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Article

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OPERATIONS, INFORMATION & TECHNOLOGY | RESEARCH ARTICLE

Total quality model for aligning organization strategy, improving performance, and improving customer satisfaction by using an approach based on combination of balanced scorecard and lean six sigma

Ardeshir Bazrkar¹, Soleyman Iranzadeh^{1*} and Naser Feghhi Farahmand¹

Abstract: Considering the importance of the service quality and the position of banks in the global and national economy, the main objective of this study was to design a total quality model in Qavamin Bank to align the organization's strategies, improve performance, and improve customer satisfaction. In the first step, after reviewing various groups of the Qavamin Bank processes, accounting processes were selected by the managers of the bank as sample processes. Then, using the six dimensions of the balanced scorecard, some indicators were defined for selecting the strategic process. After collecting data of indicators using cross-efficiency model in data envelopment analysis, "replacing the customer account book" was selected as the strategic process. In the next step, using the five phases of the DMAIC cycle in the lean six sigma methodology, the sigma level of the process was measured. After implementing the six sigma methodology, the process sigma level was increased from 2.84 to 2.88 and the average process time was reduced from 3 to 2 min and 40 s. The results showed the successful design and implementation of the total quality model in Ghavamin Bank for the process of "replacing the customer's account book". Finally,

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PUBLIC INTEREST STATEMENT

The main goal of the research was to provide a comprehensive quality model to align the strategy, improve performance and customer satisfaction. With regard to the status of service organizations in the national and global economy, the promotion of the performance of service organizations in general and banks in a specific way can increase Efficiency and productivity, and ultimately economic growth at the national and global levels. To achieve this, in this research, three goals were defined as a comprehensive quality model, and these goals were achieved with the help of a balanced score card and a lean six sigma methodology.

to measure the level of realization of the designed model's objectives, the research hypotheses were tested using one-sample *t*-test. The results of the hypothesis test showed that all three objectives of the total quality model were met.

Subjects: Production, Operations & Information Management; Operational Research/ Management Science; Operations Management

Keywords: total quality model; aligning the strategy; performance improvement; customer satisfaction; lean six sigma

1. Introduction

Total Quality Management (TQM) focuses on a set of methods including continuous improvement, fulfilling customer needs, reducing labor re-work, improving long-term thinking, increasing teamwork, improving process design, competitive modeling, and solving issues by teamwork (Arawati & Zafaran, 2011). It can be said that TQM is an approach focused on continuous improvement of the quality of goods and services that is realized with the participation of all members of the organization (Burli, Kotturshettar, & Dalmia, 2012). Total quality management is a coherent approach to fulfill the customer's needs, which is done with participation of all employees in continuous improvement of processes and cost-effectiveness (Jain, 2000). In strategic planning, it is necessary to investigate the short-term business plan and quality improvement program (Das, Paul, & Swierczek, 2008). The plans should be clear and qualitative objectives should be considered in preparing the plans (Jun, Cai, & Peterson, 2004). Strategies should always be updated and the organization's strategies should always be considered in the overall quality management program (Llusar, Tena, Puig, & Martín, 2009). Organizations spend a lot of time and resources to plan and develop their own strategies but most of them fail in the strategy implementation phase (Kaplan & Norton, 2001). We know that a strategy is a major and important program, and it will only be implemented when defined and pursued in the form of several different projects. On the one hand, in recent years, organizations increasingly have turned to lean six sigma approach and have solved their problems with this approach. In today's competitive world, the six sigma methodology is very applicable for organizations.

The six sigma approach is primarily a way to improve capabilities of the business processes using statistical tools and its goal is to reduce defects, improve profitability, increase employee satisfaction, enhance product quality, and ultimately increase customer satisfaction. It also reduces costs and eliminates losses and activities that do not add value to the organization (Wang & Chen, 2010).

Considering the importance of implementing total quality management in service organizations to pursuit organizational goals such as continuous improvement of services and processes in order to satisfy customers and ultimately enhance the profitability of the organization, the main objective of this study is to provide a total quality model for achieving three goals: aligning strategy, improving process performance, and improving customer satisfaction in the banking industry. In order to achieve these goals, we used a combination of balanced scorecard and lean six sigma methodology.

2. Thematic literature of study

2.1. Total quality management

Total quality management has been accepted as a management paradigm by many organizations around the world (Antony, Leung, Knowles, & Gosh, 2002). Total quality management is an approach to meeting the needs of both internal and external customers, in which the customer is considered as the most important factor in any process (Baidoun, 2010). A review of the three terms used in the "total quality management" helps to better understand this statement. The term "management" refers to the fact that quality is managed in the organization, rather than only maintaining it by inspection and control. The term "quality" refers to providing what is needed and expected by customers and managers. The term "total" refers to the fact that it involves all members and sectors of the organization (Sahney, Banwet, & Karunes, 2004).

