Why all service outlets should not be created equal: Identifying most influential network nodes

Many service companies run large networks of stores and/or service establishments. For example, Starbucks operates over 13,000 stores in the U.S. as of November 2017, The UPS Store has 4,667 locations in the U.S. as of September 2017, Great Clips has over 4,200 hair salons in the U.S. etc. There is a variety of approaches to managing these large networks even within one industry, e.g. all of Subway restaurants are franchises, all Chipotle restaurants are company owned, and about 85% of McDonalds restaurants are franchised while the remaining ones are owned and operated by McDonalds and are used to learn how to improve success at all restaurants in the network. Many multi-location companies turn some of their outlets into so-called flagship stores, e.g. Taco Bell has a flagship store on the Strip in Las Vegas, where the company invests heavily in marketing to increase brand awareness. Successful operation of such networks raises important questions:

• What effect does quality improvement at one store have on the success of the whole network?
• Which locations are influential for the whole network’s reputation and should be targeted by the company for ownership and development?

Consider a service network with multiple outlets that share the same brand. Customers’ decision to stay engaged with a service outlet that they visited may depend not only on their experience at this focal outlet but also on the reputation of the brand and/or customer experiences at other outlets of the same brand name. For example, customers may be less likely to come back to the visited outlet if the overall customer experience at the adjacent outlets of the same brand is higher. We refer to this phenomenon as the competition effect. In contrast, given that all of the service outlets share the same brand name, good overall customer experience at adjacent outlets may improve the reputation of the brand and make customers more likely to keep coming to the visited focal outlet. We refer to this effect as the reputation spillover effect. We combine the two effects into the network effect. If better overall customer experience at adjacent outlet reduces customers’ churn rate at the focal outlet, the network effect is positive, implying that the reputation spillover effect dominates. Otherwise, the network effect is negative, and the competition effect dominates. Customers’ perception of the quality of the neighboring outlets may be acquired through one or both of the following channels: word-of-mouth or personal experience (e.g., personal visits to the adjacent stores). We build our model in a way that allows us to separate the network effects by channel.
To demonstrate the significance of the network effect with model-free evidence, we first show that sales at a focal location are significantly correlated with the quality at its neighboring locations even after controlling for the lagged focal location sales, focal quality, and promotion activities using regression analysis. Using forecasting algorithms from the machine learning literature, we further show that including neighbor quality can improve the relative forecasting accuracy of sales at a focal location by up to 20%. To better understand the mechanism by which customer experience at adjacent locations impacts their behavior at a focal location and causally quantify such network effect, we propose a latent attrition model which allows us to capture not only the impact of perceived quality on customers current purchasing behavior but also on their future purchasing behavior. We let customers make transactions with a service outlet according to a Poisson process. We allow customers to have different arrival rate, which follows a Gamma distribution. After each transaction, a customer may decide to stop visiting the focal service outlet and become permanently inactive with certain probability, which we refer to as the churn rate. Customers’ churn rate at the focal store is a function of their experience at the focal store and their perception of quality of other stores that share the same brand name.

We estimate our model using a rich dataset from a nationwide restaurant chain in the United States that operates multiple restaurants under the same brand. Our dataset has several important features that allows us to take a holistic look at the problem at hand. First, we have transactional-level and store-level data from a network of over 4000 restaurants that are tightly clustered in 5 distinct markets within the U.S. for 2 years. The tightly connected network with rich variations in its structure provides us with an ideal context to study network effect. Second, we have customer satisfaction survey data that allows us to assess the quality perceived by customers along different dimensions at different locations within the network. Third, our data tracks customer ID, which allows us to track the entire transactional history of any given customer at all outlets within the network during our observation period. It provides us with important variation to causally quantify the network effect and do so through both customers’ current and future purchasing behavior.

Our estimation results show that both customer experience at the focal store and the perceived quality of the neighboring restaurants have a significant impact on customers’ purchasing decisions. Incorporating the perceived neighbor quality in the model significantly improves the model performance, both in its goodness-of-fit and forecasting accuracy. We show that better overall perceived neighbor quality reduces customers’ churn rate at the focal store regardless of whether the customers have visited the adjacent stores, which implies that the network effect is positive and that the reputation spillover effect dominates the competition effect. We also show that the reputation spillover effect is even stronger relative to the competition effect for customers who have visited the neighbor stores than for those who have not.
In a counterfactual study, we quantify the incremental value generated in response to a quality improvement at the focal store plus at all the impacted stores in the service network. For example, in Figure 1, we present the total incremental number of transactions generated at the focal restaurant, that generated at the adjacent restaurants, and that generated in the entire network of restaurants as we improve customer experience at the focal store from 8 to 9 (on a 0 to 10 scale). This total incremental value generated in the entire network characterizes the influence score that the focal store has on the whole service network, which can be used by service networks to select locations that should be targeted for ownership and quality investment. For example, companies like McDonalds may select which locations to own or turn into flagship stores based on this influence score. In the presence of budget constraints, the service network management can prioritize the stores with the highest influence scores for their quality investments. Figure 1 shows that both the incremental value for the focal restaurant and that for the adjacent restaurant increase with the perceived customer experience of the adjacent restaurants due to the dominating reputation spillover effect. Thus, the service network management should prioritize restaurants with adjacent restaurants that provide higher customer experience.

![Graph showing total incremental number of transactions for a sample restaurant network as the customer experience at the focal restaurant changes from 8 to 9 (on a 0 to 10 scale).](image)

**Figure 1** Total incremental number of transactions for a sample restaurant network as the customer experience at the focal restaurant changes from 8 to 9 (on a 0 to 10 scale).

In summary, we show that there exists a strong positive network effect and that investment in one store not only generates incremental value at the focal store but also generates significant incremental value at the adjacent stores. This, in turn, allows us to quantify the impact that a quality investment in one store has on the future value generated by the whole network. This result provides important managerial implications allowing the network management to select the most influential stores and hence, prioritize the investments based on the future network value.