Advice You Can Bank On: Improving the Efficiency of and Digitizing the Banking Experience

Maya Hatoum
Department of Industrial Engineering and Management
American University of Beirut
Beirut, Lebanon
mbh15@mail.aub.edu

Sabine Kanaan
Department of Industrial Engineering and Management
American University of Beirut
Beirut, Lebanon
snk21@mail.aub.edu

Alessandro Chelala
Department of Industrial Engineering and Management
American University of Beirut
Beirut, Lebanon
amc25@mail.aub.edu

Lilas Moughrabi
Department of Industrial Engineering and Management
American University of Beirut
Beirut, Lebanon
lhe08@mail.aub.edu

Abstract* — *A growing number of banks are currently concerned with the optimization and digitization of their banking processes. New approaches and technologies are now available to cater to the specific needs of the banking system. This knowledge has directed us to study the possibility of combining the two banking profiles, referred to as the Personal Banker (who handles sales operations) and the Teller (who is responsible for cash operations) into one unified profile whose operations are assisted by new technologies. In order to do this, a detailed understanding of the different tasks performed by each and the times required for completion were necessary. From here, we selected a branch of study, documented the standard method for multiple banking operations, conducted time studies on six of these operations, and applied lean principles to identify waste. Small–scale improvements were then introduced and studied to obtain a more efficient set of operations for the new (merged) profiles. Two simulation models of the branch were also built. The first was built to simulate the current queueing system in order to analyze the branch at a macro-level, and the second to predict the number of bankers needed following the issuance of the updated and improved operations. That way, we maximize operator utilization while minimizing waiting time. New technologies will be introduced to assist both the operator and the client and to mitigate the operational risks associated with the merger. A final optimal branch layout will then be constructed.

Keywords* — *waiting time, lean principles, simulation, optimization, time studies

I. Introduction and Motivation

On a global level, the banking sector has adopted new tools such as ATMs and mobile banking in response to the growing trend of digitization (Reimink, 2019). By using mobile channels, banks are able to reduce walk-ins for simple cash transfers or deposits, which increases cost savings by $1.5 billion dollars. As such, branch visits have decreased dramatically by 10 percent since 2010, while the usage of mobile banking has increased at the same rate (Javelin, 2013). This facilitates people's transactions and bank interactions to the point where bank visits become similar to coffee chats (Wadhwani & Srinivas, 2019).

On a national level, Lebanese people are used to being served and value human interactions during their bank visits, according to expert Nicolas Badaro from Byblos Bank. This urged us to find an adequate solution to respond to the global trend and still match the Lebanese environment, in order to ultimately make the Lebanese bank competitive on an international scale. To fulfill this motive, we partnered with Byblos Bank, a full-service financial institution that offers world-class support and empowers communities with economic benefits.

After meeting with Byblos Bank's representative, he exposed us to some of the various problems that their branches are currently facing. One major problem is that customers experience unnecessary walking when requesting cash and non-cash operations. Another is the increase in the idle time of salespersons (personal bankers) and the increase in waiting time in queue at the cash counters. The reason for this increase is explained in Bank Audi's Annual report which indicates that the banking sector has experienced a deceleration due to the country's deteriorating economic situation (Bank Audi Group, 2018). Lastly, Mr. Badaro, highlighted to us the importance of introducing a new layout that would incite clients to fully utilize existing technologies.

II. Objectives

In order to solve these problems, we decided to study the introduction of a new "Branch 3.0" that incorporates universal profiles. These profiles are entities that can do both the sales and cash operations in the branch. To complete this study, our team has developed two high–level objectives:

- Combine the sales and cash operations performed by the personal banker and teller profiles at the bank into one profile in order to increase efficiency and minimize cost;
- Automate several tasks performed by the new profile to further increase efficiency, reduce operational risk, and digitize the banking experience.

Each of these objectives was further divided into multiple subtasks, which rely on Industrial Engineering

tools. They include lean processes to increase the productivity of personnel, and simulation and facility planning to improve the overall branch layout. Risk analysis and the automation of some processes through the introduction of new technologies are also major parts of this study. Combined, the aforementioned tasks will contribute to enhancing the overall customer experience at Byblos Bank.

