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Investigating causal linkages and strategic mapping in the balanced scorecard: A case study approach in the banking industry sector

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Abstract

One of the main challenges of strategic management is implementing the strategies. Designing the strategy map in Balanced Scorecard framework to determine the causality between strategic objectives is one of the most important issues in implementing the strategies. In designing the strategy map with intuition and judgment, the link between strategic objectives is not clear and it is not obvious which strategic objectives are related and influenced each other. Hence, it is essential to offer a quantitative and accurate method to design the strategy map and clarify these relationships. In this paper, after reviewing the methods for determining the causal relationships among BSC perspectives in the literature, a framework on the basis of historical data analysis and multi-response surface regression analysis is offered to determine causal relationships among strategic objectives with respect to data of key performance measures of past years in order to obtain the coefficients and equations that can be used in the prediction of the responses. Using statistically significant models, the correlations between the factors and several responses were acquired. The presented quantitative approach is useful for determining the causal relationships resulting in an accurate strategy map and is a supporting approach for improving decision makers' opinions and enabling them to reach a more accurate picture of the relationships. This research also presents a case study to demonstrate the applicability of the proposed approach. The application and implication of the proposed method in a real case show that the contributions of the research are not only theoretical, but practical as well. The strategy map constructed in this study can also serve as a reference point for similar businesses.

Keywords: Strategy Maps; Balanced Scorecard; Key Performance Indicators; Statistical Modeling; ANOVA.

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1. Introduction

The Balanced Scorecard (BSC) is a method of strategic planning and organizational performance management.

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This method has emerged as a useful analytical system to aid organization in performance management as it includes both financial and non-financial measures classified into four perspectives (i.e., financial, customer, internal process, learning and growth) (Kaplan & Norton, 2004a; Atkinson, 2006, 2011; Cao et. al. 2015).

The BSC assist managers in monitoring the execution of strategy by mapping leading (cause) and lagging (effect) indicators and accentuate linkages between employee activities and strategy implementation (Peral et al., 2017; Sayed & Lento, 2018).

In recent years, professionals, directors, managers and academics have recognized BSC as one of the most popular and important management tools (Nudurupati et al., 2010; Rompho, 2012, Wudhikarn, 2016). Indeed, BSC has been implemented in many large organizations and various industry sectors and sizes (Rigby & Bilodeau, 2013; Hoque, 2014).

Both proponents and opponents of the BSC agree that a performance management system such as the BSC cannot work in practice if it lacks strategic causality, which may explain why the BSC is often regarded as irrelevant for practice (Nørreklit et al., 2012).

Organizations put a great effort into implementing the four BSC perspectives as a set of numbers, but forget to construct the causalities among these numbers. Strategy maps seem to be an accessible tool, because they facilitate the complex causal relations which the BSC is built upon (Lueg, 2015).

Strategy maps interpret all causal relationships so that strategies can be developed, translated, deployed and communicated effectively (Sayed & Lento, 2018).

Strategy map is a method for visualizing and communicating organizational strategy that can help organizations tackle the problems of communicating the strategy and its complexity by depicting the organizational strategy (Kaplan & Norton, 1996 a, b; Scholey, 2005).

In addition to simply visualizing strategy, Kaplan and Norton (2008) further recommend that strategy maps must clearly show the relationships among a company's financial, customer, internal processes, and learning and growth perspectives – specifically those elements associated with their BSC assessment of an organization's strategic position (Salas & Huxley, 2014). The strategy map lets managers at each level of the organization specify scorecards that describe the strategy as a set of causality relationships which can be examined and adjusted (Achterbergh et al., 2003).

The strategy map facilitates the maze of strategic objectives by showing how a few strategic objectives link tangible and intangible assets to value-creating processes (Kaplan and Norton, 2004; Lueg, 2015).

The strategy map makes BSC implementers think about specific goals they want to achieve, and how they need to be measured (Lueg, 2015).

According to what was mentioned above, it can be said that one of the most important steps in implementing the BSC in any organization, is establishing causal relations between strategic objectives (Evans, 2005) which is also known as the most important stage in the implementation of the model (Leung et al., 2006).

Given the role and importance of strategy maps in the implementation of the BSC and despite the fact that numerous studies have been done on it, few of them have addressed the correct implementation of this approach and the importance of strategy maps as the crucial link between strategy and the BSC (Azofra et al., 2003; Lueg, 2015).

