DELWARCA CASE STUDY TECHNICAL REPORT

Group G

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Introduction

Delwarca is a company that helps firms aggregate and integrate disparate software programs to manage their supply chains. The ad-hoc nature of its clients' software configurations and dependencies often means that the problems that arise are often unique to each client and require expert assistance that might not be available elsewhere. From clashes between the multiple software used in the supply chain process to differences in system failures due to updates and deprecation, multiple points of failure exist in the portfolio of supply chain management tools that firms employ. Delwarca exists to resolve these issues.

At the time of the case study, the company's customer support was split into four branches: software development, field support, critical support, and the remote support unit. This case focuses on the remote support unit, which has received substantial negative feedback from its clients concerning waiting times, despite the department's technical competence. This surge of criticism occurred in the wake of a new process flow developed (ironically) to improve customer experience.

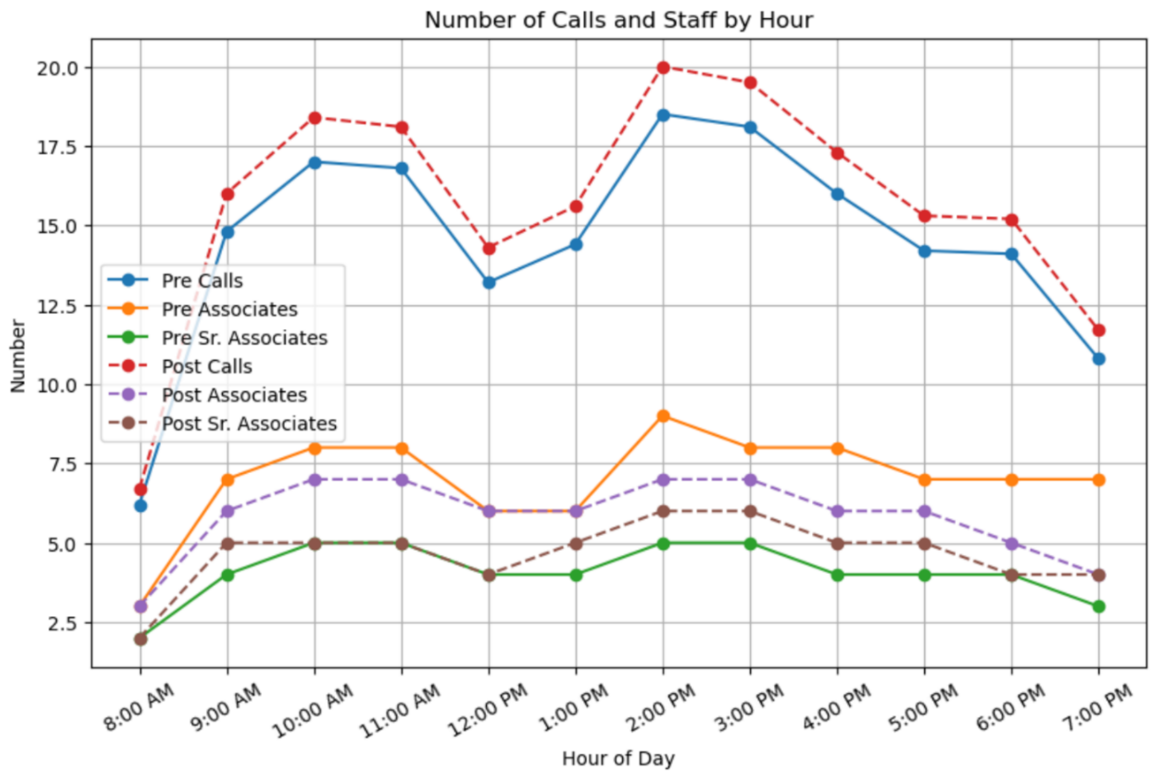

Figure 1: Average Daily Trend in Calls and Staff

Control Flow Mapping

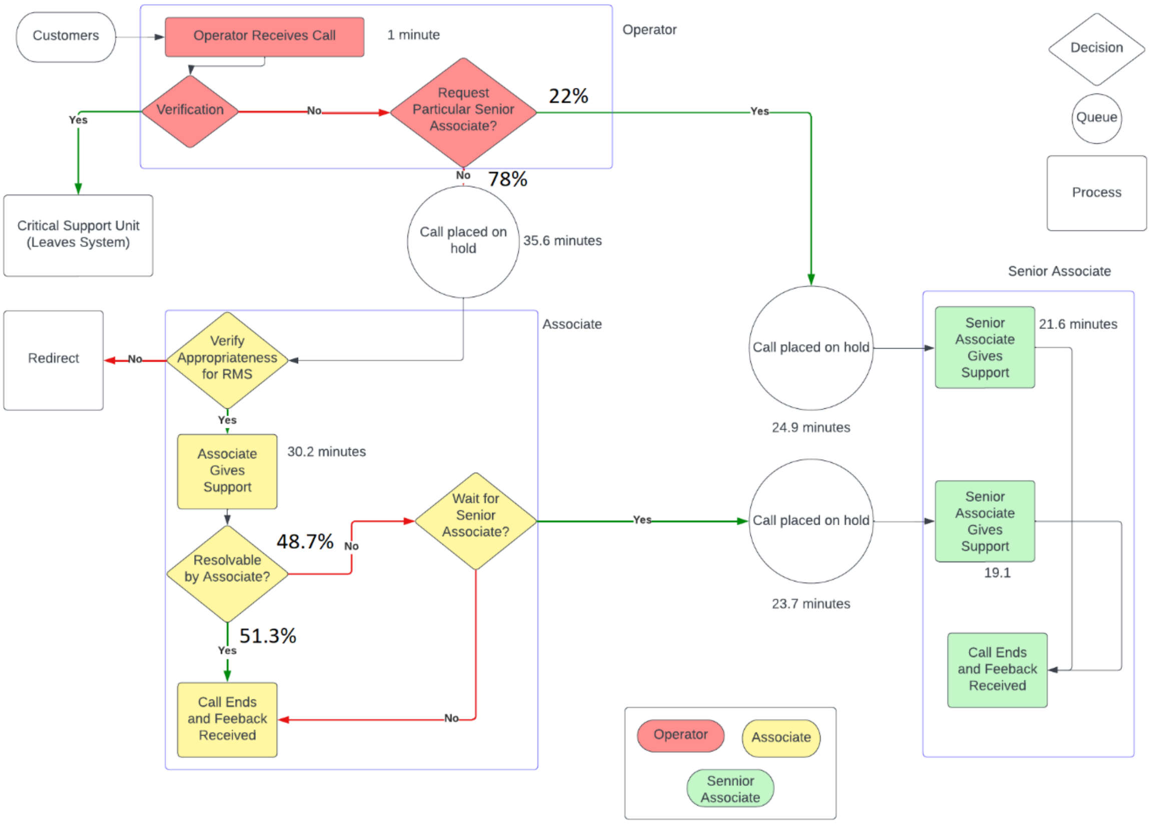

Figure 2: Pre-Rapid ID Process Flow

Prior to the implementation of the Rapid ID procedure, the workflow began with customers placing calls to Delwarca's RSU. This call was first received by an operator who verified the caller's status as a client and forwarded them to other departments if their requests were unsuitable for the RSU. This was a relatively rare occurrence. If the caller was both a valid client and had issues relevant to the RSU's role (which was most cases), they were presented the option of either speaking to a senior associate they knew by name (which was often useful for picking up on past problems) or if not, speaking directly to a regular associate. Both pathways involved some queuing, with the queues for senior associates often bearing heavier traffic. If the customer was directed to a regular associate, they had about a 50% chance of resolving their issue. If the associate could not resolve their problem, then they were put in another queue to speak with the next free senior associate. On average, about 22% of clients requested specifically for the senior associates, while the remainder went to regular associates. The senior associates had a near 100% resolution rate in comparison to the regular associate's 50%.