2.2. *Balanced scorecard*

The balanced scorecard or BSC was developed by Kaplan and Norton in 1990. The balanced scorecard which is increasingly being considered today is not only a comprehensive and integrated performance measurement tool, but it is also a management system with a new strategic management approach that was introduced in the 1990s. Norton and Kaplan, by proposing their performance evaluation system, drew managers' attention to the point that it would be better to evaluate employee performance with a more general approach. Kaplan and Norton said that in order to perform a complete evaluation of performance, it should be assessed from four perspectives: finance, customer, internal processes, and learning and growth perspectives (Niven, 2002). Norton and Kaplan's other research, called the Strategy Map, deals with the importance of employee satisfaction and satisfaction of the society (communications). The last two perspectives are important in integrating the main factors in the balanced scorecard (Rezaee & AghaSeyedHosseini, 2011).

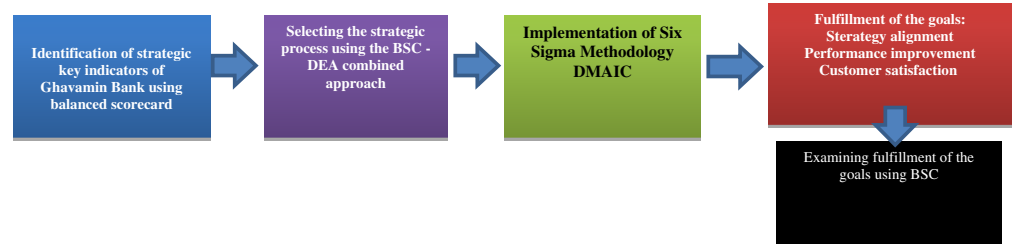
2.3. *Lean six sigma*

Six sigma was introduced for the first time in the mid-1980s as a business process improvement model by Bill Smith, an engineer of reliability at Motorola (Brady & Allen, 2006). Six sigma is a powerful business strategy that enhances service efficiency and significantly reduces defects in the provision of services (Antony, 2005). In fact, six sigma is an effective methodology to accelerate the improvement of the quality of products and services, along with the elimination of activities and processes without value added (Kwak & Anbari, 2004). The fundamental concept of lean thinking lies in eliminating losses and creating value in the organization. Lean thinking is an attitude to increase productivity and continuous value creation and to minimize costs and losses. Thus, it can be said that the purpose of using the sigma method is to reduce defects, losses, and evident errors through quick methods and techniques such as lean thinking (Shah, Chandrasekaran, & Linderman, 2008). The goal of the six sigma is to grow, and this growth is achieved not only by reducing costs but also by increasing productivity (Byrne, Lubowe, & Blitz, 2007). Hes and Benjamin (2014) in a study entitled "Applying Lean Six Sigma within the university: opportunities for process improvement and cultural change", used a combined six sigma approach to improve cultural change at a university. The study findings showed that if the goal is to change the cultural and behavioral patterns of staff and students, it is necessary to use lean methodology and lean thinking in combination with six sigma. The DMAIC cycle is the most common methodology in lean six sigma to improve organizational processes. Bhat and Jnanesh (2013) in a study entitled "Enhancing performance of the health information department of a hospital using lean Six Sigma methodology", used a combined approach of lean six sigma to improve the performance of a hospital's information system. Shanmugaraja and Nataraj (2012) in a study entitled "Total performance excellence—a model to implement six sigma in service organizations" used a combination of six sigma and QFD approaches to improve organizational processes. The result showed that the customer satisfaction increased due to correct identification of modified processes. Heavey and Murphy conducted a study entitled "Integrating of Balanced Scorecard with Six Sigma". The ultimate goal of the researchers was to know whether the combination of the two approaches would be useful to measure and improve the performance or not. In that study, the Balanced Scorecard was introduced as a prerequisite for selecting six sigma improvement projects.

3. *Methodology*

The present study is a practical study in terms of the purpose and it is a descriptive survey study in terms of method. In the first step, the strategic indicators of the Ghavamin Bank are identified and examined by the developed balanced scorecard (6 perspectives). In the second step, the processes are prioritized with considering the strategic indicators and the combination of the balanced scorecard and data envelopment analysis. In Step 3, after selecting the process that needs to be improved, the selected process will be analyzed using the six sigma combined approach based on the DMAIC methodology. In Step 4 and after receiving feedback, fulfillment of the following three objectives will be assessed using balanced scorecard approach: strategy alignment, performance improvement, and customer satisfaction.

Figure 1. Conceptual model of research.



3.1. Conceptual model

Considering the main purpose of the research, in this section, the conceptual model of the research is presented to achieve the triple goals of research: aligning strategy, improving performance, and increasing customer satisfaction. This model shows how the research objectives can be achieved. This model is shown in Figure 1.