Lueg (2015) has stated that "only a few academic studies have analyzed strategy map" (Lueg, 2015).

Considering the aforementioned points about BSC and despite its many advantages as one of the most important managerial tools, it has some shortcomings due to which few organizations have managed to implement this model successfully.

In fact, one of the challenges in the implementation of the BSC is the problem of determining the relationship pattern between strategic objectives and the influence value of strategic objectives and finally their effect on the organization's ultimate and long term goals (Farokhi & Roghanian, 2018).
Given the importance of constructing the strategy map and the relationships between strategic objectives accurately, in order to design and develop the strategy map in this paper, multi response surface regression of historical data and values of key performance measures are used so that the correlation between lower and upper perspectives of the BSC through the effect of different strategic objectives have on each other can be found. It should be noted that this technique (multi response surface regression) involves a set of methods that try to understand the relationship between the input and output of the system. In fact, the designer in this technique seeks to establish an optimal relation between these variables (Kim & Lin, 2006).
In other words, using response surface analyses, the relationship between strategic objectives in different perspectives of the BSC method is determined and it becomes clear which strategic objectives have a significant relationship.
This paper is organized into five sections: The introduction part and the concepts of strategy maps are introduced in Section 1. The relevant literature is reviewed in Section 2. The proposed framework for constructing a structural model of strategy map is described in Section 3. Section 4 illustrates an empirical case study. In describing the application, the focus is on presenting the proposed method to design strategy map in a real context and highlight some reflections of this method from it. Finally, the conclusions are presented in Section 5.
In fact, this research attempts to help organizations investigate the complicated causal relationships of strategic objectives and key performance measures for stablishing the strategy map on the basis of Balanced Scorecard framework.

2. Literature Review

Banker et al. (2011) found that a strategy map improves the use of a BSC. Othman (2006) showed that the absence of a causal model can create difficulties in developing a strategic action plan and attaining the needed consensus and involvement on the part of lower organizational levels. Causal maps foster the alignment of individual mental models (Gonzalez et al., 2012).
Bresciani et al. (2014) provided evidence that strategy mapping improves positive manager attitudes towards the content, as compared to a textual representation.
In spite of the importance of the causal model in BSC, there is no specific method to help organizations to develop such a causal model (Malmi, 2001; Speckbacher, 2003).
It is important to highlight that there have been efforts in formulating qualitative and quantitative models for developing strategy maps. The previous studies done on designing the strategy map are listed in Table 1.

Table 1. Pervious methods and research for constructing strategy maps

The proposed approach	Sources
Cognitive maps, Fuzzy cognitive maps	Abernethy et al., 2005; Glykas, 2012a; Glykas, 2012b
Digraph theory	Shahsavari-Pour et al., 2017
Expert systems	Kunz & Schaaf, 2011
Experts' opinions, Organizational knowledge, judgmental approach	Ahn, 2001; Papalexadris et al, 2005; Banker et al., 2011; Yang et al., 2015
Exploratory factor analysis (EFA), correlation matrix	Bruno, 2005; Tapionos et al, 2005; Huang et al., 2008; Huang, 2009
Hierarchical structures; Fuzzy analytic hierarchy process	Chan, 2006; Lin et al., 2014; Pérez et al., 2017
Interpretive structural modeling	Thakkar et al., 2007
Knowledge-based system	Huang, 2009
Multi-criteria methods: Decision Making Trial and Evaluation Laboratory (DEMATEL), Fuzzy DEMATEL, Linear programming, Analytic network process (ANP)	Tseng, 2010; Jassbi et al., 2011; Seyedhosseini et al., 2011; Seyedhosseini & Soloukdar, 2011; Falatoonitoosi et al., 2012; Wu, 2012; Hashemkhani Zolfani & Safaei Ghadikolaei, 2013; Ren et al., 2013; Shaik & Abdul-Kader, 2014; Sachin & Ravi Kant, 2014; Valmohammadi & Sofiyabadi, 2015; Kala & Bagri, 2016; López-Ospina et al., 2017; Sayed & Lento, 2018; Quezada et al., 2018
Scenario-based approach	Buytendijk et al., 2010; Glykas, 2012b
Structural equation modeling(SEM), partial least squares(PLS), Path analysis	Yang &Tung, 2006; Rodriguez et al., 2009; Perlman, 2013; Alolah et al., 2014; Park et al., 2017; Porporato et al., 2017; Castellano & Gobbo, 2018; Zahoor, & Sahaf, 2018
System dynamics	Rydzak et al., 2004; Showing & Chiang, 2004; Cardoso de Salles et al., 2016; Hu et al., 2016
Quality Function Deployment (QFD) matrix	Ip & Koo, 2004

