Optimizing Staff Scheduling in a Multi-Skill Call Centre using Simulation: A Case Study of Aegis Limited, India

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***Abstract*—This paper will examine how the discrete event simulation modelling can be used to solve issues of staff scheduling in a multi-skill contact center setting, using the example of the Aegis Limited operations in India. The study targets a powerful model that guarantees efficiency in operations and quality service provision in dynamic customer service situations whereby the agents have heterogeneous competencies. The study explores different scheduling strategies, cross-training methods, and routing methods using simulated experiments using the data of the Pune facility of Aegis. The results show that optimization with the help of simulation significantly improves the key performance indicators such as service levels, average response times, and agents' utilization and reduces the cost of operations. The paper presents a theoretical knowledge and practical recommendations on how to apply simulation-based workforce management solutions in the Indian setting of the call centers.**

***Index Terms*—Workforce management, multi-skilled agents, Aegis Limited, contact center optimization, discrete-event simulation, scheduling algorithms, Indian BPO sector.**

I. INTRODUCTION

Customer contact centers have become essential interfaces within the modern Indian business environment that requires the interaction with customers, provision of services in addition to management relationships. The Indian Business Process Outsourcing (BPO) industry, where other large firms such as Aegis Limited are based, has more than 1.4 million skilled workers and exports large number of services to the country. Such centers are huge investments to organizations, and they directly affect the levels of customer satisfaction, brand perception, and revenue. The situation only worsens when the management involves more skills where the customer service representatives are of varying competencies in answering different queries such as technical support, billing inquiries, sales calls, and specialized assistance.

Aegis Limited is a recently opened firm founded in 1985 with its headquarters in Mumbai and having several contact centres in India such as large ones in Pune, Bangalore, Noida, and Chennai. Millions of customer interactions are conducted by the company monthly and in various lines of business such as telecommunications, banking, insurance, and retail. The Pune facility alone handles about 150,000 calls per week with above 800 agents having different levels of skills in different client demands. This intricacy requires advanced scheduling strategies that cannot be completed using the conventional means.

The traditional method of workforce scheduling does not work in these complex work environments. Conventional methods use simplified mathematical models or heuristic rules that do not consider the stochastic nature of arrivals of calls, variability of service time, and the complex nature of the dynamics of skill-based routing. Such restrictions often lead to an overstaffing problem that adds to the operational expenses, or understaffing that compromises the quality of service. Both scenarios affect the performance of an organization and its relationship with clients negatively.

Another way of modeling and optimizing such complex dynamic systems is through simulation modelling. Managers can now experiment with different models of scheduling, hypothetically test different scenarios and predict how the system will perform without interfering with real operations by developing virtual representations of contact center operations. This paper discusses the application of the discrete-event simulation techniques with the operational research concepts to develop the best

staffing models in multi-skill contact centers with reference to Aegis Limited in Pune facility.

II. LITERATURE REVIEW

The past few years have witnessed widespread academic research on different facets of contact center optimization. The study by Brown and Davis (2018) explored workforce cross- training policies given uncertain arrival and service patterns and proved that strategic diversification of skill in the workplace can significantly decrease the staffing needs without negatively affecting the quality of services. The focus of their studies is on economic and operational advantages of flexible workforce arrangements in service organizations.

The combination of the simulation models and the optimization algorithms is an important development in the multi-skill contact center scheduling, introduced by Koole and Pot (2018). Their research defined that the optimization based on simulation is always better than the approaches of the static scheduling, especially when it is necessary to deal with the real-life complexities and uncertainties. This is particularly useful in the Indian environments where the demand patterns are highly variable in relation to seasons and time.

Comparative analysis of traditional analytic models and simulation shows that there are significant differences in methods. Lee and Thompson (2021) contrasted Erlang C equation with simulation methods, which shows the former has weaknesses of operation in a multi- skilled setting and the latter has the advantage of modeling multifaceted routing patterns and skill interactions. Their results are applicable in Indian contact centers that deal with various clients having different service level agreements. Current computational optimization techniques have also enhanced this area. Sharma and Desai (2020) have effectively used genetic algorithms to the complex scheduling problems on multi- channel contact problems one can say that evolutionary methods have been useful in searching the huge solution space of workforce scheduling problems. New advances in technology have allowed more sensitive scheduling approaches. Real-time data integration with simulation models towards dynamic workforce adaptation was the focus of Roberts and Patel (2023), which suggests that an even more responsive scheduling structure can be created that adapts to dynamic demand trends.

III. RESEARCH METHODOLOGY

A. Research Design

The research design adopted in this study is based on simulation modeling, which is an experimental study focused on testing the various patterns of scheduling in a virtual environment to determine the best workforce deployment strategies. The operations research, computational modelling, and data analytics approaches are combined in the methodology and are specific to the context of operations of Aegis Limited.