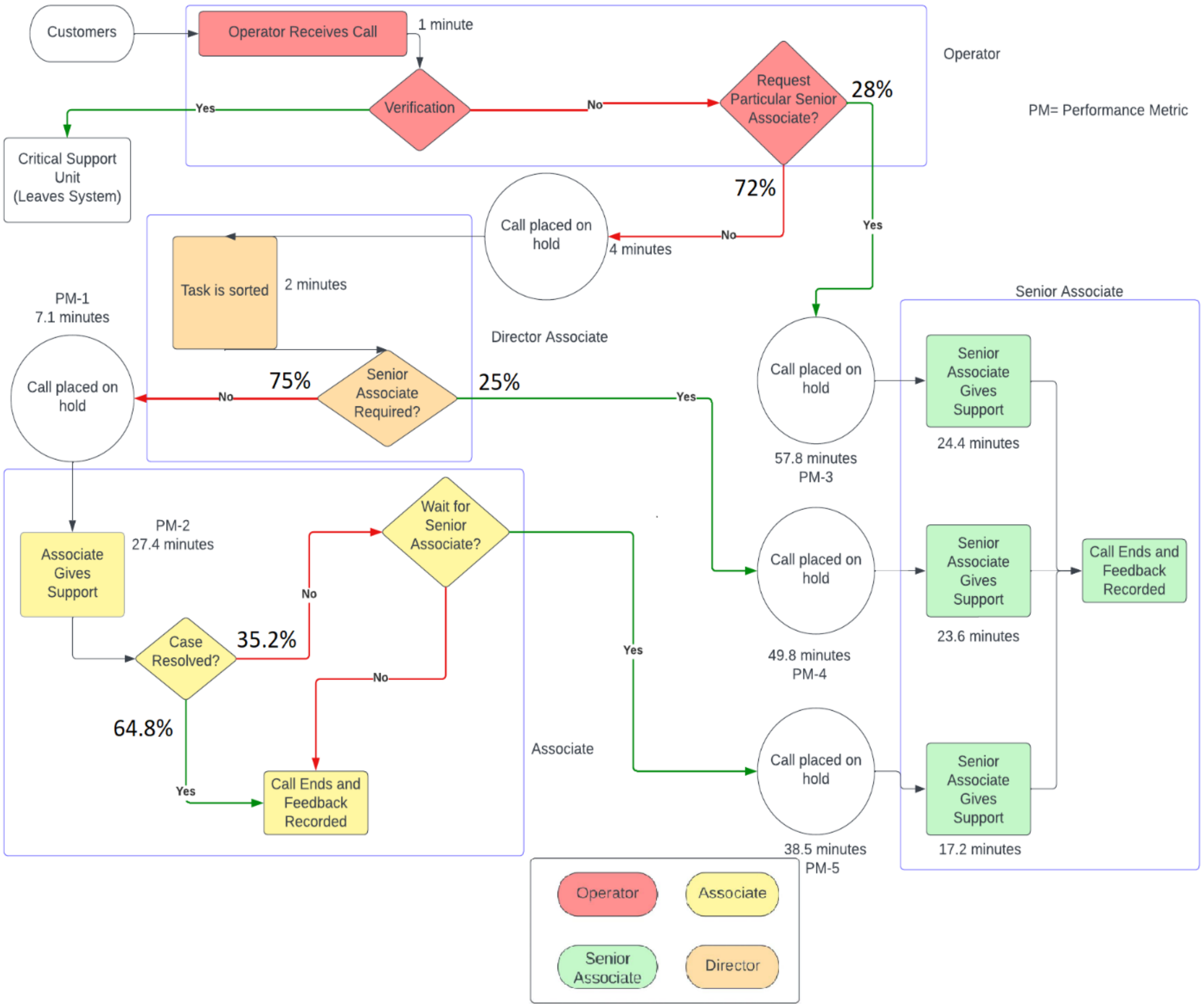

Figure 3: Post-Rapid ID Process Flow

Following the implementation of Rapid ID, the operator's role was restricted to verifying the client status of the caller and ascertaining that their issues could be resolved by the RSU. After speaking with the operator, a director associate would connect with the customer to pre-emptively determine which group of associates (senior or regular) would be more likely to resolve their issues successfully. Like before, if a customer requested a specific senior associate, the director would forward them to the individual's queue. And the same mechanisms of escalation existed if a regular associate was unable to resolve the issue. Under this procedure, the wait times for senior associates rose to 57.8 minutes on average from 24.9 minutes prior to rapid ID. Fewer calls were sent to associates, and their hold times decreased from 35 minutes to just over 7.

Important Metrics

The key measurement of the success of a process change is customer satisfaction as if customers were willing to wait as long as they were to get technical support, then this would be acceptable. Unfortunately, data was not available on this metric even though reviews of customers were gathered. As such, in future research, it would be advisable to analyse this data by gathering either a numerical rating from customers or performing sentiment analysis on reviews using machine learning. It is also important to note some survivorship bias to this metric as a customer who hung up halfway through the system is unable to give a review at the end.

Since customer satisfaction is unavailable, the main metric that will be analysed is the average hold time as the limited information on customer opinions seem to be that there was much frustration at the long wait times, but the technical support was satisfactory when it was finally received. As such, the primary aim should be to reduce hold times to reduce customer frustration. It is also important to look at the longest wait times (in this case top 5%), as these will have the largest impact on queue buildups and lead to large amounts of dissatisfaction.

Linked to this is the idea of utilisation, as if utilisation can be reduced, then naturally, queue times will also decrease as a result. However, utilisation should obviously not be reduced too heavily to create redundancy on the part of associates.