4. Data analysis

4.1. Selection of the strategic process

First, the strategic areas of the Ghavamin Bank were studied which were taken from the strategic plan of the organization. Investigations showed that choosing a strategic process to improve performance with the goals of reducing customer expectations and reducing the time of the process is completely in line with the approach of accelerating the provision of services in the strategic plan of Ghavamin Bank. In this research, balanced scorecard was used to align the strategy. For this purpose, using the main criteria for selecting a strategic process were identified using six aspects of balanced scorecard. Interviews and nominal group techniques were used to define the subcriteria related to the processes of the accounting department of the Ghavamin Bank. Finally, 12 sub criteria were defined for choosing the strategic process.

After introducing the main and secondary criteria, given that the cross-efficiency model was used to evaluate and prioritize the processes of the accounting department of Ghavamin Bank, it was necessary to analyze these processes with respect to specific inputs and outputs. These outputs and the inputs of the criteria taken from six measures of balanced scorecard were defined using the previous studies and the opinions of the experts of the bank. Definitions of Inputs and outputs of key indicators of Ghavamin Bank are provided in Table 1.

The accounting group processes, which were in total 25 processes, were evaluated by 12 criteria. After collecting information through the organization database and questionnaire, data were evaluated by the cross-performance model in the data envelopment analysis. Finally, 25 processes were ranked based on the obtained score of the performance. The results are presented in Table 2.

- Cross-efficiency ranking model: assume that we have n DMUs that by getting m inputs produce s outputs. Also assume that i_{th} input and r_{th} output of DMU _{j} are x_{ij} and y_{rj} , respectively. Charnes, Cooper, and Rhodes (1978) proposed the following multiplier CCR model for performance evaluation.

$$E_{dd}^* = \max \frac{\sum_{r=1}^s u_r y_{rd}}{\sum_{i=1}^m v_i x_{id}} \quad (1)$$

S.t

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \quad j = 1, \dots, n$$

Table 1. Types of inputs and outputs of key indicators of Ghavamin Bank

Aspect of balanced scorecard	Key indicator	Type
Financial aspect	Direct cost	Input
	Direct income	Output
Customer aspect	Number of customers	Output
	Repeat rate of serving customers	Input
Internal processes aspect	Rate of labor engagement	Output
	Response time to customer requests	Input
Learning and growth aspect	Staff training hours	Input
	Number of staff with high academic degree	Output
Employee satisfaction aspect	Staff turnover rate	Output
	Number of employee complaints	Input
Environment and society aspect	Alignment with society macro strategies	Input
	Compliance with environmental laws	Output

Table 2. Ranking of accounting group processes using cross-efficiency score

	Processes (DMUs)	Cross-efficiency score	Rank of the process
1	Opening a Ghavamin card account	0.4376	17
2	Opening a current check book	0.3752	20
3	Opening the current account of the facility	0.3328	24
4	Opening a long-term investment deposit account	0.26864	25
5	Close check current account	0.43328	18
6	Closing a short-term investment deposit account	0.37132	22
7	Transferring a long-term deposit to another person by the account holder	0.69788	3
8	Closing long-term deposit account	0.3716	21
9	Depositing the interests of the deposits to customer accounts	0.542	9
10	Clearing checks of other banks	0.4856	13
11	Clearing the bank checks	0.524	10
12	Issuing a coded check, Santa, Paya, and Sahab	0.4668	14
13	Issuing an installment book	0.4868	12
14	Issuing a draft	0.56528	6
15	Issuing a check book	0.4148	19
16	Issue of billing for customers	0.61788	5
17	Taking money out of customer account by the bank	0.55224	7
18	Replacing customer account book	0.896	1
19	Deposit to customer account	0.6676	4
20	Taking money out of account by customer	0.46	15
21	Blocking the accounts by customer	0.698	2
22	Request a gift card	0.3572	23
23	Payment to the customer via pos	0.55	8
24	Controlling the opening of accounts and provide report for the head of the branch	0.44292	16
25	Putting money inside ATM	0.4908	11

$$u_r \geq 0, v_i \geq 0, \quad \forall r, i$$

The optimum value of the model (1) is smaller or equal to 1. The model is efficient if its optimal value is equal to 1, otherwise the unit is inefficient. Suppose that (u^d, v^d) are optimal weights for DMU_d using the CRR model. Then, cross-efficiency of DMU_j will be calculated with regard to the optimum weights DMU_d .

$$E_{dj} = \frac{\sum_{r=1}^s u_r^d y_{rj}}{\sum_{i=1}^m v_i^d x_{ij}}$$

The cross-over efficiency index of each unit is obtained using the following equation:

$$E_d = \frac{\sum_{j=1}^n E_{jd}}{n}$$

According to the results, the process of “replacing the customer account book” was identified as the first process in the ranking. A remarkable advantage of this method compared to the traditional methods of data envelopment analysis was that all processes were ranked without any problem. In the traditional models, if the efficiency index of all processes is equal to 1, ranking is not possible and we should use other methods of ranking such as the Anderson-Patterson (AP) method. With regard to the fact that the process of “replacing customer account book” has been identified as the most efficient process in the group of accounting processes of Ghavamin Bank, and due to the fact that the selection of this process is based on the strategic indicators of the balanced scorecard, this process can be considered as the strategic process for use in lean six sigma methodology.

