Branch Network Optimization Model following Two Banks Merger

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Abstract

As entities merge, operations consolidation by reducing the number of operating facilities, minimizing the staffing levels and reengineering flow between supply and customers' demands are of utmost importance for mergers success. In this paper, branch restructuring of two Saudi-based banks after their mergers will be discussed. The bank branch restructuring will be optimized by minimize the operating cost, satisfying customer demand (number of transactions) and discarding extra supply by closing some branches. Set covering and transportation models will be used in assigning each branch to a customer node area, ensuring it satisfies their demand. Final results suggest a 3% decrease in operating costs.

Keywords
Bank Mergers, Branch Network, Capacitated Facility Location Problem, Mixed Integer Linear Programming

1. Introduction

Saudi Arabia recent social and economic reform blueprint has created a major focus on developing the financial services sector. Driven by high operating costs and a competitive banking market, Banks in Saudi Arabia are focusing on decreasing costs, consolidating their operations and in particular, mergers; where entities reengineer and construct a single operating model. Considering this major change at organizational level, the distribution of services centers, specifically branches, has to be redesigned to reflect the new merger organization. This research paper presents the work conducted with the merger team responsible of consolidating two Saudi banks branch operations after their merger in 2019. The main objective of this work is to evaluate and deliver a new design of the branch network distribution, yielding to an optimum branch network that can process customer transactions (satisfy demand) with minimized cost. This work is organized as follows:

-First, a literature review that will cover bank mergers, branch consolidation, Bank operations optimization.

-Second, the branch network optimization model will be covered by introducing the problem statement, methodology, data and the mathematical Model.

-Finally, results of the mathematical model will be discussed

2. Literature Review

Merging Banks is a popular research area, and it has been widely addressed in the literature where many published studies try to evaluate the arguments of achieving positive results through bank merging (Madura, J. & Wiant, K. 1994).
For example, (Mavri, M. 2015) developed a mathematical framework algorithm for reconfiguring bank branch network. In the first phase, the proposed algorithm finds the optimum number of branches for bank networks and the optimum performance each branch should provide. While in the second phase, the model finds branches' optimum locations. The proposed performance algorithm defined the values of the variables to improve performance and relocation costs.

In (Gattoufi, S. et al 2012), the authors proposed an Inverse Data Envelopment Analysis application (InvDEA) model. To achieve higher level of efficiency, InvDEA model gathered information about quantities of input and used it to predict the level of produced output. To show the practicality of the proposed method, the model has investigated 42 banking units for merging banks in real data set.

While mergers present great opportunities to consolidate operations and increase profits, achieving that is not as easy and straightforward as it seems. For instance, (Healy, P. et al 1992) suggested that there is a clear positive relationship between stock returns at merger announcement and post-merger raises in operating cash flow returns. Also, the authors in (Al-Sharkas, A. et al 2008) confirmed (using Stochastic Frontier Approach (SFA)) the positive impacts on cost and profit efficiency effects in case of bank merging. However, some other researchers highlighted the challenges faced in Bank mergers. For example, the author in (Rhoades, S. 1998) reviewed nine case studies and found that cost efficiency is not necessarily achieved when merging banks, due to the difficulty in integrating operations and data processing systems.

In this research, the restructuring the branch network after the merger of the two entities (denoted as Bank A and Bank B), is in fact a capacitated facility location problem, where the number of branches and their locations should be optimized while fulfilling customer demand defined as bank transactions.

The facility location problem has always been discussed and presented in Operational research area that considered optimization and cost reduction (Ulukan, Z. & Demircioğlu, E. 2015). Moreover, branch restructuring, which is one form of facility location, applied similar methods utilized for industrial problems like distribution centers, inventory stores and plants (Manzini, R. & Gebennini, E. 2008).

3. Branch network optimization

3.1. The Problem Statement

Creating an entity merger results in increasing the revenue, market share and overall costs as well. To eliminate the possibility of financial loss and benefit from a merger, many operational and cost aspects must be taken into consideration. One of the most critical aspects in such organizational change is branches. While the two banks are in progress to unify the operational and business model, cutting branch costs become crucial in making an integration change. The redesign of the branch network become then a statement of power, and optimizing it reboots liquidity and efficiency. In this work, which was conducted with the Merger Integration team, the objective is to provide a new redesigned network that involves both bank branches and will be able to serve customers with the best possible customer service.

3.2. Methodology

In this work, the branches of Bank A and Bank B are the service providers, offering supply in terms of transactions to the customers who are the initiators of the demand. Transactions include but not limited to: opening a bank account, deposits, withdrawals, loan requests and approvals, Money transfers, customer complaints...etc. So, any developed solution should satisfy demand and customer service requirements. Other than that, the developed solution should ensure that the correct number of branches are open by eliminating extra capacity through branch closures. Therefore, a Capacitated Facility Location Model CFLM will be adopted to redesign the branch network with an objective function that minimizes the branches costs under the constraint of satisfying the customers demand. In this model, the decisions variables are the number of transactions processed by each branch to satisfy each customer node demand, along with binary variables corresponding to the decision of Open/Close of each branch. Hence, the CFLM will be a Mixed Integer Linear Program MILP.

3.3. Data Collection

In order to build the CFLM, the following data were collected from the two Banks:

- The number of branches per Bank: which is equal to 26 and 22 for Bank A and Bank B, respectively.
- The annual transaction volume (customer demand), which is the sum of all physical (non-online) transactions within the bank. This includes but not limited to: opening a bank account, deposits, withdrawals, loan approvals, customer complaints...etc.
- Branch service capacity limit (supply capacity), defined by the number of transactions that can be processed. This was defined as the maximum number of transactions that was processed by the branch in the last 3 years. Sample data is depicted in Table 1.
- The branch operating cost, including salaries, rent, utilities, security…etc. Actually, depending on branch size, location and number of customers' accounts, the bank management allocates a spending budget to be able to process its different types of transactions. Branches can't exceed such limit; however, when it does which is in very rare cases, an exception approval is provided.
- Customer addresses.