Escalation rate is measured as the number of calls that need to be transferred to a senior associate after being handled by a standard associate. This gives a measurement of the competency of non-senior associates. This is useful to consider in the long term as the system may improve as associates gain experience. A lower escalation rate will mean less frustration from customers as their problems are resolved faster, but this mustn't be done at the expense of denying associates learning opportunities.

Finally, although limited information is made available, it is important to evaluate the cost-benefit analysis of any changes, as improvements must not come at too large an expense to Delwarca. Even if the current results can be maintained, reducing the cost of this is still an improvement.

Capacity Limits

The effects of such a change on the call centre's capacity constraints must be taken into account as Delwarca is considering switching to a 24-hour service. It is essential to create a more effective system that can handle the additional demand that comes with 24-hour service because the current Remote Support Unit is approaching its capacity limits.

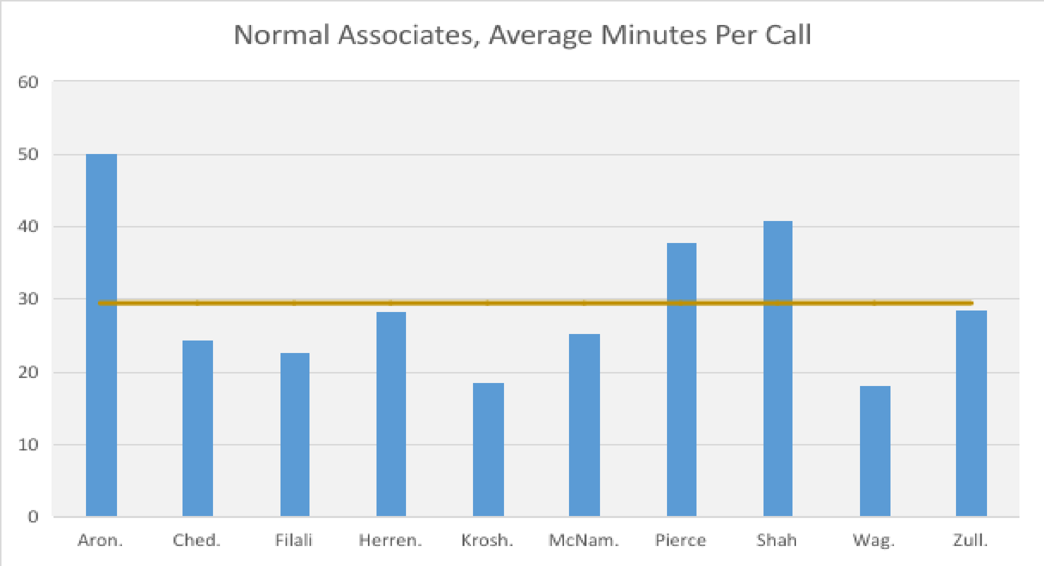

Figure 4: Average Minutes Per Calls, Regular Associates

It's interesting that attempts to enhance the effectiveness of the Rapid ID process have resulted in poorer results than previously, indicating that more research is necessary to find and address the root causes. The lack of work rotation among employees is one potential contributing factor, which may lead to tiredness because of the repetitive nature of their tasks (Batt & Terwiesch, 2004). Delwarca may guarantee staff engagement and uphold performance standards by implementing work rotation and cross-training.

The queueing mechanism in the call centre is also challenged by differences in staff performance. A more consistent and effective call centre experience can be achieved by addressing these variations through focused training, performance assessments, and employee incentives.

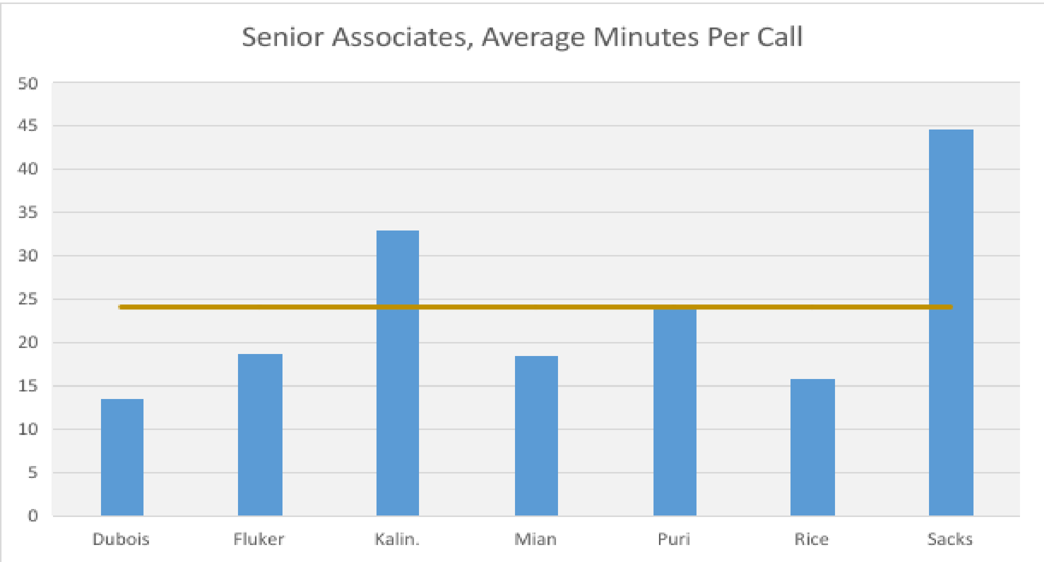

Figure 5: Average Minutes Per Calls, Senior Associates

If the call centre encounters a considerable rise in call volume, the presence of only two Director Associates may also cause a bottleneck in the call processing process (Armony & Maglaras, 2004). To make sure that calls are handled properly, Delwarca might think about hiring more Director Associates or putting in place a more effective call routing and escalation mechanism.

Finally, Delwarca's switch to a 24-hour service demands a careful analysis of the call centre's capacity restrictions, worker productivity, and potential bottlenecks. Delwarca may successfully scale up its operations and provide first-rate customer support around-the-clock by solving these difficulties through strategic planning, focused training, and effective system deployment.

Validation

White Box Validation

To ensure that the elements of our model correspond with the situation present in the case, the team performed white box validation from several angles. We determined the theoretical distributions closest in nature to information provided on-call times, hold times and so on. We confirmed that the process flow established within our initial model reflected the information present in the case and that the decision of which theoretical distributions to fit the model with was made based on statistical appropriateness. We further used the case study information as a template to establish schedule times, routing flows and resource properties. A deeper explanation of these steps is expressed in the following subsections.

Distribution Fitting

To establish the theoretical distributions most similar to the various data at hand, we combined visual analysis and statistical tests.

