

Electronic Companion

OR Process Skills Transform an Out-of-control Call Center into a Strategic Asset

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Estimating Financial Savings

The estimation of financial savings from reducing telephone calls to an inbound call center appears at first glance to be a simple analytic problem: lower arrival rates enable the call center to staff fewer agents, thus reducing labor costs. However, the actual benefits-estimation problem is trickier. The company's customer base was growing each year; therefore, while our project was focused on decreasing the number of calls per customer, the overall arrival rate was continuing to grow, albeit at a lower rate because of the call-stopping program. The company was also selling multiple products, and releasing major new versions annually and minor upgrades throughout the year; in addition, there was significant seasonal variation in the call arrival patterns. The historical call-volume data was difficult to interpret because periods of significant understaffing had produced high levels of call abandonment and long waiting times, suggesting that historical call volumes were sometimes not an accurate reflection of actual customer demand. Finally, there was constant change to the mix of full-time, part-time, and outsourced agents, call-routing strategies, hours of operation, and agent deployments.

We believe that creating an accurate, robust model for estimating the financial benefits of a call-stopping program is an open research question. Given the increasing focus on such programs (Price and Jaffe 2008), a full resolution of this research question should be beneficial to the call-center industry. We present three approaches below; undoubtedly there are others. We hope that future researchers will extend one or more of these models or devise entirely new approaches to address this highly relevant question.

A Basic Model to Estimate Cost Savings

As part of a budgeting process to extend our approach to the client's other business units (an engagement not discussed in this paper), we were asked to provide a rough savings estimate. We built a "quick-and-dirty" model to estimate cost savings with the call-stopping program in place. We estimated the baseline number of TSRs needed for each version i of a product. We computed the average number of calls per hour by dividing total annual calls (V_i) by the annual open hours (3,000). We used the steady state $M/M/s/\infty$ queueing equations to estimate the staff required in an average hour to achieve the client's service-level goal. We calculated TSR full-time equivalents by multiplying by annual open hours (3,000) and dividing by full-time annual on-duty hours (1,750). Table A1 summarizes the results for one product line.

This model underestimates the necessary agents because it does not account for understaffing because of the problem of matching individual TSR shifts to time-varying staffing requirements (Gans, Koole, and Mandelbaum 2003), and it uses the $M/M/s/\infty$ in the presence of peaked call volumes (Green, Kolesar, and Soares 2003).

To estimate the number of TSRs needed if the call-stopping program had not been implemented, we must estimate the number of calls prevented by the program. We define F_b as the frequency of the top 50 issues in the last product version prior to the call-stopping program, F_i as the frequency of the same issues in version i , and $\delta_i = F_b - F_i$. For our product line, $F_b = 31.37$ percent of total calls and $F_3 = 18.50$ percent; hence, the reduction in calls for these issues in version 3 is $\delta_3 = 12.87$ percent. The fraction of the reduction caused by the call-stopping program is unknown; we parameterize it as ρ . The calls stopped by our program are $\rho \delta_i V_i$; hence, the total calls without the call-stopping program are $V_i + \rho \delta_i V_i$.

In Table A2 we repeat the calculation of TSRs needed, setting calls/year to $V_i + \rho \delta_i V_i$ for different ρ values. Labor savings are based on the direct cost of \$50,000 per TSR. This model indicates that total savings in the first two years were between \$0.75 million and \$3.3 million. The

percentage of calls prevented was similar for the two smaller product lines; however, we did not perform the savings analysis.

A Simplistic Model

A financial analyst in the client organization used a different, simplistic methodology to estimate the total savings across all products. He used our stopped-call estimates for each product line based on the top 100 issues, using ρ of 1. We do not know why he made these choices. He multiplied this value by the AHT of 10 minutes to determine call minutes saved, which were valued at \$1 per call minute. We were told that this value includes TSR direct costs of \$0.48 per minute, and additional costs for agent recruiting and training, facilities and information technology, telecommunications, call-center management, and cost allocations for the corporate staff. The client estimate of savings for the first two years was in excess of \$10 million; while we think this is a gross overestimate, it was accepted within the client organization.

An Extension to the Basic Model

An anonymous referee generously provided an extension to our basic model. We present this model exactly as provided by the referee. We occasionally provide clarifying comments in square brackets. This model is illustrated using the data associated with the change from version 2 to version 3. [This corresponds to the first row of the basic model results in Tables A1 and A2.]