In order to define the customer nodes (demand points), to be later assigned to a branch (or more) for service, the Merger Integration team was tasked with building new customer nodes, which is a geographic cluster of customers presented by the total number of customers and the node geographic longitude and latitude. using the two banks before-merger customer nodes, potential population growth areas, along with data from the Saudi post, which is a governmental institute that maintains, the new customer nodes were determined to be 62 nodes scattered across the whole country. Customer nodes with their corresponding demand in terms of number of transactions is depicted in Table 2. Based on best practices experience in the banking industry and to ensure minimum coverage is granted to serve the demand, the Merger Integration team set a threshold of 7km between the customer node and the set of branches that can serve it. Actually, if a customer node is more than 7km distance apart from any branch; that branch would have been considered unreachable and can't serve the customer node. For each of the 62 customer nodes, the list of reachable branches was identified (Sample data is presented in Table 3). After applying the distance constraint, the final network that comprises the 48 branches and the customer nodes that can serve is constructed. Part of the network corresponding to the first 10 branches is presented in Table 4.

Table 1: Branch supply

Branch	Supply
10	104,280
11	58,344
12	30,888
13	48,840
14	28,776
15	25,080

Table 2: Customer node demand

Customer node	Demand
1	5,600
2	12,830
3	70,600
4	24,320
5	10,460
6	27,903
7	9,740
8	8,990
9	10,002
10	20,239
11	19,102
12	29,800
13	56,120
14	33,209
15	11,003

Table 3: Customer node-Brach distance

Node	Branch	Distance (km)	Reachable or Not
1	27	4.8	Y
1	37	1.9	Y
1	41	7.8	N
1	44	10.1	N
1	11	9.7	N
2	12	6.6	Y
2	11	5.9	Y
2	41	15.2	N
2	37	6.5	Y
2	44	11.6	N

Table 4: Branch-Node network

Branch	Node 1
1	36,37,44
2	35,43,37
3	41,45,56,57
4	34,59
5	25,41
6	17,28,30,33
7	26,31
8	22,26
9	26,28,30
10	1,2,5

3.4. The Mathematical Model

The Branch Network Optimization will select of the set of branches that can cover the customer nodes demand with the optimal cost where each customer node can be served by one branch or more. In the following, the mathematical Model including the decision variables, parameters, Objective function and the different constraints will be presented.

- Decision Variables

Y_i : binary variable corresponding to Branch i (i=1,2,…,48)

$$Y_i = \begin{cases} 1, \text{ if branch } i \text{ is open} \\ 0, \text{ otherwise} \end{cases}$$

$X_{i,j}$=number of transactions of customer node j fulfilled by branch i, (i=1,2,…,48, j=1,2,…,62)

Parameters

C_i= Cost of operating branch i

D_j = Demand of customer node j

S_i = Supply of Branch i

Objective function

Min $\sum_{i=1}^{48} CiYi$

Subject to

For each Branch i (i=1,2,…,48), $\sum_{j=1}^{62} X_{i,j} \leq S_i$ (1)

For each Customer node j (, j=1,2,…,62), $\sum_{i=1}^{48} X_{i,j} \geq D_j$ (2)

$X_{i,j} \leq MY_i$ (3)

Constraint (1) guarantees that each branch doesn't process more transactions that its capacity.

Constraint (2) ensures that the number of transactions required by each customer node are fully fulfilled

Constraint (3) uses the big M method to ensure that if a branch is closed, it doesn't process any transactions demanded by customers. M is chosen to be the highest capacity within all branches.

4. RESULTS AND CONCLUSIONS

The Branch Network Optimization Model introduced in part IV was implemented and solved using LINGO with data (demand, capacity, cost...etc.) being imported from Excel. The implemented Model that selects the set of branches that will fulfill customer nodes demand at the minimum cost, resulted in 20 and 18 branches, corresponding to Bank A and Bank B respectively, with significant cost savings. Actually, by closing 10 branches, a total of SR51.7 M (around US$13.7 M) per year will be saved.

After presenting these results to the Merger Integration team, a second scenario where capacity and demand are not considered emerged. In fact, the Merger Integration team wanted to quantify the potential savings if the minimum number of branches that will cover all the customer nodes is kept open, without necessarily fulfilling the required demand. While fulfilling demand constraint is necessary to have a realistic and feasible solution, the Merger Integration team wanted to investigate this scenario, quantify the potential savings, and expand capacity (if needed) later on.

For this scenario, a new Mathematical Model was built and consisted of a Set Covering Model where the customer nodes are covered with the minimum number of Branches. Actually, the Set Covering Model built:

- ✓ uses the same objective function and the binary decision variables as the Capacitated Facility Location model presented in part IV

- ✓ ignores the capacity and demand constraints
- ✓ includes the coverage constraint: each customer node should be covered by at least one branch.

The set covering Model was implemented and solved with LINGO. The solution consists of a set of 34 branches (21 branches from Bank A and 13 branches from Bank B) with total savings equal to SR72,9 M (around US$19.4 M) per year.

while investigating the two scenarios discussed earlier gave the Merger Integration team a better understanding of the financial ramifications of the available consolidation options, the final branch network will take several months to be finalized because of several challenges like: terminating or reassigning employees and the costs related to that, growth perspectives, Reassigning existing Customers to new Branches, and Marketing the new redesigned Network.

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Biographies

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