It should be noted that the analysis and testing of casual relations are important parts of designing strategy maps. Rodriguez et al. have stated: "Looking at the statistical literature, the multivariate analysis has the potential to identify relationships between variables over time" (Hair et al., 1995; Jackson, 2003). They also believe: "From these, the main techniques to be applied include: factorial analysis, principal component analysis, structural equation models and the analysis of variance" (Rodriguez et al, 2009).

Indeed, a different set of articles focuses specifically on the design of strategy maps. Most of them use multi-criteria decision making methods especially DEMATEL and a combination of ANP and DEMATEL, as showed in Table 1.

Some authors have stated that limited empirical research evidence is available in the literature that tries to examine the reliability of the linkages among the strategic objectives (Bryant et al., 2004; Yang and Tung, 2006; Cohen et al., 2008; Huang et al., 2008; Morard et al., 2013; Perlman, 2013).

By reviewing the relevant literature in order to fill the gap of the existing body of knowledge regarding the strategy map development, the current research proposes a new and systematic approach using the multi response surface regression analysis of historical data and values of key performance measures, to integrate experts' experiences and knowledge in order to determine the causal relationships among the key performance measures of a strategy map.

3. The proposed method

It should be noted that the purpose of this this research is to explain the ability and potential of the proposed method to be applied to different kinds of organizations which use the BSC because the paper specifically suggests a framework for constructing strategy maps in the context of the BSC. In fact, the proposed method has been designed particularly for strategy maps within the context of a BSC method.
Also BSC is a general and public method that can be applied in different kinds of organizations and it can be applicable to any kinds of organizations but it is necessary to adapt the proposed model to their conditions and requirements.
The approach used in this study involves the following steps:

Step 1: Investigating an initial strategy map in line with the organization's vision and goals
In this phase it is necessary to determine the relationships and associations among the strategic objectives of different perspectives from top to bottom in the strategy map. It should be noted that due to the complexity of the data and the time needed for their identification and extraction, expert knowledge and opinion can be of help in the design and development of strategy maps (Parmenter, 2015). Also Shahsavari-Pour et al. (2017) have stated that, strategy maps are built using the opinions of senior managers and experts and the ideas of organizations.
Hence, the opinions of the organization's managers are used to clarify these linkages and relationships to design the initial strategy map. Therefore, the initial strategy map is prepared based on the views and experiences of managers and experts in the field of strategy.

Step 2: Analysis of historical data on related KPIs and scorecards
In this phase, the historical data of previous key performance indicators are extracted and analyzed from the results of the scorecards and related KPIs which are based on databases that recorded the organization's history and assisted in gaining a more realistic view of what is achievable. Therefore, all calculations done in the proposed method follow KPIs related to the strategic objectives

Step 3: Applying multi-response surface analysis for testing and approving the significant relationships
In practice the judgments of the senior team cannot be simultaneously considered for either previous data or qualitative data. Therefore, the most important factor influencing the design of strategy maps is the experience and knowledge of the management team and organization experts while other factors tend to have less influence. Thus, a model that can offer a combination of these is difficult to obtain (Kaplan & Norton, 2004a; Rydzak et al., 2004; Niven, 2008).
Since in the BSC method and strategy map, strategic objectives of every perspective influence the strategic objectives of the higher perspective and indeed there is a causal relationship between the four perspectives which connects them to each other, the KPIs of the higher perspectives of BSC are considered as dependent variables and the KPIs of the lower perspectives are considered as independent variables on the basis of managers and experts' opinions.
Therefore, using historical data on key performance indicators and considering the fact that strategic objectives influence strategic objectives of other perspectives from lower to higher perspectives of the strategy map, response surface regression equations of the KPIs in financial perspective can be taken as dependent variables while KPIs of other perspectives that affect the financial perspective can be considered as independent variables. In the same way, for the next perspective which is that of customer, response regression equations within the customer

perspective are taken as dependent variables while lower perspectives, that is, internal processes, and learning and growth are used as independent variables. Also for the internal processes perspective, strategic objectives of this perspective serve as dependent variables and strategic objectives of the learning and growth perspective are used as independent variables. In this way, a series of equations between various perspectives of strategy map from top to bottom are formed. After that the relationships obtained in response surface equations are tested and checked for significant correlations that form the cause and effect relationships used in developing and constructing the final strategy map.