III. Background

A. Efficiency & Competitive Advantage:

Rising competition, changes in customer preferences and desires, and new technologies are pushing banks to develop truly differentiated strategies and operating models to remain competitive. There is an evident shift to digital and technology-based processes, with banks increasingly investing in automation and self-service facilities (Reimink, 2019). This aligns with the main objectives behind our study, where the restructuring of operations and the incorporation of new technologies aim to increase efficiency and ultimately the competitive advantage of our industry partner.

B. Lean Principles:

In our assessment of the existing operating model of Byblos Bank, an important approach is Lean concepts and tools to identify and eliminate wastes within operations. International banks such as BNP Paribas, Bank of America, and multiple others have benefited from lean implementations in the following ways: increased productivity, lead time reductions, increased customer satisfaction, cost reductions, improved quality of services, and gain of competitive advantage (Santos & Cabrita, 2016). Our use of lean principles was focused on eliminating unnecessary motion and avoidable delay from the most significant banking operations. We were able to then study improvements to minimize the aforementioned waste categories and ultimately increase productivity and reduce operational cycle time.

C. Simulation:

Another way banks can improve their overall productivity is by increasing customer satisfaction through the improvement of service quality. In any service industry, customers' waiting time is a factor that can affect their overall satisfaction (Sarkar, Mukhopadhyay & Ghoshc, 2011). Simulation has proven to be efficient and capable of representing a current branch and evaluating its different setups (Madahi, Roudsaru, Wong and Gakankashi, 2013). To find the most appropriate resource configuration at a branch, the use of computer simulation software has enabled us to enhance servers' utilization rates and waiting times in queue.

One of the foremost fundamental preparatory assignments in simulation is to distinguish the dispersion of data collected. This can be done using different software. In our case, Input Analyzer was the one used to fit likelihood distributions to a set of data, and to assess the adequacy of distributions (exponential, lognormal, etc.; Gingu, E. I., & Zapciu, M., 2015).

Lean Principles and Simulations were the techniques we most focused on as they were proven to be suitable by research and thus enabled us to study the banking system effectively and reach realistic conclusions.

IV. Methods

A. Time Studies and Lean Principles

To proceed with our specified objectives, we documented the standard methods for the operations done by each profile at the bank. We conducted multiple interviews with a personal banker (sales operations) and a teller (cash operations) at a selected branch of Byblos Bank. The personal banker and the teller dictated to us the standard methods of the nine and eight processes executed by each profile, respectively.

To compute the standard time, we conducted time studies on the branch grounds for the most complex, most used, and longest operations done by each profile. For the personal banker, the tasks we involved were Account Opening, Loans, and Credit Cards, and for the teller, those studied were Cash Deposit, Cash Withdrawal, and Byblos Check Paid Cash. This contributed in understanding the operations, identifying major wastes (unnecessary motion and waiting for the next step), and calculating the elemental time of each operation.

We continued the application of time studies to find the standard time of the chosen operations by adding performance factors, using the Westinghouse system, and allowances to the elemental times. Since the bank is not a manufacturing workplace, we used a constant allowance of 10% for each operation.

Having documented the standard method of each operation, we were then able to identify wastes using operation flow process charts. These charts helped us identify that the most important wastes to tackle were in the form of unnecessary motion and avoidable delays.

We then studied multiple basic improvements to the operations to be performed by the merged profile. The improvements were categorized into 4 classes: Machine, Material, Method, and huMan, which are the major components of an Ishikawa model.

Upon studying and applying the improvements, we were able to eliminate wastes from operations and to obtain an optimal set of cash and sales operations to be utilized by the merged profile. With the assistance of the current personal banker and teller, we estimated the time occupied by each type of waste, and thus the time saved by each improvement. This enabled us to finally document the new operations and assign the cycle time of each by subtracting the time of the eliminated wastes from the initial cycle time. A significant percent reduction in time was thus obtained for most operations.