4.2. Implementation of lean six sigma

The technique used in six sigma to improve the problem-solving process is based on five phases: definition, measurement, analysis, improvement, and control. Each phase is logically related to the next and previous phases.

4.2.1. Definition phase

In this phase, the goal and scope of the project are defined and the existing information about the process is gathered. The title of the project was “the length of time of replacing the customer account book” in the central branch of the Ghavamin Bank and the main goal of the project was “reducing the time needed for replacing the customer account book” from 3 to 2:35 min.

4.2.2. Measurement phase

In this phase, the goal was to accurately determine the location or origin of problems by making a real understanding of the problems and conditions of the existing processes, and to determine capability of the process and the sigma level. Initially, by considering the previous phase information, a table of critical indicators whose qualities are important from the perspective of the customer, was prepared. This table helped to review the indicators in terms of unit of measurement and defect criteria (Table 3).

Table 3. Characteristics of critical quality indicators

	Critical quality indicator	Unit of measurement	Defect criteria
1	Time of request for replacing the account book	Time (s)	$T > 7$
2	Time of entering the information into the system	Time (s)	$T > 89$
3	Time of writing the account balance in the account book	Time (s)	$T > 16$
4	Time of revocation and archiving the account book	Time (s)	$T > 43$
5	Total process time	Time (s)	$T > 2.35$

Data on the time spent on these processes was collected (in terms of minutes) over a period of 15 days for 5 randomly selected customers in each day. After collecting time data using a timer, the normality of the data was tested. The sample size of this test was 75, and the mean and standard deviation of the sample were calculated for the total time of the process cycle. The results showed that the p -value in this test was more than 1% and the collected data followed the normal distribution.

Before drawing the control chart, we should examine the randomness of the data using run chart and eliminate non-random data. If the p -value for each of them is less than 0.05, then there is a non-random data in the process and should be eliminate. The test results show that the p -values for all tests are greater than 0.05 and there is no non-random data in the process. Subsequently, to assess the controllability of “replacing the customer account book” process, control charts are used based on the data obtained from the process, so that, while calculating the control limits for computing process capability, a common language is developed for discussing process performance and identification of specific or general causes of “replacing the customer account book”. In order to obtain the process voice in the examined branch of the bank, the control chart ($\bar{X} - R$) for the continuous time data is drawn at this stage (Figure 2).

The mean of the sample population is $\bar{X} = 2.867$ and the average variability of the sample is $\bar{R} = 1.043$. Also $UCL = 3.468$ and $LCL = 2.265$. For the process to be controlled, all points in the graph must be placed between the control limits. In this section, the process capability is first examined using the control charts, and then indicators such as the efficiency index and process sigma level are calculated (Figure 3).

After calculating the process capability, we calculate efficiency index, DMPO indeed, and process sigma level:

$$P = P_r(Z > (3.468 - 2.867)/0.448) = 1.34$$

$$P = P_r(Z > 1.34)$$

Figure 2. Calculation of process voice using the control chart ($\bar{X} - R$).

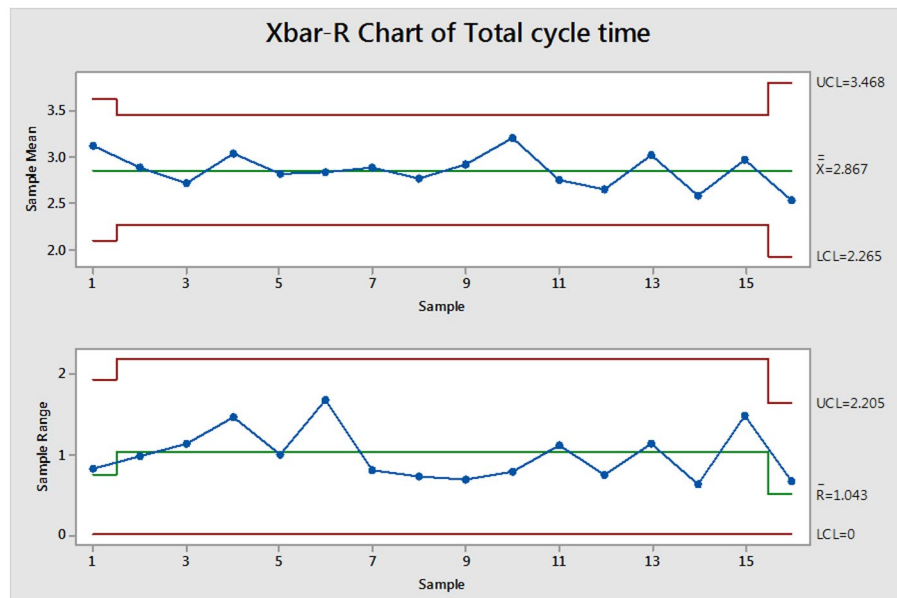
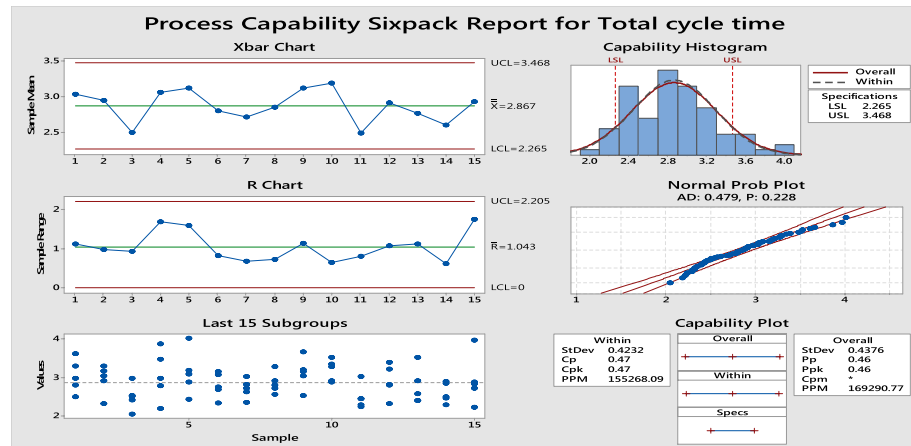


