RESEARCH INSIGHT

Call Center Labor Cross-training: It's a Small World After All

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For many companies, call centers have become a primary way of communicating with their customers. Most organizations with customer contact -private companies, as well as government and emergency services- have reengineered their infrastructure to include call centers, either internally managed or outsourced. The call centers thus form an important and a vast service industry, employing roughly 3-4 million Americans according to Data Monitor. For both the privately held businesses and the emergency services, improving customer service levels for call centers is critical. Careful attention to the management of the workforce can help call centers to avoid lost calls and reduce long waiting lines. One effective workforce management technique to create flexibility and improve service performance is labor "cross-training," achieved by training the workforce for multiple tasks.

The "Small World Network" (SWN) literature, on the other hand, reveals important characteristics of real-world networks in settings as diverse as social networks, networks of cellular phones, and spread of infections. SWN theory formalizes the well-known concept of Six Degrees of Separation, which is based on the notion that everyone in the world is most probably connected to everyone else through a chain of at most six mutual acquaintances. A very crude explanation for this effect on a network is that it only takes a few shortcuts between well-connected nodes to turn a large world into a small world.

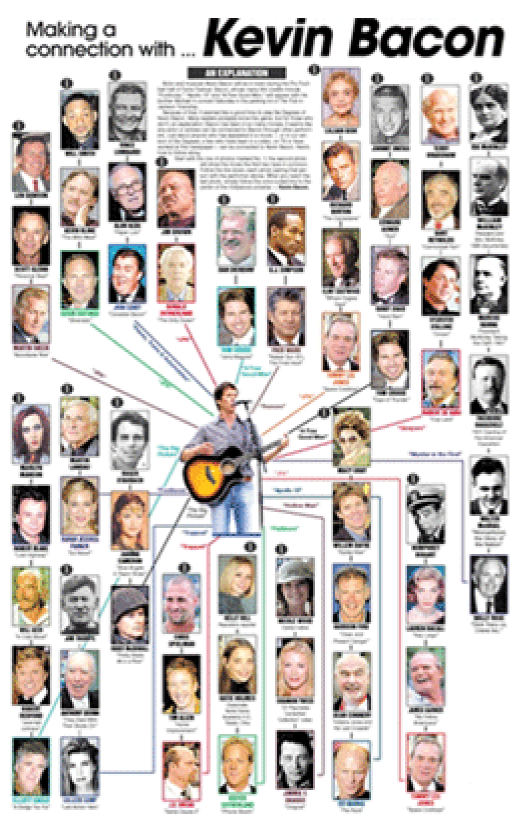


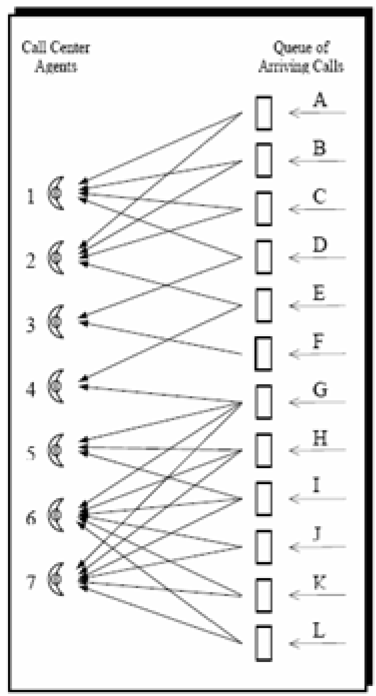
Image: http://www.newspagedesigner.com

Some communities such as mathematicians and actors have been found to be densely connected by chains of professional associations. Mathematicians have created the Erdos number to describe their distance from Paul Erdos based on shared publications, and a similar exercise has been carried out for the actor Kevin Bacon for actors who appeared in movies together. The latter is referred as "Six Degrees of Kevin Bacon" and presented at the webpage named "The Oracle of Bacon at Virginia" (http://www.cs.virginia.edu/oracle/)

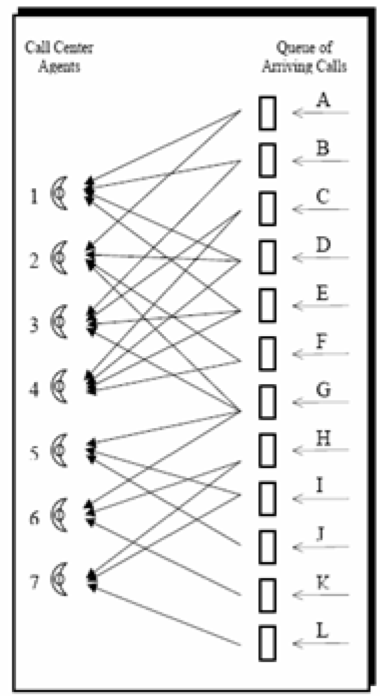
We propose a new approach to analyzing flexibility arising from the cross-trained service (e.g., call center) agents. We show that the Average shortest Path Length (APL) metric of the SWN theory is one simple deterministic solution approach to the complex stochastic problem of designing effective workforce cross-training structures in call centers.