In fact, considering the obtained relationships in response surface equations, the cause and effect relationships among strategic objectives are tested for identifying the relations that have significant correlations. In this way, the final strategy map is constructed and developed using these cause and effect relationships among the strategic objectives.

It should be noted that according to the proposed method in this research associations and relationships among the four perspectives of the BSC are hierarchically investigated (i.e., the relationships among different strategic objectives in each perspective or layer are examined with their lower influencing layer). For example, in the first step, the relationships among strategic objectives of the financial perspective and the strategic objectives affecting them in the customer's perspective are examined. In the second step, the relationships among strategic objectives of the customer perspective and the strategic objectives affecting them in the internal processes perspective are examined and finally the relationships among internal processes and learning and growth perspectives are examined. In fact, in the proposed approach of this research, when a dependent variable and several independent variables (which are the strategic objectives of different perspectives of BSC) are examined in the multi-response regression models, it is assumed that there is no multi-collinearity or hidden and latent variables. In cases where there are significant multiple correlations between the independent variables or predictors, the regression coefficients are not estimated from the ordinary least squares (OLS) method. Therefore, in these cases, using ridge regression, exploratory factor analysis (EFA), and principle component analysis (PCA) methods are recommended to resolve multiple correlations between variables (Johnson & Wichern, 2002).

Indeed, it is important to notice that the proposed method assumes that the experts and managers have agreed upon reasonable strategic objectives, key performance indicators, and hypothesized cause–effect associations in the strategy map while there might be other relationships among the strategic objectives in the strategy map. Therefore, according to managers' opinions, the linkages and relationships among strategic objectives are considered and tested to accept the significant relationships and constructing the final strategy map.

The steps used in the proposed method are summarized in Figure 1.