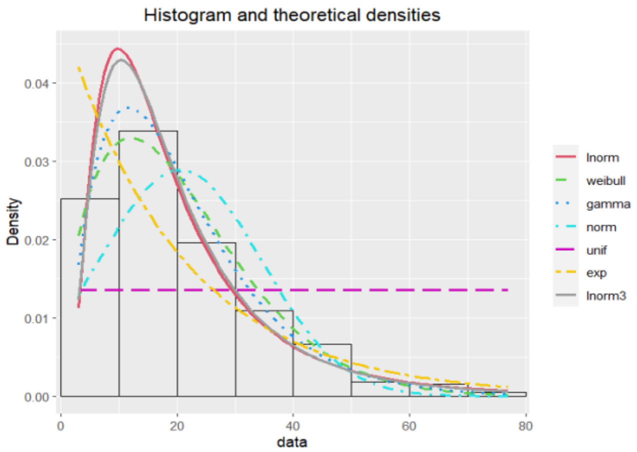

Figure 6: Associate Wagoner's Histograms and Distributions

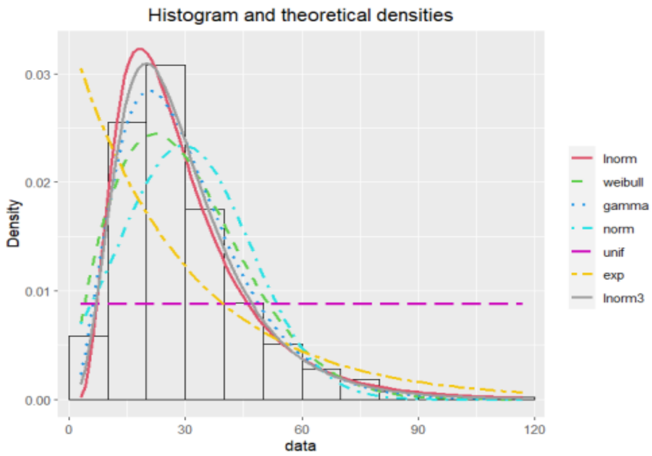

Figure 7: Combined Associates Histograms and Distributions

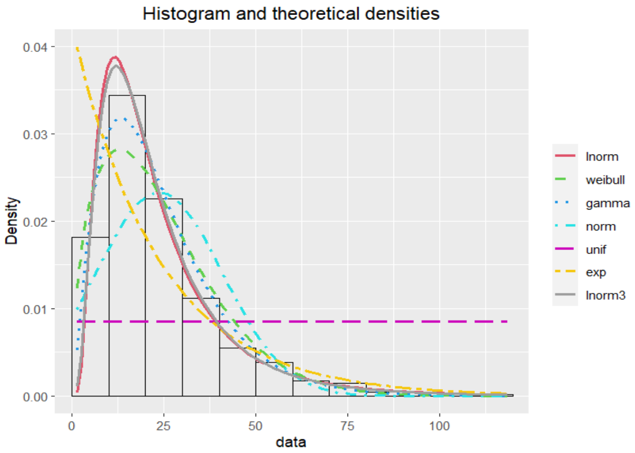

Figure 8: Combined Senior Associates Histograms and Distributions

A visual appraisal of figures 6, 7, and 8 hinted to us that both kinds of lognormal distributions were likely going to be good fits for the operator, combined senior associates and combined regular associates' data. This is hinted at by the left skewness of the histograms. Further analysis of the potential Q-Q plots also yields useful insights.

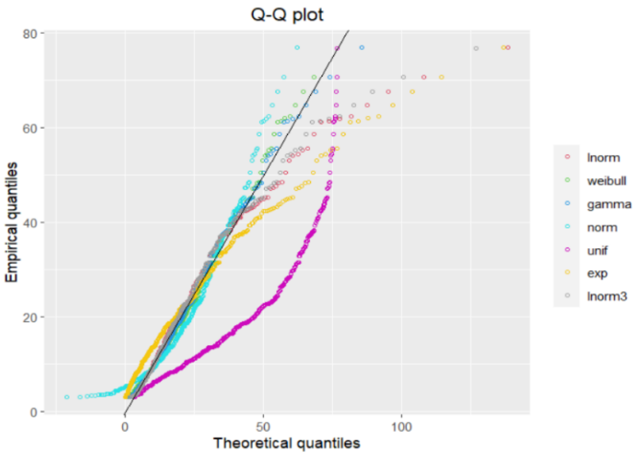

Figure 9: Associate Wagoner's Q-Q Plot

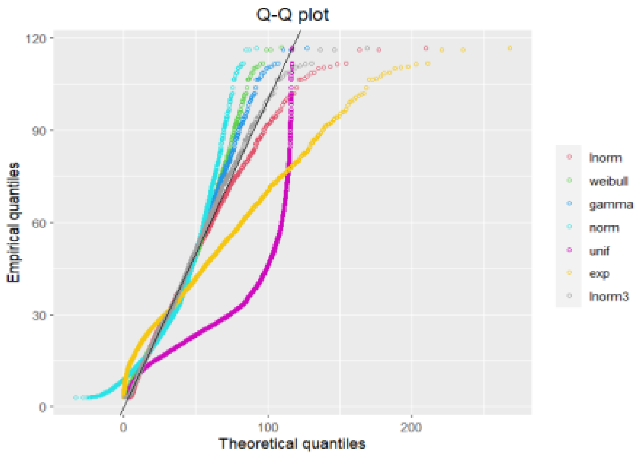

Figure 10: Combined Associates' Q-Q Plot

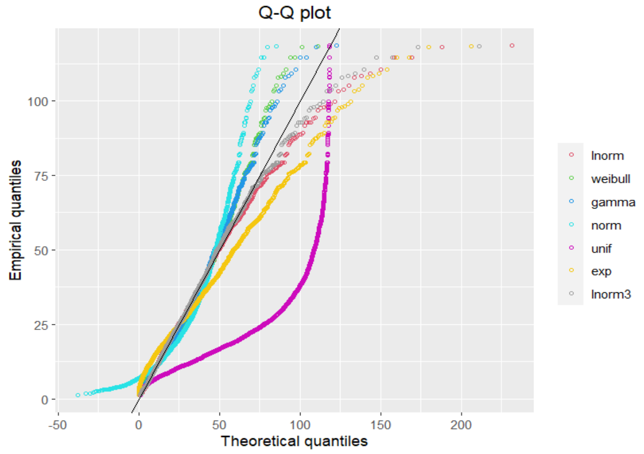

Figure 11: Combined Senior Associates' Q-Q Plot

As shown, the lognormal distributions tend to fit better than the others. But in Associate Wagoner's case, a gamma distribution might be an even better fit compared to that. We can ascertain further using statistical tests like the Kolmogorov-Smirnov test paired with selection criteria like the AIC. Table 1 highlights the various test results for the distributions.