B. Simulation

We then decided to study the queueing system at the bank. We started by studying the current system, in order to pinpoint the bank's weaknesses and thus suggest improvements. This would help us enhance the macro level problems and make the experience of visiting a branch more satisfactory to the customer. The bank provided us with data of the queuing processes of five medium size branches. The data were documented over a six-month period (January 2019-June 2019).

More than fifty thousand data entries were at our disposal. We cleaned the data by filtering all unnecessary information, and then input the filtered results into Input Analyzer, which is a software add-on for ARENA that automatically fits distributions to provided data. It gave us the service time of the personal bankers and tellers and the interarrival times of the customers, as shown in Table I.

TABLE I. INTER ARRIVAL AND SERVICE RATE DISTRIBUTIONS

	Input Analyzer	
	Service	**Inter Arrival**
Non Cash	Logn(13, 17.1)	Gamm(46.8 , 0.965)
Personal Loan	15+Gamm(26.9 , 1.13)	Weib(28.8 , 0.778)
Business Loan	15+Gamm(27.7 , 1.06)	72 * Beta(0.467, 0.483)
Cash Below	Logn(9.22 , 9.75)	Weib(4.95, 0.895)
Cash Above	1+Gamm(11.3 , 1.14)	301 * beta(0.826, 3.8)

The obtained distributions were considered the basis on which we built the simulation. We created the ARENA model where we included 5 different arrival rates for each service. At Byblos Bank, there is a total of 3 tellers and 5 personal bankers at most during peak times at a branch. Using this information, we came up with a simplified schedule for the number of people at each shift, with a 30-minutes break for each teller and a one-hour break for each personal banker accounted for.

Due to time limitations, we chose to replicate the simulation ten times with the condition of stopping the system when all customers have been served at the end of a seven–hour working day. The final results were recorded and analyzed to display the current queuing system at a Byblos Bank branch.

Following the improvements applied to the operations in the *Time Studies and Lean Principles* section, a new cycle time was introduced for most tasks. The percent reduction in time that resulted upon comparing the current and updated cycles was used to build a new simulation model. This model incorporated a merged profile that applies the enhanced set of operations, and determined the optimal number of necessary (merged) profiles at a medium–sized branch.

V. RESULTS

After identifying the major wastes associated with the processes executed, we suggested improvements to help minimize wastes based on the application of the Ishikawa Model. Table II shows the improvement in each improvement category with its description.

TABLE II. INTER ARRIVAL AND SERVICE RATE DISTRIBUTIONS

Improvement Category	**Improvement Title**	**Improvement Description**
Machine	Printers	Every profile will have a (new) printer at his/her desk to minimize unnecessary motion and transportation;
	Scanners	The profile will be able to make use of existing scanners at times to minimize motion to and from BM/ABM's office;
	Card Printers	Card printers will be available for every profile at his/her desk to reduce motion and delays;
Material	Stamps	The profile will have all the needed stamps at his/her desk – this will eliminate motion to and from the counter when purchasing stamps as needed;
	Application Forms	The most commonly used application forms will be placed in lockers directly near the profile to avoid unnecessary motion;
	Cards	Cards will be safely placed near the universal profile's desk to eliminate wasted motion (downstairs);
Method	Authorization	The request for authorization will (for the maximum number of operations applicable) be changed to a system process and will show up as an alert on the screen of BM/ABM to minimize the delay of calling for authorization;
HuMan	Profile Combination	The number of bankers will be reduced to 5 (based on simulation results) upon the combination of profiles.

After applying the improvements, documenting the new operations, calculating the cycle times, and the degree of improvement of the combination of profiles, we documented the results in tables III, IV and V.

Table III shows percentage reduction in cycle time after combing the operations of the two profiles and eliminating wastes by applying the improvements. Table IV displays the time that each improvement saved per operation, and Table V, the total time saved per improvement per day.