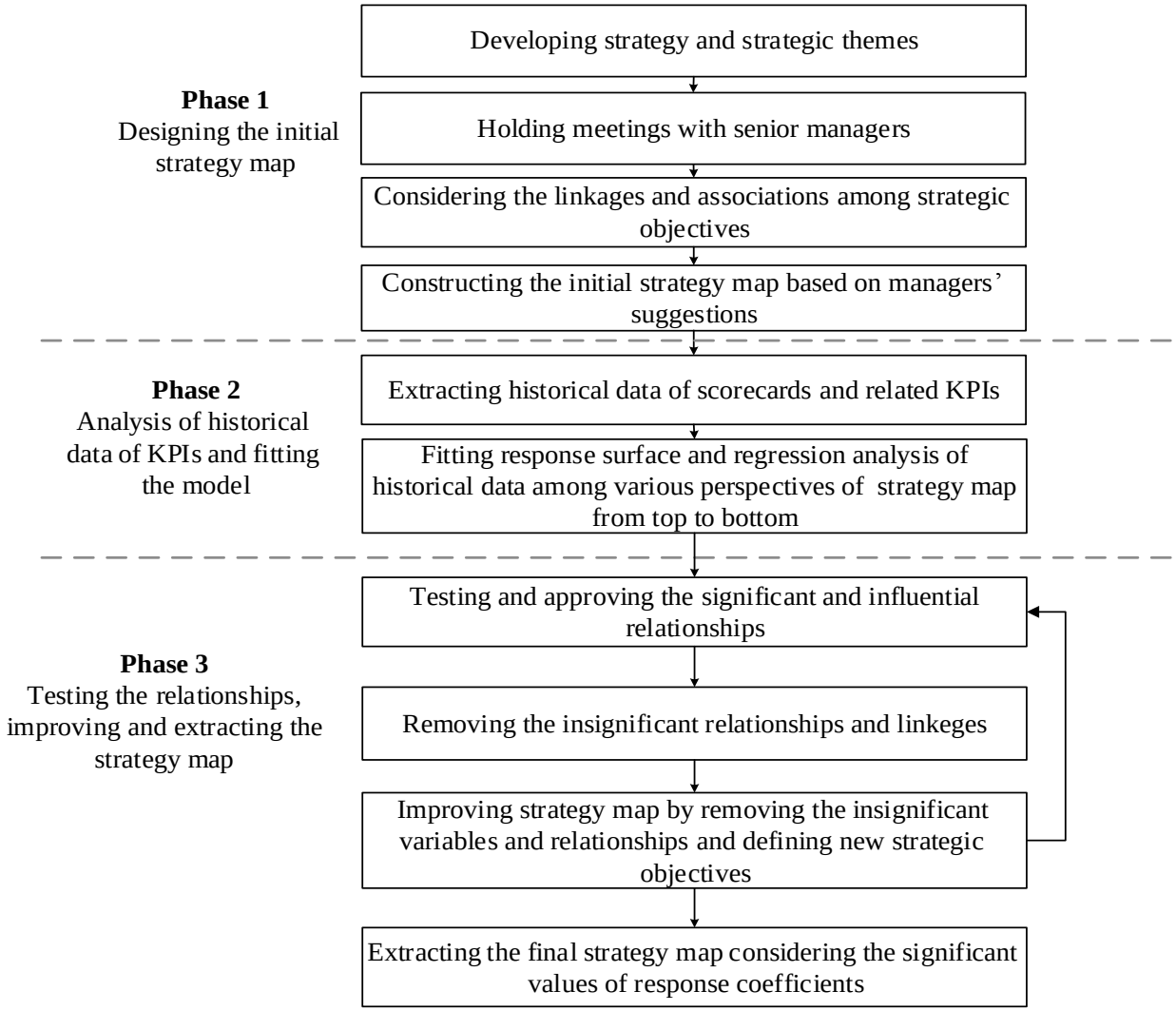

Figure 1. Diagram of The proposed method

It is worth noting that the research methodology is a solid framework proposed in general and demonstrates the associations and interactions among strategic objectives and it is in general applicable to the BSC context. In addition, the various steps of the proposed method presented in Figure 1 are investigated, implemented, and applied to a real case study to demonstrate the applicability of the proposed approach and test it with real data of key performance indicators in the framework of BSC. It is important to mention that the proposed method maintains the classical structure of BSC. The application in a case study showed that the contribution is not only theoretical, but practical as well.

4. Case study

As was mentioned above, the BSC method as a new performance measurement system is able to overcome the problems and barriers existing in traditional management systems since it can overcome obstacles in implementing and applying strategies. The purpose of the current study is to provide a quantitative method for designing, testing and approving the causal relationships of strategic objectives within the framework of the strategy map in the BSC model.

In other words, the main theme of this study is to propose a methodology to determine the BSC strategy map and provide profound analysis of the complicated interactive relationships among the strategic objectives. In this regard Figure 2 illustrates the structure and process of defining and constructing the BSC and strategy map.