Let $\lambda(B)$ = total call rate before the change, i.e., before the introduction of version 3 [i.e., version 2 of the software]. Let $\lambda(A)$ = total call rate after the change if there had not been any intervention. This is the call rate that would have resulted because of more subscribers, assuming that the software had not been improved. [In terms of the basic model above, where i is the software version, this notation generalizes to $\lambda(i)$ with $B = 2$ and $A = 3$.]

$\lambda(B) = \lambda(B,50) + \lambda(B,R)$, where the first term on the right side is the call rate for the top 50 reasons and the second term is the call rate for the remaining reasons. Similarly, $\lambda(A) = \lambda(A,50) + \lambda(A,R)$.

Let $k = \lambda(A) / \lambda(B)$. k is the multiplier, assuming that your project had no effect. [In addition, it will be necessary to assume $\frac{\lambda(A, 50)}{\lambda(B, 50)} = k$ (1) and $\frac{\lambda(A, R)}{\lambda(B, R)} = k$ (2).]

Now assume that the project only stopped calls involving the original top 50 reasons. Let b = the fraction of top 50 type calls that were stopped because of the new version of the software. Then $\lambda(A,50) * b = k \lambda(B,50) * b$ = the number of calls stopped by the new version of the software [using (1)].

The fraction of top 50 calls going through after version 3 of the software is

$$\frac{k \lambda(B, 50) (1 - b)}{k \lambda(B, 50) (1 - b) + k \lambda(B, R)} = 0.1850 \text{ [Note that .185 is } F_3 = 18.5 \text{ percent from the}$$

basic model.] The k 's cancel. Divide top and bottom of the left side by $\lambda(B)$ and you obtain

$$\frac{.3137 (1 - b)}{.3137 (1 - b) + .6863} = 0.1850. \text{ [Note that .3137 is } F_b = 31.37 \text{ percent from the basic model,}$$

and $.6863 = 1 - .3137$.] Solving for b , we obtain $b = .5034$.

The number of saved calls is given by $\lambda(A,50) * b = k \lambda(B) (.3137) * b$, and the fraction of calls saved is given by $\frac{k \lambda(B)(.3137)b}{k \lambda(B)} = (.3137)(.5034) = 15.8$ or 15.8 percent.

Now we need to find the total number of stopped calls. Note that $k = \frac{\lambda(A, R)}{\lambda(B, R)}$. The total number of calls saved is given by $k * 0.3137 \lambda(B) * b =$

$$\frac{\lambda(A, R) (0.3137)\lambda(B)b}{\lambda(B, R)} = \lambda(A, R)(0.3137) \frac{1}{0.6863} (0.5034) = 0.23\lambda(A, R).$$

Now the actual number of calls after the introduction of the new version is 1.75 million and the fraction that are not the original top 50 causes is $(1-.185) = 0.815$. Hence, $\lambda(A,R) = 0.815 * 1,750,000 = 1,426,250$. The total number of calls stopped is $0.23 * 1,426,250 = 328,038$. This compares to the basic model estimate of 225,225.

References

- Gans, N., G. Koole, A. Mandelbaum. 2003. Telephone call centers: Tutorial, review and research prospects. *Manufacturing Service Oper. Management* **5**(2) 79–141.
- Green, L. V., P. J. Kolesar, J. Soares. 2003. An improved heuristic for staffing telephone call centers with limited operating hours. *Production Oper. Management* **12**(1) 46–61.
- Price, B., D. Jaffe. 2008. *The Best Service is No Service: How to Liberate Your Customers from Customer Service, Keep Them Happy, and Control Costs*. Jossey-Bass, San Francisco.

Figures and Tables

Version (i)	Calls/year (Vi)	Calls/Hour	AHT	S. L. Goal	TSRs/Hour	TSR FTE
3	1.75m	583.3	10	90% in 3 min	103	177
4	2.50m	833.3	10	90% in 3 min	145	249

Table A1: The data represent the baseline number of technical support representatives (TSRs) required to meet service level (S. L.) goals for one product line; “AHT” is average handling time; “TSR FTE” represents TSR full-time equivalents.

Version	Baseline TSR FTE	$\rho = 0.25$			$\rho = 0.50$			$\rho = 1.00$		
		Stopped Calls	TSR FTE	Savings	Stopped Calls	TSR FTE	Savings	Stopped Calls	TSR FTE	Savings
3	177	56,306	182	\$0.25m	112,612	187	\$0.50m	225,225	199	\$1.10m
4	249	116,625	259	\$0.50m	233,250	271	\$1.10m	466,500	293	\$2.20m
(Two Year Total)		\$0.75m			\$1.6m			\$3.3m		

Table A2: The data represent estimates of calls stopped and cost savings for different ρ values for one product line; “TSR FTE” represents TSR full-time equivalents.