TABLE III. UPDATED SERVICE TIME AND PERCENT REDUCTION IN CYCLE TIME UPON WASTE ELIMINATION AND APPLICATION OF IMPROVEMENTS

Operation	Average Nb. Of Operations Per Day For Current and Updated Processes	Cycle Time (ST) for Current Processes (sec)	Cycle Time (ST) for Updated Processes (sec)	% Reduction in Cycle Time (sec)
Account Opening	2	2064	1465.8	29.0 %
Loans	3	10440	9940.2	4.8 %
Credit Cards	2	2076	1592.3	23.3 %
Byblos Check Paid in Cash	30	189	165.5	12.4 %
Cash Deposit	35	107	107	0 %
Cash Withdrawal	50	106	106	0 %

TABLE IV. TIME SAVED PER OPERATION PER IMPROVEMENT

Operation		Account Opening	Loans	Credit Cards	Byblos Check Paid In Cash
Times / Day		2	3	2	30
Time Saved Per Operation for Each Improvement (sec)	Printers	22	168	157	19
	Scanners	133	-	-	-
	Card-Printers	44	-	113	-
	Stamps	242	216	-	-
	Cards	-	-	103	-
	App Forms	-	20	25	-
	Authorization	10	10	10	-

TABLE V. TOTAL TIME SAVED PER IMPROVEMENT

Operation / Times / Day		Total Time Saved (sec/day)	Total Time Saved (min/day)
Improvements	Printers	1432	**23.87**
	Scanners	266	**4.43**
	Card-Printers	314	**5.23**
	Stamps	1132	**18.87**
	Cards	206	**3.43**
	App Forms	110	**1.83**
	Authorization	70	**1.17**

To understand the current branch, a primary simulation model was built. We notice that the service utilization is of 81.37% for Tellers, and 56.48% for Personal Bankers. This shows that personal bankers are idle for a large majority of their day. As for the queue time, we obtained 15.61 mins for the teller and 3.91 mins for the Personal Bankers. Thus, clients have to wait for a long time before getting served at the teller.

With the percent reductions in cycle time obtained from Table III, we were able to estimate the percent reduction in time for the categories cash above, cash below, business loan, non-cash and personal loan. Table VI shows the updated service time for each operation and the minimum, average and maximum values each operation would take.

TABLE VI. UPDATED SERVICE TIME OF EACH OPERATION

	Total Current Service Time (min)			% Reduction	Total Updated Service Time (min)		
	Min	Avg.	Max		Min	Avg.	Max
Cash Above	10.07	13.21	15.52	5%	9.57	12.55	14.75
Cash Below	7.66	8.81	9.66	5%	7.28	8.37	9.18
Business Loan	38.17	42.35	46.81	4.8%	36.84	40.32	44.56
Non Cash	5.74	9.13	11.85	25%	4.31	6.85	8.89
Personal Loan	39.80	47.07	58.46	4.8%	37.89	44.81	55.65

We then combined both Personal Bankers and Tellers into a "Universal Profile" that can perform all of the different operations. The service time to perform each operation is a Triangular Distribution with minimum, average and maximum values as stated in Table VI.

Inputting these into Arena, we found the optimal number of universal profiles needed in a way that maximizes operator utilization while minimizing customers' waiting time.

The results show that 5 profiles (of the new entity) is the most convenient as it increases server utilization from 65.8% to 78.6% while having a reasonable average waiting time of 4.5 minutes. The results are summarized in Fig. 1.

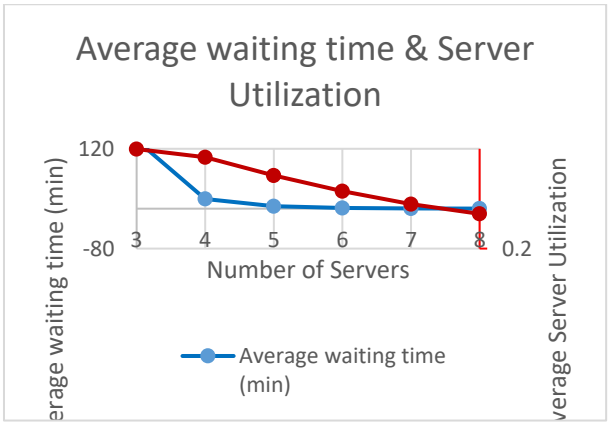

Fig. 1. Average waiting time per customer and average service utilization for possible number of operators

VI. DISCUSSION AND CONCLUSION

The main objective of this research was to combine simulation and lean manufacturing in order to reduce client's waiting time at cash counters while decreasing personal bankers' idle time by merging the two profiles into a Universal Profile. The above results guarantee the improvement and the increase in efficiency of operations at the bank by combining the two profiles into one, where cycle

time of the updated operations performed by the universal profile has decreased and time saved per day per operation is significant.