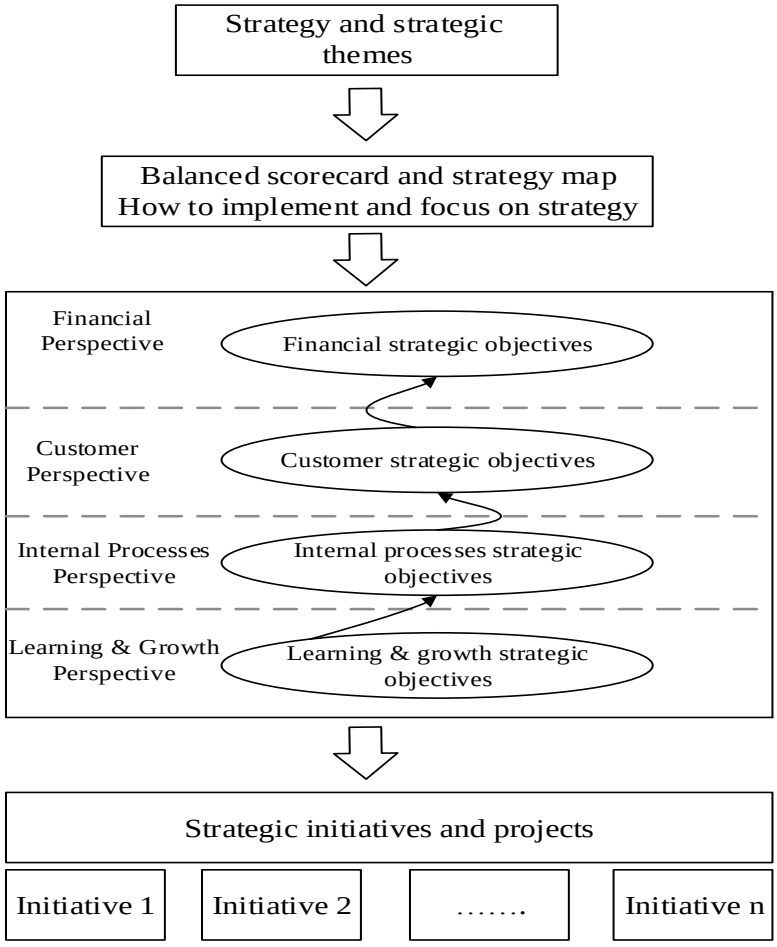

Figure 2. The process of developing the BSC and strategy map

In this section, the application of the stages of the proposed approach is investigated in a private bank in Iran. The competitive and complex conditions of Iran's current economy, the increasing number of private banks, presenting new plans for attracting and retaining customers, and the increasing level of awareness and expectations of banks' customers have urged top executives of banks to change their strategic attitudes to the market and customers. Therefore, designing and implementing the strategy map is more important to them than before. Consequently, this study addresses the implementation of a BSC method in one of Iran's private banks.

According to the proposed framework in Figure 1 and also the process of defining BSC in Figure 2, in the first step, it is required that strategic themes of the bank under study be specified and complied based on its vision, mission, and organizational values. In the second step, for the interpretation and implementation of the strategic themes, the strategic objectives derived from the first step are divided into four perspectives of BSC and key performance measures are specified. Using the opinions and experiences of the managers, specialists and decision makers in the field of strategy and experts of the bank under study, the relationships between strategic objectives are determined and the initial strategy map is drawn. The final result has been presented in Figure 3.