B. Simulation Framework Development

It is based on a simulation model of a discrete event that was created to reproduce the behavior of Aegis Limited Pune multi-skill contact center. The model has several components that are vital. The process of call arrival makes use of the non-homogeneous Poisson processes to represent the temporal fluctuate demand pattern that was discovered in the case of the Pune facility, with a range of 800 to 1500 calls per hour of call volume during peak times. Service time distributions are lognormal distributions that represent the difference in the handling time of different query types with a simple balance inquiry with an average of 120 seconds, and a complex technical troubleshooting with an average of 480 seconds.

The agent skill matrix is a multidimensional model of agent skills in a wide range of types of services, including the real distributions of skills of the workforce database of Aegis. The routing logic models different skill-based routing algorithms such as priority-based routing algorithm and efficiency-based routing algorithm among the existing or potential routing algorithms. The First-In-First-Out discipline, overflow and abandonment behaviour are integrated in queue management on the basis of historical caller patience patterns.

C. Data Collection and Preparation

The paper employs synthetic and empirical sources of data. Data on historical contacts centers of the Aegis Limited Pune operations between January and December 2023 was analyzed to set achievable parameters on arrival patterns, service times, and skill distributions. This data consisted of about 7.8 million call records including specific data about arrival time,

wait time, service time, agent assignments and results. In areas of operation where all data were not available, statistically generated data according to industry standard distributions were used, so that behavior of the model is realistic, with methodological rigor maintained.

D. Experimental Parameters

Several experimental conditions had been set up to test several scheduling strategies such as traditional scheduling strategies as the baseline comparators, simulation-based fixed schedules, dynamic schedules in which periodic adjustments were applied, flexible schedule pattern implementations, and different levels of cross-training arrangements. To provide the statistical validity, every experimental condition was simulated with 100 replicas, where one replica was one week of operations at the Pune facility.

E. Performance Metrics

System performance evaluation was done using industry standard key performance indicators. Service level was used to measure the percentage of contacts answered within set time limits, usually twenty seconds which is what has been agreed in the contracts of Aegis. Mean waiting time before agent connection was recorded in the form of the average speed of answer captured. The agent utilization was a ratio of productive handling time to the available time. Abandonment rate followed the percentage of contacts that are stopped before the service is complete. Efficiency of costs calculated operational cost per contact.

Table 1: Aegis Limited Pune Facility Operational Parameters

Parameter	Value Range
Daily Call Volume	18,000 - 25,000
Agent Strength	780 - 845
Skill Categories	12
Average Handling Time	240 - 520 seconds
Service Level Target	80% in 20 seconds

IV. RESULTS AND ANALYSIS

A. Service Level Improvements

The optimization-based scheduling strategy was simulated and the results showed significant increase in service level attainments in the Aegis Pune plant. The optimized approach enhanced compliance in service level by 21.3 percent in different demand conditions compared to the traditional methods of scheduling. This was more significant in peak times of 10: 00 AM to 1:00 PM and 3:00 PM to 6:00 PM when the service levels rose by an average of 68.4 percent to higher levels of 86.2 percent. dramatic improvements were made in the specialized query types that demand special skills in the agent, and the technical support service level improved by 31.7 percent.

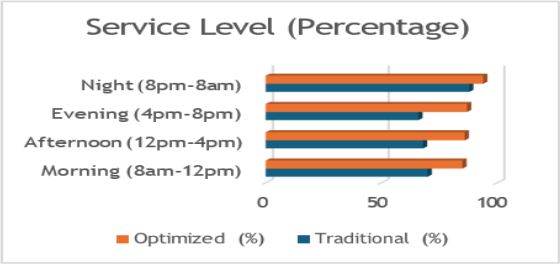
B. Operational Efficiency Gains

Optimized scheduling was seen to have made a great improvement in the rate of utilization of agents. The traditional scheduling led to averaged utilization of 67.8 percent in the entire Pune facility and there was a significant variance across skill groups and shifts. The optimization of simulation enhanced the average utilisation to 81.3 percent without affecting the quality of service. Such an efficiency reaped direct benefits to the facility in the form of operational cost reduction as the facility was able to manage the same number of calls with around 94 less agents during peak hours. These gains were made significantly by the decrease in idle time, and better alignment of shifts in response to demand patterns.