Dist.	Metric	Lognorm. (2)	Weibull	Gamma	Norm.	Uniform	Expon.	Lognorm. (3)
Associate Wagoner	AIC	3042.77	3053.54	3040.30	3184.11	3385.29	3163.82	3043.93
	K_S Test	not rejected	not rejected	not rejected	rejected	rejected	not rejected	not rejected
Collective Associates	AIC	35068.17	35377.97	35052.61	36431.26	40526.31	37569.01	34988.12
	K_S Test	rejected	rejected	rejected	rejected	rejected	rejected	rejected
Collective Senior Associates	AIC	23742.37	24016.06	23833.35	25323.49	28309.46	24756.26	23736.94
	K_S Test	rejected	rejected	rejected	rejected	rejected	rejected	not rejected

Table 1: Statistical Distribution Test for Wagoner, Combined Associates and Combined Senior Associates

Interestingly, the collective associates' data fails on all available distributions. However, a look into the components of this series (i.e., the individual series of each regular associate) reveals that all of them, asides from wagoner, are best fitted by some form of lognormal distribution. If we take this into account alongside the apparent visual fit of a lognormal distribution in figures 3 and 4, we can fit a lognormal distribution to it. Therefore, the rejection may be due to a large sample size in that of collective associates largely increasing the chance to reject. However, for better accuracy, we decided to design the model so that individual associates were represented separately. The respective distributions are presented below. In the case of lognormal distribution, the parameters are given on the natural scale with the third parameter being the shift parameter. In the case of the gamma distribution, the parameters are the mean and shape parameter (if you wish to calculate the rate parameter just divide the shape parameter by the mean parameter) as they are the requested parameters by Simul8 for an Erlang distribution. This is done because gamma distributions are not recommended as they are computationally expensive, so using an Erlang distribution is suggested instead in Simul8 (even though this is technically incorrect as Erlang distributions are discrete, it works in Simul8).

Senior Associate	Mean Provided	Distribution
Dubois	13.6	gamma(13.567, 2.899)
Fluker	18.8	lognormal(15.544, 11.010)
Kalinowsky	33.1	lognormal(31.545, 19.105)
Mian	18.5	lognormal3(15.343, 15.631, 2.038)
Puri	24.1	lognormal3(16.442, 9.947, 7.946)
Rice	15.8	lognormal3(15.907, 17.684, 2.083)
Sacks	44.6	lognormal3(33.510, 21.720, 9.599)
Combined	N/A*	lognormal3(24.733, 18.285, -0.903)

Table 2: Senior Associate Fitted Distributions

Associate	Mean Provided	Distribution
Arsonson	50.0	lognormal(45.599, 16.237)
Chedekel	24.3	lognormal(24.236, 7.472)
Filali	22.6	lognormal3(11.821, 10.438, 9.889)
Herren	28.2	lognormal(28.014, 3.722)
Kroshian	18.5	lognormal(19.055, 8.445)
McNamara	25.3	lognormal(25.078, 20.018)
Pierce	37.8	lognormal(37.139, 18.052)
Shah	40.8	lognormal(39.579, 17.818)
Wagoner	18.0	gamma(20.546, 2.307)
Zuller	28.5	lognormal(28.035, 18.000)
Combined	N/A*	lognormal3(34.128, 17.046, -4.511)
Operator	1.0	lognormal3(0.897,0.445,0.192)
Director	2.0	lognormal3(0.860,1.816,1.093)

Table 3: Regular Associate Fitted Distributions

*Data provided on the Talk Time of combined associates and senior associates did not include note-taking time, unlike other data provided.

Structural Soundness of the Model

Returning to Figure 2, we assembled a representation of the system based on the information provided within the case study.

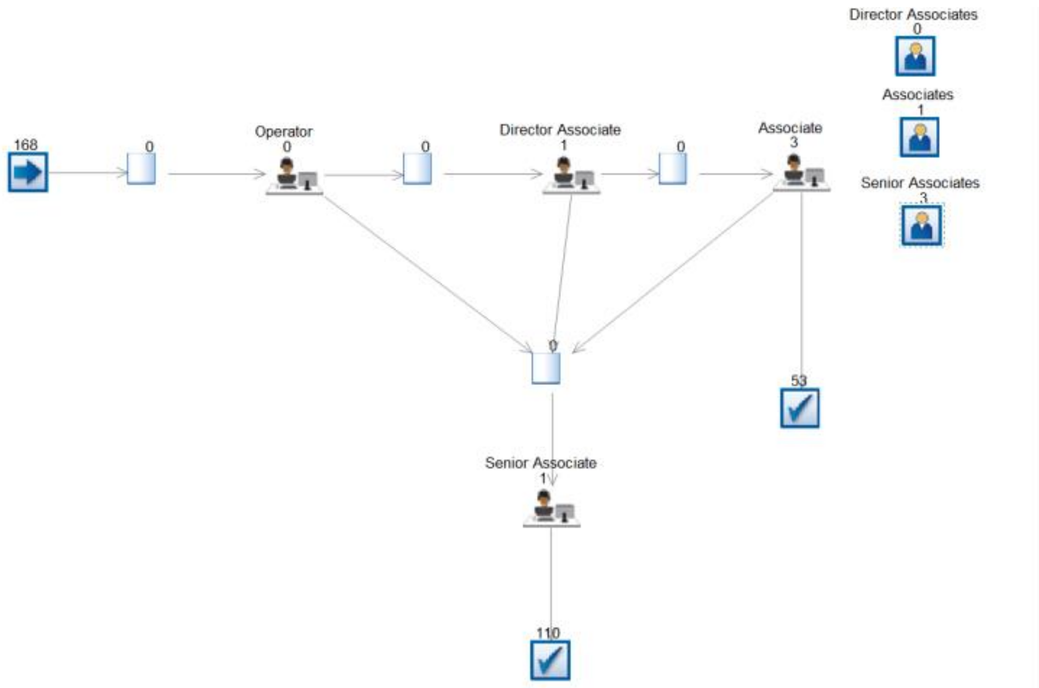

Figure 12: Simul8 Model Configuration

Exhibit 3 Percentage Calls Resolved by Associates and Sr. Associates

	Pre-Rapid ID	Rapid ID
Calls sent to Associates	78	54
Calls "directed" to Sr. Assoc.	N/A	18
Calls resolved by Assoc.	40	35
Calls forwarded to Sr. Associate	38	19
Calls requesting specific Sr. Assoc.	22	28

Figure 13: Case Study Exhibit 3

Activities, resources, agents and queues were properly designed and linked to one another according to the routing percentages given under Exhibit 3 in the case document. Resource and inflow schedules were based off the historical data provided in Exhibit 4, and resource properties were tweaked in accordance with the distributions provided in the data, with means and variances representing the underlying series of each entity. The inflow was assumed to be distributed with a Poisson distribution, but these means were rounded, which is a potential inaccuracy but is required by Simul8. Since data were not available on the scheduling of individual associates, associates and senior associates were each one resource and calls were randomly assigned a distribution from the list of associates and senior associates upon entry into the system.