Figure 3. Capability of the process “replacing the customer account book”.



$$P_r = 1 - P(Z < 1.34)$$

$$P_r = 1 - 0.9099 = 0.0901$$

The DPMO index (number of defects per one million opportunities) and process efficiency are derived from the following relationships:

$$DPMO = DPU \times 10^6$$

$$DPMO = P_r \times 10^6 = \frac{\text{number of defects}}{\text{number of oppo}}$$

$$\text{Yield} = (1 - P_r) \times 100$$

$$DPMO = 90,100$$

$$\text{Yield} = 90.99\%$$

Given the DPMO value and performance index, the sigma level was calculated using the six sigma table, and the results showed that the current sigma level of “replacing the customer account book” process is equal to:

$$\text{Sigma Level} = 2.84$$

4.2.3. Analysis phase

In the analysis phase of the six sigma approach and the DMAIC methodology, we seek to identify and analyze the critical stages affecting the “time needed to replace the customer account book”. This is well illustrated in Pareto chart which is based on the process steps and the amount of time spent on each stage (activity) of the process (Figure 4).

With regard to the results of the Pareto chart, taking into account the importance of each stage in the process of “replacing the customer account book”, it can be concluded that the two stages “entry of information into the system” and the “revocating and archiving of the old account book” are the most critical stages in the process. The data normality test was performed to check the normal distribution of the data of each stage of the process. The results showed that the distribution of the data related to the critical process stages was normal due to having p-values greater than 0.01. The critical variables that had the greatest impact on the length of the time of the process of “replacing

Figure 4. Critical stages affecting the process.

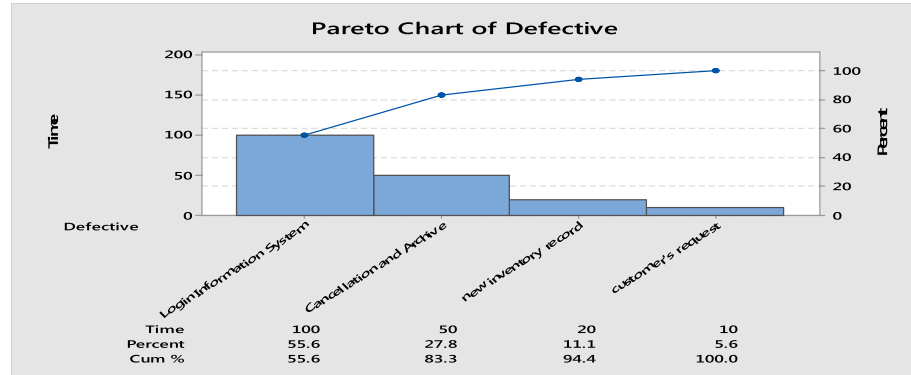
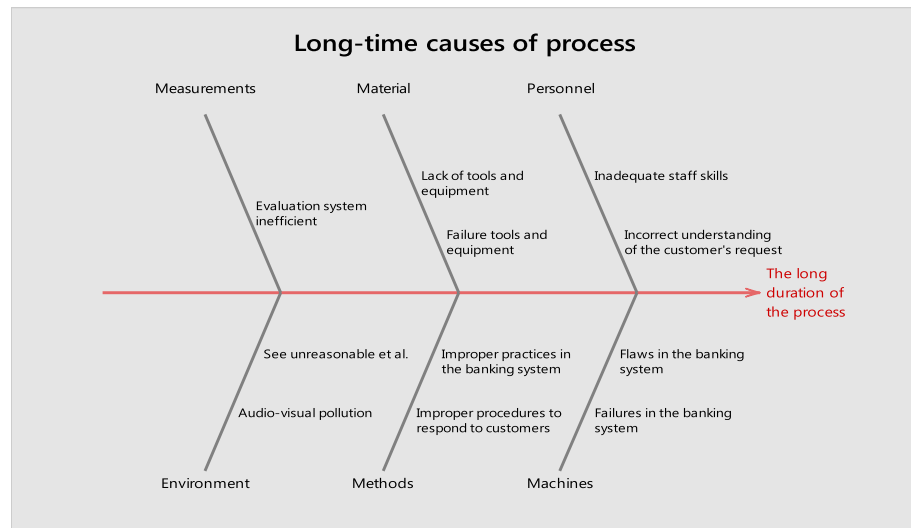