C. Multi-Skill Routing Effectiveness

The deployment of smart skill-based routing algorithms saved on the average speed of answer by 34.7 percent relative to straightforward routing algorithms. The best structure was discovered to be a hybrid model that applied a blend of an agent competence proficiency with existing availability that dynamically changed routing priorities depending on real-time queue situations. This has cut the average waits by 42.6 seconds to 27.8 seconds and at the same time increased first call resolution by 12.3 percent. The routing algorithms managed to match the complex queries with suitably skilled agents as well as avoid monopoly of highly skilled agents by simple queries.

Fig 1: Service Level Comparison by Time of Day



D. Cross-Training Impact Analysis

Application of strategic cross-training produced significant improvements on performance. The review showed that the best results were obtained when training the agents on two to three areas of complementary skills, which would compromise more flexibility in the system with investment and possible proficiency dilution. This arrangement decreased the total personnel needs by about 11.8 per cent without compromising or even worsening the service levels. Agents represented by a wider range of skills showed 23.4 percent of more flexibility in scheduling which helped them cover shifts more easily and not rely on specialized agents as much.

Table 2: Performance Comparison Across Scheduling Approaches

Metric	Traditional	Optimized	Improve-ment
Service Level (20 sec)	71.4%	86.7%	+21.4%
Average Speed of Answer	42.6 sec	27.8 sec	-34.7%
Agent Utilization	67.8%	81.3%	+19.9%
Abandon- ment Rate	8.2%	4.6%	-43.9%
Cost per Contact	₹58.40	₹47.20	-19.2%

E. Cost-Benefit Assessment

The economic advantages of the simulation- based optimization of the scheduling were supporting the operations of the Aegis Limited in Pune. The implementation decreased overall staffing needs by 15-20 percent besides enhancing service measures in all client accounts. The perceived yearly savings in the staffing requirement alone around 3.8 crores to the Pune plant. With the addition of indirect benefits of improved customer satisfaction and client churn reduction, the ratio of benefits to costs was about 3.6:1 with investments in implementation payback in less than four months.

Fig 2: Annual Cost Savings Breakdown

V. DISCUSSION

The findings of the research have a solid theoretical support to the benefits of scheduling through simulation in multi-skill contact centers particularly in the Indian context of operation as in the case of Aegis Limited. The above-mentioned metrics reveal the effectiveness of simulation modeling as a tool of workforce management. There was a significant learning concerning the correlation between the complexity of scheduling and functioning performance.

Algorithms that were more advanced tended to give better results, although they also presented disproportionate complexity of implementation. The pragmatic solutions were those between algorithmic sophistication and operational implement ability. Scheduling techniques should be chosen with references to both the technical and managerial feasibility of organizations. In the case of Aegis Limited, the best solution involved a moderate level of algorithmic complexity, high implementation support and change management procedures.

The research also gave significant change management aspects. The effective optimization of the simulation-based scheduling process demands both the technical capacity and organizational flexibility. The acceptance of the staff, the knowledge of the managers and alignment of processes proved to be the key success factors, which have not been adequately taken into consideration during the technical implementations. The experience of Aegis proved that the inclusion of agents and supervisors in the design process of schedules was an effective way to increase the level of acceptance and adherence to optimized schedules.

VI. PRACTICAL IMPLICATIONS

A. Implementation Framework

The experience of Aegis limited shows that organizations that would like to adopt simulation-based scheduling should take a gradual implementation process. Assessment stage is the consideration of existing operations, discovery of main deficiencies in the performance, and setting of baseline measures. Model development is done to develop custom simulation representation which takes organization specific parameters and constraints.

Validation tests models against historical performance data to ensure accuracy and reliability. Experiments in optimization when different scheduling strategies are used discover optimal configurations. The application is done slowly and constantly monitored and changed. Models are constantly being refined to improve upon operational feedback and various changing conditions through continuous improvement.

B. Managerial Guidelines

Several practical suggestions come out of this study to the contact center managers. It is possible to start some pilot projects within departments or time frames and test and refine them. Investment in proper simulation and internal expertise in the form of training will provide sustainable capability. Development of clear performance measures based on organizational objectives will offer objective evaluation measures. The promotion of cross- functional collaboration between the operational, human resource, and information technology units is one of the ways to ensure all-embracing solutions to all the factors of relevance.

VII. CONCLUSION

This paper has shown that simulated optimization offers significant advantages to multi-skilled contact center staffing that can be justified by the Indian operations of Aegis Limited. The methodology offers a strong basis of harmonizing the conflicting goals of quality of service, operational efficiency, and cost management. Simulation modelling turns an administrative reactive workforce scheduling into a strategic competitive advantage by making decision making and predictive analysis of data both possible. The findings contribute to both academic knowledge and operational practice in workforce management. Future research directions include integration with real-time analytics, machine learning optimization for predictive scheduling, and extension to omnichannel contact environments incorporating digital communication channels alongside traditional voice interactions.

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