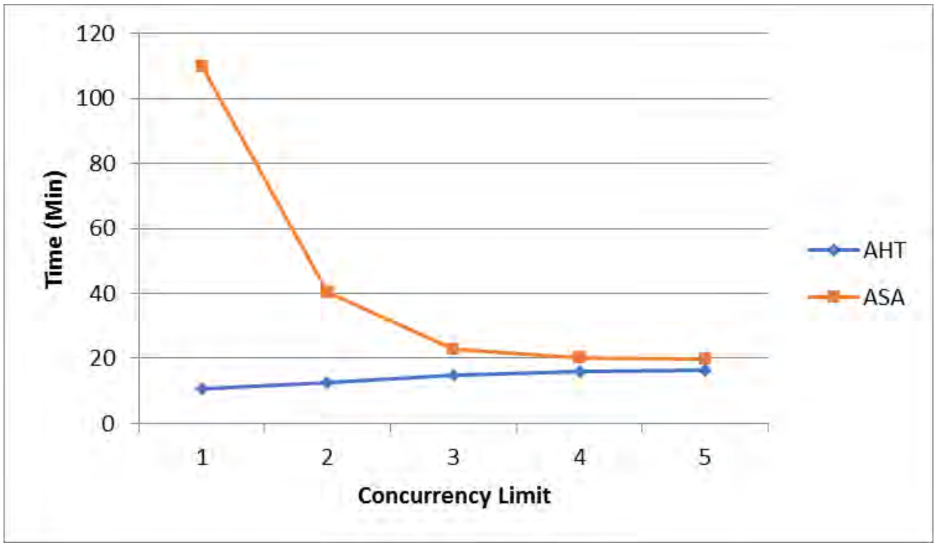

Figure 2: The impact of concurrency limits on AHT and ASA.

Depending on their experience and skill level, different chat agents are assigned different concurrency limits. A trainee agent for instance will only handle a single session at a time while they learn to use the chat software and become proficient at understanding and resolving customer queries. With the type of information presented in Figure 2, a connection center manager can begin to understand, explain and predict the performance implications of different concurrency limits. With this insight, management can better prepare for seasonal staff ramp-ups when the team will consist of a higher proportion of inexperienced agents. In addition to considering the agent workload implications of concurrency limits, management can now also consider the customer experience implications in terms of initial waiting times and time to resolution.

4 CONCLUSIONS AND FUTURE WORK

Current contact center analysis is predominately limited to spreadsheet analysis and the experimental capability of the WFM tools in situ. While often useful, the Erlang models that underlie most analyses are designed for studying telephone calls and therefore limited in what can be imagined and evaluated. Even in the case of telephone calls, shortcomings in the accuracy of these models have been identified and published for many years. Given that now, or in the very near future, calls won't account for the majority of contacts handled in a "call" center, the critical mass required for change may at last be occuring.

The traditional challenges to capturing a full understanding of a connection center are known and have been proven in past research to be addressed in an appropriately designed simulation model. In this paper, as part of an ongoing research project, simulation has been shown capable of modelling additional characteristics of modern digital channels. Future work in this research will consider the use of social media channels (Facebook, Twitter, etc.) - which on initial investigation present many similarities to in-app messaging (always accessible, customer initiated, etc.) - and the greater use of artificial intelligence and 'chatbots' to automatically respond to routine or straightforward queries (adding additional complexity to staff scheduling requirements as agents can be required to take over a conversation once the the questions become more complicated). Further research is also required on the additional data capturing/processing that is required for connection centers to utilize simulation more readily (e.g. the additional granularity for agent chat time as noted earlier). A greater understanding of customers' willingness to wait (depending on their query and channel) would also be a worthy pursuit that can aid model refinement and managerial interpretation of simulation results. Indeed, to make the power of simulation more accessible and informative to practitioners in modern connection centers, it may be necessary to embed models into broader managerial and analytical processes, where simulation output can be considered in the context of information from other sources (Net Promoter Score (NPS), Customer Satisfaction (CSAT), etc.) as part of a holistic call/contact/connection center analysis and decision support tool.

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