Figure 5. Identifying the critical variables.



the customer account book” were identified by the experts of Ghavamini Bank central branch with the help of the cause and effect graph (Figure 5).

Among the 11 variables presented in the cause and effect graph, 5 variables were identified as the main variables using the brainstorming technique:

- First variable (x1): defect in the bank system.
- Second variable (x2): failure in the bank system.
- Third variable (x3): failure of the necessary tools and devices.
- Fourth variable (x4): lack of necessary tools and equipment's.
- Fifth variable (x5): inadequate personnel skills.

In the present study, these five variables are considered as the independent variables (x) and the time taken to perform the process of “replacing the customer account book” is considered as the dependent variable (Y). After identifying the variables affecting the length of the process time, the fuzzy regression technique was used to analyze these variables.

4.2.3.1. *Results of fuzzy regression analysis.* In order to apply the fuzzy regression technique, first, data related to independent and dependent variables were collected from the statistical population using a questionnaire based on a five-point likert scale. In this regression model, the goal is to find fuzzy coefficients that minimize the fuzzy output range for all data values:

$$O = \min \left\{ \sum_{i=1}^p \sum_{j=1}^n s_i x_{ij} \right\}$$
$$Y_j \geq \sum_{i=1}^p a_i x_{ij} - (1-h) \sum_{i=1}^p s_i x_{ij}$$
$$Y_j \leq \sum_{i=1}^p a_i x_{ij} + (1-h) \sum_{i=1}^p s_i x_{ij}$$

Because there are two types of restrictions for each observation, the total number of restrictions is $2n$. In this research, i is the number of independent variables and j is the number of respondents. Also $h = 0.5$.

After implementing the linear programming model of fuzzy regression in Lingo software, the optimal response of the model was calculated as follows (assuming $h = 0.5$):

$$s_1 = 0.7427, s_2 = 0.2313, s_3 = -0.1476, s_4 = -0.0510, s_5 = -0.4655$$

$$a_1 = 0.0240, a_2 = 0.1238, a_3 = 0.3654, a_4 = 0.2295, a_5 = 0.5801$$

Also, the minimum value of the objective function, namely O , is 33.391 and the fuzzy coefficients are as follows:

$$\tilde{A}_1 = (0.0240, 0.7427)$$

$$\tilde{A}_2 = (0.1238, 0.2313)$$

$$\tilde{A}_3 = (0.3654, -0.1476)$$

$$\tilde{A}_4 = (0.2295, -0.0210)$$

$$\tilde{A}_5 = (0.5801, -0.4655)$$

With regard to the software outputs, the fuzzy regression model is as follows:

$$Y = (0.0240, 0.7427)x_1 + (0.1238, 0.2313)x_2 + (0.3654, -0.1476)x_3 + (0.2295, -0.0210)x_4 + (0.5801, -0.4655)x_5$$

After obtaining fuzzy coefficients, we used the defuzzification of fuzzy weighted average method to obtain the definitive data of the regression model.

In the fuzzy weighted average method, Defuzzification of triangular fuzzy numbers (x_l, x_m, x_u) is performed as follows (Radfar, Hossein, Lotfi, & Khalillo, 2011):

$$X_{\max} = \frac{x_l + 2x_m + x_u}{4}$$

Since the fuzzy numbers in the model of this study are symmetric triangular numbers, then:

$$x_{\max} = \frac{(a - s) + a + (a + s)}{4} = a$$

As a result, x_{\max} is equal to the value of a , which is the median value in regression fuzzy coefficients. Finally, according to the above relations, the definitive regression model is as follows:

$$Y = (0.0240)x_1 + (0.1238)x_2 + (0.3654)x_3 + (0.2295)x_4 + (0.5801)x_5$$

Here, we set y -intercept \tilde{A}_0 to zero and it is not used in analysis of the regression results. In fact we want the regression equation to pass the origin. The results obtained from the fuzzy regression model show that all five variables identified by the bank experts affect the process time but three variables (x_3, x_4, x_5) have greater impact. The effect of each independent variable on the dependent variable is provided in Table 4.