An important note is that travel times needed to be turned off upon loading the simulation as they re-enabled each time.

For the sake of the model, several more assumptions were made.

- **Senior associate times are similar regardless of route.** Data provided suggested slightly different talk times for senior associates depending on pathing through the system, but as data was not available, senior associate talk times were modelled as independent of the route the call had taken.
- **No customer fail verification.** There is a verification step at the beginning of the process in which some calls are redirected, but as these redirected calls have no effect on the queue times and no data is made available, this step is ignored.
- **Customers are not sent to specific associates.** In the actual system, customers can request specific senior associates, but this was not built into the simulation.
- **There are no seasonal patterns.** In this case, it is stated there is little variation in the number of calls across the week, so each day is modelled the same.
- **Associates have the same escalation rates.** It was stated by a member of Delwarca that escalation rates are similar across associates.
- **Customers do not hang up.**
- **Note-taking is included in service times.** The data provided on associates included notetaking in the timings. This should not affect queues but will mean a slightly longer total time in the system for customers.

Black Box Validation

To assess the suitability of the model when facing historical data, we ran 1000 trials of the model to generate the average queue times and resolution times for senior and regular associates. The results are presented in the table below.

Phase	Associate	Actual Value	Simulation Value
Queue	Regular Associate	7.1	3.88
	Senior Associate	49.94	11.21
	Director Associate	4	1
Speaking Time	Regular Associate	27.4	33.08
	Senior Associate	22.07	N/A
Time in System	Regular Associate End	41.5	36.96
	Senior Associate End	86.52	46.18

Table 4: Actual Process Information vs Simulated Process Information

As shown in the table, there are substantial deviations between all three measures of performance between the simulated and actual processes. This is the case despite careful structuring of the model; hence, there are likely additional factors not reflected within the case that influence the flow of calls through the system.

Several potential reasons for this exist. It is possible that the information on arrivals is insufficient. At the moment, all we have are the averages of the arrivals at each hour of the day. This is a one-dimensional metric and fails to convey variation or complex trends in the patterns of new calls. It is likely that having the minute-to-minute record of calls for three months would be more accurate and would yield better results in the model. Furthermore, since only the means

were provided, a Poisson distribution was selected to model arrivals; however, this may be inaccurate. A reason for this is key assumption of a Poisson distribution is that arrival of each event is independent, but this is clearly untrue in this case as many calls are linked to recurring problems.
The failure of black-box validation could also be due to any of the other assumptions made beign incorrect or inaccurate.

The director associates are also responsible for forwarding client requests to associates whom they feel are competent at resolving their issues. This represents a degree of implied allocative efficiency (or inefficiency) that can't be reflected in our model without more information.

For the queue times, the causes of disparity can range from brief breaks taken during the workday to systematic delays in the forwarding process that were unmentioned in the case document. Speaking times, however, where measurable, seem to hover around the actual values presented in the case.

Simulations

To get accurate simulation results, one day was simulated 1000 times. This was done as the simulation by default was not emptying queues at the end of each day, so to mimic this, one day was repeatedly run.

Arrivals Reduction

To reduce incoming calls from customers, consider implementing the following strategies:

1. **Improve self-service options:** self-service alternatives like FAQ sections and troubleshooting manuals may be added to the website or mobile app.

2. **Use chatbots and AI:** Use chatbots or AI-powered support solutions to tackle straightforward and repeated inquiries.

3. **Proactively interact with customers:** Keep them informed about new features, services, and products on a regular basis to avoid misunderstanding and cut down on the number of calls for clarification.

4. **Invest in employee training:** Make sure customer service representatives are knowledgeable so they can effectively handle client difficulties at the initial contact so that subsequent calls are unnecessary (Zeithaml et al., 2002).

5. **Examine consumer input:** Gather feedback to pinpoint persistent problems and enhance goods and services, ultimately cutting down on call traffic.

The exact effect of these changes is somewhat ambiguous, but they certainly will facilitate some reduction in the daily call volumes. Although (Kumar and Telang, 2012) found that the characteristics of the Web portal have an impact on the influence of Web portal usage. According to their research, demands for information drop by 29% when it is readily available and understandable online. This was modelled in simulation by reducing the mean parameter in the arrivals Poisson distribution by a given percentage; this was done for a range of percentages to see the effect on the system.

Number of Calls Reduction	Average Associate Queue Time	Top 5% Associate Queue Time	Average Associate Utilization	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
None	3.90	4.21	67.87%	11.57	12.41	79.81%
5%	3.13	3.38	64.51%	8.44	9.01	76.15%
10%	2.58	2.81	62.01%	6.94	7.37	73.30%
15%	1.99	2.17	58.74%	5.15	5.51	69.76%
20%	1.39	1.52	54.46%	3.66	3.95	64.68%
25%	1.01	1.11	51.94%	2.96	3.20	61.60%
30%	0.81	0.89	48.89%	2.28	2.47	57.99%

Table 5: Effect of a Reduction in Call Volume on Utilization and Queue Times

Here it can be seen that even just a 5% reduction in call volume has a significant decrease in terms of senior associate queue times and especially the Top 5% Senior Associate Queue Times. For larger reductions, the queue time can decrease by a much larger magnitude. Naturally, there is a reduction in utilisation along with these changes as associates have fewer calls to handle. This gives confidence that these measures will lower customer queues and frustration.

Training Program

For a training program to help associates improve their call resolution skills, we can consider the following suggestions:

1. **Create a platform for knowledge sharing:** Senior associates should be able to submit notes, call recordings, and other pertinent documents to this platform for the benefit of others.

2. **Hold call analysis workshops:** Arrange for staff members to attend seminars where they may hear call recordings, go over their notes, and talk about best practices.

3. **Train using regular call scenarios:** Identify frequent problems and create training modules to deal with certain circumstances.

4. **Arrange role-playing exercises:** Give colleagues the opportunity to practise managing various call types while receiving feedback from senior associates or trainers.

5. **Establish a buddy system:** Assign junior colleagues to senior associates for advice on challenging calls.

6. **Promote self-reflection:** Teach staff members to assess their performance following each call and pinpoint areas that need improvement.

7. **Conduct routine performance reviews:** Evaluate associates' advancement, offer pertinent criticism, and develop individualised learning strategies.