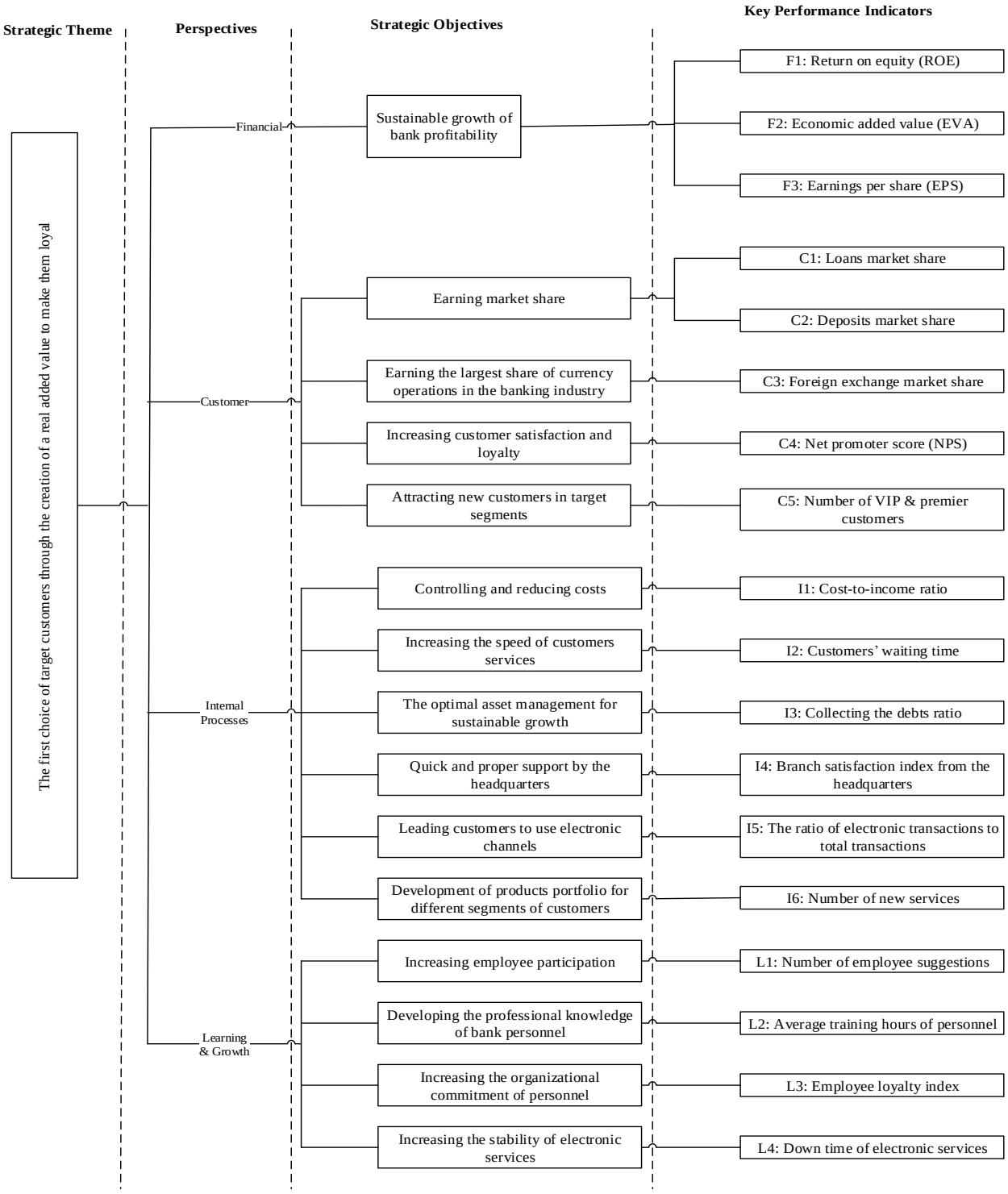

Figure 3. Hierarchal structure of BSC in the bank under study

By studying this case, it can be concluded that the strategy map can become an efficient tool for developing and implementing the strategy of the bank and effectively fulfil the performance evaluation. The collaboration and commitment of the senior managers (especially human resources manager, financial manager, business units' managers, branches directors, product development manager, and sales & marketing manager) were critical.

By considering the strategies of the bank under investigation, the strategic objectives of Balanced Scorecard's different perspectives and the influential factors on the abovementioned strategic themes were determined based on the opinions of the bank's decision makers.

Furthermore, the associations between various strategic objectives in various perspectives of BSC were determined and the initial strategy map was drawn based on experts' opinions. The initial strategy map according to managers and experts' opinions is shown in Figure 4.