4.2.4. Improvement phase

In the first stage, with regard to the results of the analysis phase, and in order to improve the performance and increase customer satisfaction by considering the effective variables, using the 12 solutions (improvement projects) were proposed using brainstorm technique in order to reduce the process time. Then, in order to select the best improvement project to reduce the process time, improve process performance, and improve customer satisfaction, the cross-efficiency model in the data envelopment analysis technique was used. In order to select lean six sigma improvement project, the appropriate criteria were identified and defined based on the strategic plan of the Ghavamin Bank and the study of previous researches. After reviewing all the criteria, considering the opinions of the experts of the bank, and using the nominal group technique, five criteria were selected:

- (1) Cost of improvement project
- (2) Project duration (in terms of days)
- (3) Cost of low quality service
- (4) Customer satisfaction
- (5) Sigma level.

In the second stage, after selecting the appropriate criteria, in order to use the cross-efficiency model in the data envelopment analysis technique, the criteria were divided into two groups of inputs and outputs. Information about the improvement projects was collected in the quarterly accounting department of Ghavamin Bank, based on expert opinion (through interviews with the bank's experts) and database of the organization, within three months after the execution of each project.

These criteria along with the information collected for each of them are presented in Table 5.

In the third stage, after collecting information about the criteria based on the improvement projects, data analysis was performed using the cross-efficiency model used earlier for selecting the strategic process. The results of the improvement projects' ranking are presented in Table 6.

Table 4. Effect of each independent variable on the dependent variable

Independent variable	Effect on the dependent variable	Rank
First variable (x_1): Defect in the bank system	0.0240	5
Second variable (x_2): Failure in the system of the bank	0.1238	4
Third variable (x_3): Failure of required tools and devices	0.3654	2
Fourth variable (x_4): lack of necessary tools and equipment's	0.2295	3
Fifth variable (x_5): Inadequate personnel skills	0.5801	1

Table 5. Criteria for selecting the improvement projects

	Criteria				
	Inputs		Outputs		
	Project cost	Project runtime	Cost of low quality	Customer satisfaction	Sigma level
1	280	77	303	29	0.43
2	263	72	240	19	0.31
3	203	70	306	21	0.46
4	196	61	345	31	0.42
5	215	79	264	22	0.50
6	281	71	239	17	0.37
7	233	66	338	10	0.37
8	263	84	310	27	0.80
9	198	60	341	32	0.30
10	220	80	308	15	0.35
11	284	79	325	23	0.74
12	214	77	303	29	0.43

Table 6. Ranking of the improvement projects

Project number	Cross-efficiency score	Rank of the improvement project
1	0.728333	12
2	0.743333	10
3	0.904167	3
4	0.989167	1
5	0.8325	5
6	0.731667	11
7	0.843333	4
8	0.7775	7
9	0.965833	2
10	0.791667	6
11	0.760	9
12	0.77666	8

The results indicated that the improvement project #4 is the best choice to reduce the process time, improve performance and improve customer satisfaction. After implementing an improvement project entitled “implementing a process-based comprehensive training course for the branch personnel”, we concluded that implementing the six sigma methodology and the improvement project for the process of “replacing the customer account book” reduced the process time from 3 to 2:40 min. With regard to the project charter, it can be said that the goal of the project has been achieved and the implementation of the improvement project has significantly reduced the time of the process. The average process time considered in the charter of six sigma project was 2:35 s and the time it took differed only 5 s from the target time of the project.

4.2.5. Control phase

In this phase, we seek to ensure that the process has been improved. We collect process time data and then test the collected data to obtain the sigma level. Based on the calculations performed in

Table 7. Documenting the improvement activities

Characteristic under control	The standard of supervision	Data recording methods
Training the staff of the bank branch	Organizing an annual process-based learning course	Control and registration in the education system
	Controlling the improvement paths and skills of personnel	
Time to complete the process	Maximum 2:40 s after customer acceptance	Control in the bank queue system

the control phase, the following results were obtained for DPMO index, efficiency, and sigma level of the process of “replacing the customer account book”:

$$\text{DPMO} = 83,800$$

$$\text{Yield} = 91.62\%$$

$$\text{SigmaLevel} = 2.88$$

As the results of the control phase show, it can be concluded that the implementation of the project has improved the sigma level of the process of “replacing the customer account book”. In order to document the activities related to the improvement of supervisory, educational, and standardization activities, the control phase was developed as shown in Table 7. This table, as a process control document, shows how the process can be controlled and improved. For example, organizing an annual process-based learning course in relation to the accounting department processes that had not previously been in the bank’s education system will be considered after the implementation of the improvement project as a regulatory standard in the bank’s training system.

4.3. Assessment of the study objectives using BSC

The main objective of this research was to design a total quality model to align strategy, improve performance, and customer satisfaction in Qavamin Bank using a combination of six sigma and balanced scorecard approaches. In order to accurately measure the objectives of the model, three hypotheses were proposed.