8. **Provide soft skill and communication training:** such as classes on conflict resolution, active listening, and empathy.

9. **Use technology:** Track success and guide future training endeavours by using call monitoring and analytics technologies.

10. **Reward and recognise improvements:** Promote continual development through reward schemes, unofficial compliments, or chances for professional progression.

By implementing these strategies, we can help associates enhance their call resolution skills and improve the overall performance of the call centre. This can be simulated by reducing the collective mean for associates and senior associates by a given percentage. To facilitate this, the senior associates and normal associates were changed to be modelled by a collective distribution so the mean could be changed system-wide more easily. In the case of a 3-parameter lognormal, the shift and mean were scaled equally. Although this is a significant change, since both models failed black box validation, it was decided not to be an unreasonable change.

Reduction In Mean	Average Associate Queue Time	Top 5% Associate Queue Time	Average Associate Utilization	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
None	4.10	4.36	68.69%	12.44	13.08	81.13%
5%	3.11	3.31	65.55%	9.50	10.00	77.92%
10%	2.33	2.49	62.31%	7.17	7.56	74.43%
15%	1.73	1.85	59.01%	5.38	5.68	70.73%
20%	1.26	1.35	55.67%	4.01	4.24	66.88%
25%	0.91	0.98	52.29%	2.97	3.15	62.91%

Table 6: Effect of a Reduction in Means on Utilization and Queue Time

As can be seen, regardless of the change in the mean, there are positive gains in terms of the average and top 5% queue times. There is also a drop in utilisation as associates resolve calls quicker and become idle. As such, if these recommendations can achieve a lower mean talk time for associates, there should be large benefits in terms of queue times.

Regarding training, it may be beneficial to instead target specific employees who are underperforming as this would likely be cheaper and not require as much time taken out for better-performing employees. This can be simulated by modelling each employee individually again and just affecting the means of the worst-performing associates. In this case, since senior associates had the largest queues, they were targeted. The senior associates with the longest talk times were Kalinowsky and Sacks, so these are the employees whose mean was changed in the simulation.

Reduction In Mean	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
None	11.57	12.41	79.81%
5%	9.81	10.37	78.29%
10%	8.57	9.06	76.79%
15%	7.45	7.89	75.23%
20%	6.48	6.87	73.62%

Table 7: System Effects of Targeting Underperforming Employees

There are comparable (if slightly worse) results as the previous change; as such, it would be recommended to target training measures towards the weaker performing employees as this is likely to create the largest reduction in queue times relative to the cost and effort.

Another possible benefit of training is lower escalation rates for standard associates. This would obviously improve customer satisfaction as more calls are resolved at the first point of contact, but it should also have the knock-on effect of lower queue times of senior associates as they must handle less transferred calls. This was simulated by changing the percentages of the routing out property of the associate activity.

Escalation Rate	Average Associate Queue Time	Top 5% Associate Queue Time	Average Associate Utilization	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
~35%	3.90	4.21	67.87	11.57	12.41	79.81%
30%	3.88	4.12	68.01	8.86	9.34	76.36%
25%	3.88	4.12	68.01	7.25	7.67	74.04%

Table 8: Effect of Lowering Escalation Rate on Utilization and Queue Time

As to be expected, this simulation did indeed have much lower senior associate queue times. As a result, a strategy that can reduce both escalation rates and mean talk times simultaneously should see very positive results.

Reducing Variability

We should address the issue of employees possibly not adhering to standard operating procedures (SOPs) and contributing to a greater variance if we want to raise efficiency, customer happiness, and overall performance at our contact centre. Think about the following tactics:

1. **Standardise operational procedures:** Establish precise call handling policies to guarantee uniformity across all personnel.

2. **Provide templates and call scripts:** By guiding staff members through frequent client difficulties, you can ensure consistency and cut down on variety.

According to (Aksin, Armony, and Mehrotra, 2009), employing a non-linear least squares model with a lagged (l1) variable on previous-day arrivals can minimise the predicted variability of arrivals by 50%.

This was simulated using a combined distribution for all associates and all senior associates and reducing the variance parameter by a given amount, since the exact changes to the variance that would arise from the suggestions, a variety of values were tested up to 50%.

Reduction In Variance	Average Associate Queue Time	Top 5% Associate Queue Time	Average Associate Utilization	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
None	4.10	4.36	68.69%	12.44	13.08	81.13%
5%	4.05	4.30	68.75%	12.25	12.87	81.26%
10%	3.99	4.23	68.81%	12.06	12.67	81.39%
20%	3.89	4.12	68.90%	11.67	12.24	81.63%
30%	3.79	4.01	68.99%	11.26	11.81	81.84%
40%	3.74	3.96	69.03%	10.72	11.24	82.08%
50%	3.66	3.87	69.09%	10.41	10.91	82.22%

Table 9: Effect of Reduced Variability on Utilization and Queue Time

Surprisingly, there is an increase in utilisation as variability increases as employees are not finishing calls as quickly as previously and becoming idle. A small reduction in queue times can still be seen though, as the largest talk times are much less likely to occur. But these reductions are not as drastic as previous methods. As a result, methods to reduce variability should be successful at reducing queue times but not quite as successful as other methods previously stated.

Rescheduling

Some other approaches can be taken to reduce queue times. The current system relies more heavily on senior associates, as such increasing the capacity of senior associates should reduce queue times. Since there is a desire to be cost effective, the suggestion would be promoting the most successful associate to the senior associate position. Wagoner was chosen as the most successful associate as he had the lowest mean talk time, this could have been due to higher escalation rates, but it was stated in communications with a member of Delwarca that escalation rates were roughly equal across all associates. A new schedule can then be generated by multiplying each position in the old schedule by how much it changed by (senior associates were multiplied by 8/7). This returns the following updated schedule.

	Old Schedule		**New Schedule**	
Time	Associates	Senior Associates	Associates	Senior Associates
8 AM	3	2	3	2
9 AM	6	5	5	6
10 AM	7	5	6	6
11 AM	7	5	6	6
12 PM	6	4	6	5
1 PM	6	5	6	6
2 PM	7	6	6	7
3 PM	7	6	6	7
4 PM	6	5	5	6
5 PM	6	5	5	6
6 PM	5	4	4	5
7 PM	4	4	4	5

Table 10: Schedule Comparisons

This can be input into the simulation and Wagoner's distribution can be moved to the list of senior associate distributions. This was assuming that his distribution of call times would not change upon promotion and that the percentage routing of calls would remain constant. This returned the following result:

System	Average Associate Queue Time	Top 5% Associate Queue Time	Average Associate Utilization	Average Senior Associate Queue Time	Top 5% Senior Associate Queue Time	Average Senior Associate Utilization
Old	3.90	4.21	67.87%	11.57	12.41	79.81%
New	10.28	10.80	77.45%	2.93	3.11	66.52%

Table 11: Effect of Schedule Change on Utilization and Queue Time

The new system did return much lower average and top 5% senior associate queue times, but seemingly saw a comparable rise in associate queue times. This implies that Wagoner is an integral part of keeping associate call times as low as they are, and his reallocation could not be the best decision.