Work-Sharing Network Model of Cross-Training Structures

Through our experiments, we have come to believe that if a cross-training structure is well-designed, then it shares some properties of a SWN and a revised version of the APL metric of the SWN theory can predict the more effective structure. The key difficulty in our approach is to design a method for converting cross-training structures into a particular network model for which the APL criterion will be a useful indicator of flexibility (i.e., the effectiveness of the cross-training structure). We do this by converting each cross-training structure to a network that we call Work-Sharing (WS) network. Let's consider a situation where a given number of cross-trained call center agents are supposed to answer different types of calls, where the demand arrivals and service times are stochastic with known rates. The following figure presents two alternative cross-training structures for a system with 7 call center agents and 12 call types. We would like to know which cross-training structure yields a lower average customer waiting time, i.e. has a better performance.



Structure 1



Structure 2

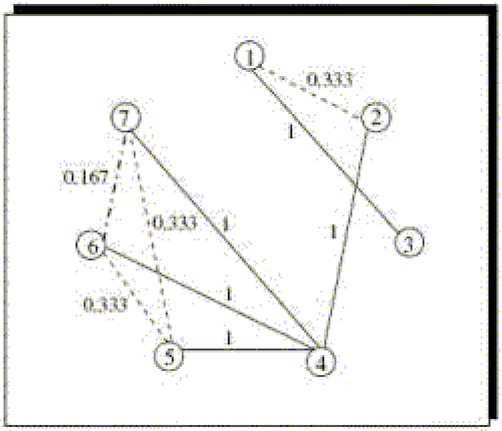
The following 3 rules define the construction of the WS network of a given structure:

(1) Every agent is represented by a node.

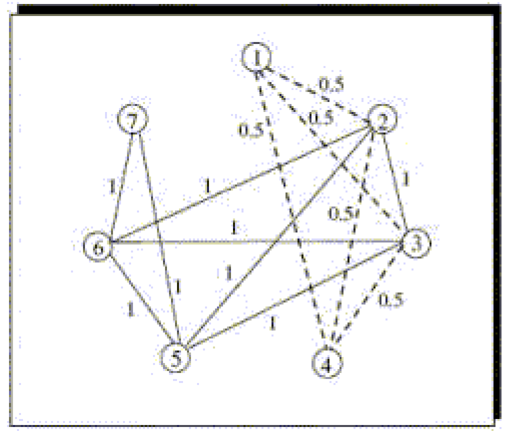
(2) An undirected arc is placed between nodes i and j if agents i and j both share at least one call type in common in their respective skill sets.

(3) The length of an arc connecting two nodes, i and j, is the reciprocal of the number of call types that can be served both by agents i and j.

The following networks are work sharing networks for cross-training structures 1 and 2.



Structure 1



Structure 2

Let's focus on the WS network of the Structure 1 and go over the WS network construction rules given before. Each node in the WS corresponds to the corresponding agent in the Structure 1. Each arc between nodes i and j denotes that there is at least one call type that both agents i and j can answer, e.g., we have the arc (1,3) as both agents 1 and 3 can serve call type D and similarly we have the arc (5,7) as both of those agents can serve call types G, H, and I. The length of the arc (1,3) is 1, since there is only one call type (call type D) that they both could serve and the length of the arc (5,7) is 1/3 = 0.333, since there are 3 call types (call types G,H, and I) that agents 5 and 7 could serve. We are using the reciprocal as the more call types the agents can help each other with, the more effective that cross-training structure would be. Therefore, the work sharing networks with a smaller Average Path Lengths (APL) should generally correspond to cross-training structures with smaller average customer waiting times.

WS network of Structure 2 has a smaller APL compared to that of Structure 1 (i.e., APL2 = 1.21 < APL1 = 1.53) predicting that the cross-training Structure 2 should be more effective than Structure 1, and therefore should result in a lower average customer waiting time. This is exactly what our simulations confirm.

Research Insight written by Seyed Iravani.