4.3.1. Hypothesis’s

- Using the combination of lean six sigma and balanced scorecard approaches in Ghavamin Bank will lead to strategy alignment.
- Using the combination of lean six sigma and balanced scorecard approaches in Ghavamin Bank will improve performance of processes.
- Using the combination of lean six sigma and balanced scorecard approaches in Ghavamin Bank will improve customer satisfaction.

4.3.2. Assessment of the research hypothesis

Thirty two individuals from the managers and experts of the bank were selected as sample from the statistical population and a questionnaire was distributed among them. The reliability of the questionnaire was measured by Cronbach’s test. The result of this test is presented in Table 8.

Table 8. Cronbach’s alpha test

Cornbrash’s alpha	N of items
0.795	18

Table 9. One-sample Kolmogorov–Smirnov test

		Strategic alignment	Improve the process performance	Enhance customer satisfaction
N		32	32	32
Normal Parameters ^{ab}	Mean	3.5321	3.3818	3.2625
	Std. deviation	0.60715	0.51524	0.61612
Test statistic		0.163	0.228	0.184
Asymp. sig. (2-tailed)		0.189 ^c	0.167 ^c	0.103 ^c

^aTest distribution is Normal.

^bCalculated from data.

^cLilliefors significance correction.

Table 10. One-sample t test results for assessing the hypothesis

Hypothesis's	T	Degree of freedom	Significance	Mean difference from test value	95% Confidence interval for mean difference	
					Lower limit	Upper limit
Hypothesis 1	32.868	31	0.000	3.53125	3.3121	3.7504
Hypothesis 2	37.099	31	0.000	3.48281	3.1968	3.5668
Hypothesis 3	28.479	31	0.000	3.66677	3.4041	3.9293

One-sample t test was performed using SPSS software to analyze data. The one-sample t test, which is the simplest type of t test, is performed to answer the question whether the observed mean of a sample randomly selected from the population is equal to the assumed mean. The Kolmogorov–Simonov test (K-S) was used to measure the normality of the data. In this test, if the decision criterion (p-value) is more than 5%, the distribution of data is normal. Regarding the obtained values, the normality of the data was confirmed. The result of this test is presented in Table 9.

After assessing the normality of the data, one-sample t test was used to measure the research hypotheses. Here, the main purpose of measuring the research hypotheses is to answer the main research question, namely whether the combined approach of the six sigma methodology and the balanced scorecard has been able to achieve strategic alignment, improve process performance, and increase customer satisfaction. The results of the test are presented in Table 10.

T test calculated values for these hypothesis's are 3.53, 3.48, and 3.66, respectively, which are greater than the values calculated in test 3. With regard to the fact that the calculated value of t is greater than the value presented in the table and the test significance (0.000) is less than 0.05, we can say that, with a probability of 0.95, all three research hypotheses are accepted. The results of the hypothesis test showed that the model designed in this study achieved all three of its objectives, namely, strategic alignment, performance improvement, and customer satisfaction.

5. Research suggestions

Considering that the concepts of process structure and reducing customer waiting time were used in the present study for strategic alignment, it is suggested that the managers of the bank use the results of this research. Managers can enhance the performance and improve the process of “replacing the customer account book” by implementing a comprehensive lean six sigma and applying designed total quality model. The result of the implementation of the six sigma methodology and the use of the comprehensive quality model is the same as the study of the use of six sigma in the hospital information department by Bhat and Jnanesh (2013) the use of this methodology has led to a reduction in the process time and improvement of the process sigma level.

They can also achieve other goals in this trend. In this research, in order to select the strategic process and select the improvement project of the DMAIC cycle, the data envelopment analysis technique and the cross-efficiency model were used. In the first selection, the process of “replacing the customer account book” was identified as the first process in the ranking of the accounting processes of Ghavamin Bank. In the second selection, the improvement project of “Implementing a comprehensive process-based training course for the bank branch personnel” was identified to improve process performance. The key point of this model was that all processes influence each other in the ranking and calculation of the efficiency score in the ranking of processes and all processes are ranked. In fact, the weakness of traditional models of data envelopment analysis, which shows the simultaneous feasibility of several processes, is resolved in this model. Applying the technique of data envelopment analysis and its results is similar to the application of this technique in the study of selecting six sigma projects: MCDM or DEA? by Yousefi and Venchek (2016). The results of this study showed that the use of cross-efficiency model can overcome the weakness of the data envelopment analysis technique in choosing the strategic process and the six sigma improvement project. It is suggested that managers of organizations and management analysts use this model in their decisions. Using this model, managers can accurately rank the decision-making units without any restrictions. In this study, the convergence of the organization’s strategies in the six sigma methodology was based on a balanced scorecard approach, resulting in the use of a balanced scorecard led to the integration of the balanced scorecard and six sigma cards, the results of which were similar to the integrating balanced scorecard with six sigma, which was performed by Heavey and Murphy (2012), showed that using these two approaches would simultaneously bring the organization into strategic alignment.

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