Recommendations

From a customer satisfaction standpoint, both systems worked equally poorly but the Post-Rapid ID system cost an estimated extra $98,400 per year. But there are some ways to improve this system.

1. **Train Low Performing Senior Associates:** Targeting the senior associates with the largest mean talk times with training will have a large impact on queues, as suggested by the simulation. Since only the weakest senior associates are being targeted, training should be cheaper, and the strongest senior associates can continue to work without needed training sessions scheduled.
2. **Cross-training associates:** Allowing associates to learn common problems and from others' experiences should bring down escalation rates and decrease talk times as associates become more accustomed to common issues. As seen in the simulation, both of these changes should result in significantly lower queue times. If the cost is too high, then this training should be targeted to only the weakest associates as their improvement will have the largest overall impact on the system.
3. **Improve self-service options:** FAQs and chatbot options should be implemented to reduce the overall number of calls received and ease the system. This is a cost-effective solution, valued at around $468/year by (Kimball, 2019), and one that yields positive results, as indicated by the model.
4. **Pulling information live**: If an associate is not able to solve the problem, it can be a good solution to pull information live from the senior associate. This can be achieved by having a communication channel between associates and senior associates, such as an instant messaging platform or a dedicated phone line, that enables associates to ask for help or advice from senior associates when needed. This approach can help to reduce the overall handling time for the customer and increase the first call resolution rate, as associates can quickly access the knowledge and expertise of senior associates to resolve the customer's issue. It can also help to reduce the utilisation capacity gap

between associates and senior associates, as senior associates can provide support to associates when needed without having to take over the call completely.

5. **Implement a more effective call routing system:** Implementing a more effective call routing system can help reduce the overall holding time for customers. This can be done by using IVR technology that can identify the nature of the customer's issue and direct the call to the appropriate associate or senior associate based on their skills and experience. This will also help to increase the utilisation of associates as they will be handling calls that are within their area of expertise. Below is the cost-benefit analysis for implementing an IVR system from JustCall (Kimball, 2019) as an example: -

   <u>Cost Estimation:</u>

   a. JustCall User Costs:
      - Premium plan: $48 per user per month
      - Total staff (Associates and Senior Associates): 13
      - Monthly cost for 13 users: $48 * 13 = $624
      - Annual cost for 13 users: $624 * 12 = $7,488
   b. Inbound Call Costs:
      - Total daily calls from Exhibit 4: 188 calls per day
      - Total annual calls: 188 calls/day * 365 days = 68,620 calls
      - Average IVR call duration: 2 minutes (assumption)
      - Average per-minute fee: $0.05 (assumption)
      - Annual cost of inbound calls: 68,620 calls * 2 minutes * $0.05 = $6,862

   Total Estimated Annual IVR Cost (inbound calls only): $7,488 (users) + $6,862 (inbound calls) = $14,350

   <u>Cost Savings:</u>

   c. Current annual cost of two director associates: $33,000 * 2 = $66,000
   d. Estimated annual IVR cost: $14,350.
   e. Annual cost savings: $66,000 (director associates) - $14,350 (IVR) = $51,650

   The implementation of an IVR system with JustCall for this support unit is estimated to have a total annual cost of $14,350, which includes $7,488 for 13 user subscriptions and $6,862 for inbound call costs based on 68,620 annual calls with a 2-minute average IVR call duration and an assumed per-minute fee of $0.05. In comparison, employing two director associates for call routing currently costs $66,000 per year. By switching to an IVR system, the business can potentially save approximately $51,650 annually bringing the total cost to down to $1,536,910 (see appendix 1.1). It is important to note that these cost estimates are approximate and may vary depending on actual per-minute fees, usage, and specific features required by the business. For the most accurate pricing, it is recommended to reach out to the provider for a customised quote tailored to the business's needs.

6. **Offer customers the option to schedule a call back**: Offering customers the option to schedule a call back at a time that is convenient for them can help reduce the frustration of customers being left on hold. This can be done through an automated system or by having a dedicated team of associates who are responsible for scheduling call-backs. The former is recommended for a lower cost.

Conclusion and Future Work

To conclude, Delwarca can improve the efficiency of its rapid-ID system by prioritising the training of low-performing senior associates, beginning cross-training of standard associates, and improving the self-service options made available to customers. It can also reduce the operating cost by investing in some degree of automation, such as IVR. Aside from this, allowing customers the option to schedule a call back may reduce frustration.

In future, more information could lead to an improvement in simulations. Data on all call-ins or knowledge of their statistical distribution can ensure they are modelled effectively. Knowledge of the scheduling of individual associates will also allow for far more accurate simulation that could help the model succeed in black box validation.

Aside from this, another important piece of information would be data on customer feedback. Whether this is in rating form or interpreted from review using sentiment analysis, this would help understand how changes to the system are felt on the consumer end and help advise future alterations. Finally, some in-depth data on the number of calls that hang up in the system can also help identify the main problem areas of the system.

Appendix

System	Associates	Senior Asso.	Director Asso.	Average Cost
Pre-Rapid ID	12	7	N/A	$1,490,160
Post-Rapid ID	11	8	2	$1,588,560
System with IVR	11	8	0	$1,536,910

Associates

Average Cost = Average Salary + (Average Salary * 0.26)

Average Cost = $53,000 + ($53,000 * 0.26) Average Cost = $66,780

Senior Associates

Average Cost = Average Salary + (Average Salary * 0.23)

Average Cost = $80,000 + ($80,000 * 0.23) Average Cost = $98,400

Average cost of an Associate = $66,780 Number of Associates = 12 Total cost of Associates = $66,780 x 12 = $801,360

Average cost of a Senior Associate = $98,400 Number of Senior Associates = 7 Total cost of Senior Associates = $98,400 x 7 = $688,800

Total cost of all employees = $801,360 + $688,800 = $1,490,160

Average cost of an Associate = $66,780 Number of Associates = 11 Total cost of Associates = $66,780 x 11 = $734,580

Average cost of a Senior Associate = $98,400 Number of Senior Associates = 8 Total cost of Senior Associates = $98,400 x 8 = $787,200

Total cost of Director Associates = $33,390 (assumption part-time, so half) x 2 = $66,780

Therefore, the total cost of all employees would be:

Total cost of all employees = $734,580 + $787,200 + $66,780 = $1,588,560

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