Our procedure included the use of lean manufacturing to restructure the operations according to categorized improvements of Machine, Material, Method, and huMan. This resulted in a significant percent decrease in cycle time for most operations studied. As earlier mentioned, multinational banks were able to make use of lean principles in order to increase productivity, reduce lead time, and improve the quality of services (Santos & Cabrita, 2016). These improvements were successfully achieved in our study, making our industry partner competitive on a global scale.

Furthermore, Arena Simulation Software was used to first model the current system and then find the most appropriate number of servers after merging the two profiles. The outcome was that the merger of the two entities into one resulted, indeed, in the reduction in waiting time and an overall increase of efficiency. In any service industry, customers' waiting time is a factor that can affect their overall satisfaction (Sarkar, Mukhopadhyay & Ghoshc, 2011). Thus, the results of our study which serve the purpose of decreasing waiting time will enable our partner to guarantee a higher level of client satisfaction.

One of the main limitations that we encountered was the deteriorating economic situation in Lebanon. This made us rely on previous data as the basis of our study and forced us to role-play some operations. Moreover, given the bank's strict confidentially rules, we had very limited access to information which made us research more and rely on our judgement.

It is important to note that a reduction in waiting time not only yields a higher level of satisfaction amongst clients but could also allow the bank to serve more customers and consequently increase its revenue.

In the coming part of this research, the automation of some processes with the introduction of new technologies will be studied in order to minimize the risk of combining cash and sales operations, to further improve efficiency, and digitize the banking experience.

Finally, through this research, we are emphasizing the role of industrial engineers in the banking sector and proving that unusual approaches could be done to improve operations. We trust that this project changes the conventional thoughts about optimization, and marks the start of collaboration between the banking sector and engineers.

ACKNOWLEDGMENT

The authors gratefully acknowledge the contribution of Dr. Nadine Marie Moacdieh and Mr. Nicolas Badaro for providing insight and expertise that greatly assisted the research. We highly appreciate their continuous guidance and supervision throughout the project.

REFERENCES

A. Sarkar A. R. Mukhopadhyay and S. K. Ghoshc "Improvement of service quality by reducing waiting time for service " J. Simul. Model. Pract. TH. vol. 19(7) pp. 1689-1698 Aug. 2011.

BankAudiGroup (2018). Annual Report 2018. [online] Available at: https://www.bankaudigroup.com/Library/Assets/AnnualReport2018.pdf

Cabrita, M. & Santos, J. (2016). Lean Banking: Application of Lean Concepts And Tools To The Banking Industry.

Javelin. (2013). Javelin Identifies $1.5 B in Mobile Banking Cost Savings by Leveraging Omnichannel Approach. [online] Available at: https://www.javelinstrategy.com/press-release/javelin-identifies-15-b-mobile-banking-cost-savings-leveraging-omnichannel-approach

Gingu, E. I., & Zapciu, M. (2015). Input Modelling using statistical distributions and arena software. Annals: Series on engineering sciences (Academy of Romanian Scientists), 7(1), 63-70.

N. Madahi, A. H. Roudsari, K. Y. Wong and M. R. Galankashi, "Modeling and Simulation of a Bank Queuing System," 2013 Fifth International Conference on Computational Intelligence, Modelling and Simulation, Seoul, 2013, pp. 209-215.

Reimink, T. J. (2019, April 19). Six strategies for improving banks' operating efficiency. Retrieved from https://www.crowe.com/insights/banking-performance/six-strategies-for-improving-banks-operating-efficiency.

Wadhwani, R., & Srinivas, V. (2019, February 13). Recognizing the value of bank branches in a digital world. Retrieved from https://www2.deloitte.com/us/en/insights/industry/financial-services/bank-branch-transformation-digital-banking.html.