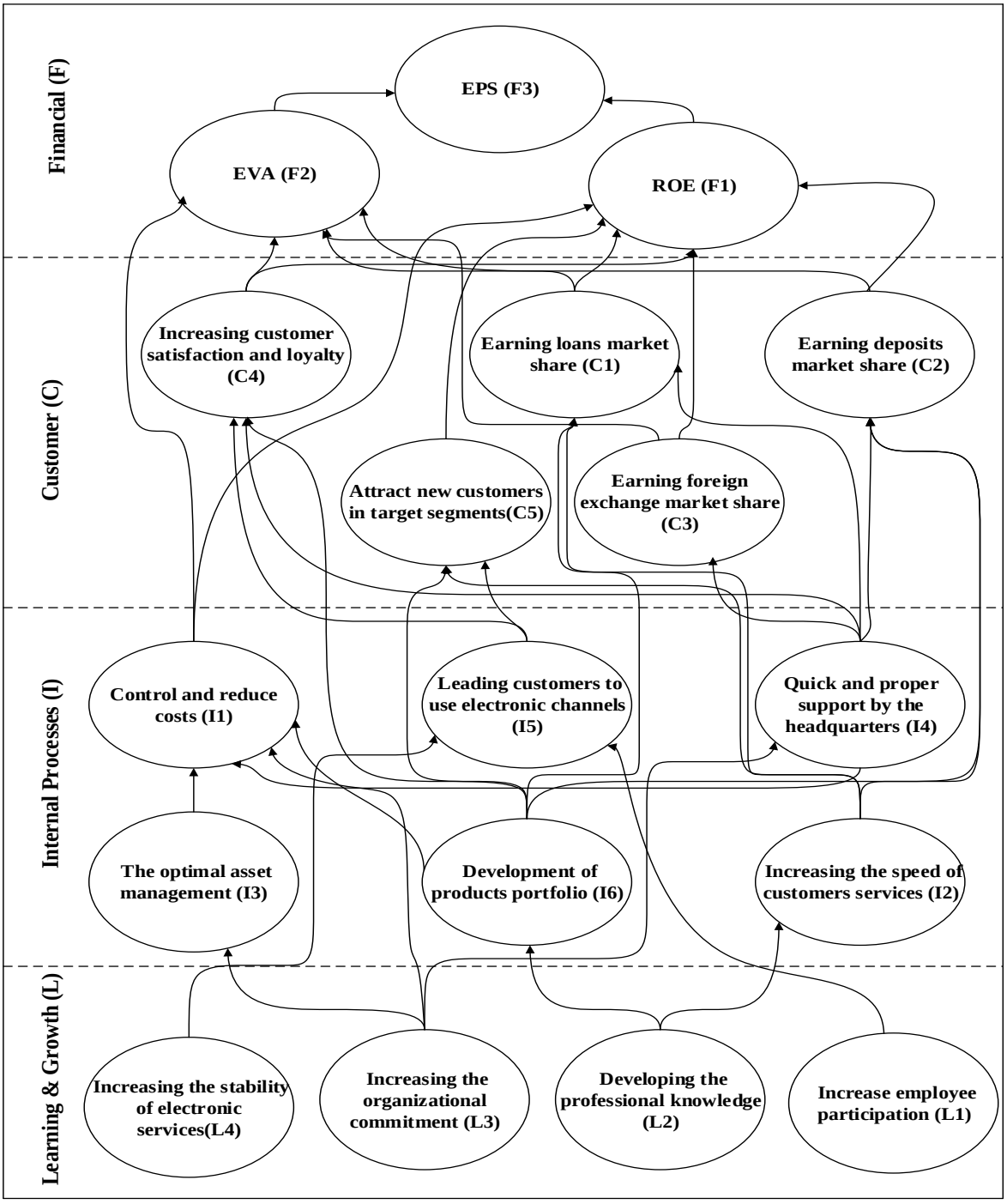

Figure 4. The initial strategy map of the bank under study

The influential factors on each strategic objective in different perspectives have been shown in Figure 4. As shown in Figure 4, according to the opinions of the experts and managers of the bank under study, the strategic objective F1 is related to the strategic objectives C1, C2, C3, C4, C5 and I1, all of which affect F1 from lower perspectives of financial perspective.

Therefore, F1 is selected as the dependent variable and the other objectives related to it are considered as independent variables. A process similar to that mentioned above is undertaken for the remaining strategic objectives.
To determine the significant associations among strategic objectives in different perspectives of strategy map specified by the experts and specialists of the bank and also to analyze the quantitative associations of key performance measures, multiple response regression analysis was employed. In fact, the influential factors on each strategic objective are at first selected and determined according to specialists and experts' opinions and the significance of input variables on the responses will be re-examined by statistical tools during the modeling phase of the study.

4.1. Applying Multi Response Regression Analysis for Financial Perspective

The real data of key performance indicators of the studied bank related to previous periods in 14 consecutive years were used and statistically analyzed so that the significance of linear effects and also the mutual interactions of factors can be identified.
Therefore, according to the relationships in Figure 4, key performance indicators of the highest perspective in BSC (i.e. F1, F2, F3) are considered as the response variables and key indicators of other perspectives affecting them (i.e. C1, C2, C3, C4, C5, and I1) are considered as the influencing factors.
It should be noted that all calculations done in the proposed method follow the real data of key performance measures related to the strategic objectives. Considering the performance measures of each strategic objective as historical data of previous performance measures, Minitab and Design Expert software were used for modeling, analyzing, and finally extracting the regression equations for all performance measures. It is necessary to mention that Design Expert software provides statistical tools for the analysis of historical data and has been referred to or used by many researchers in their research (Zhou & Kapoor, 2011; Anderson & Whitcomb, 2017).
The results obtained from the data of key performance measures related to previous periods of the studied bank were statistically analyzed so that the significance of linear effects and also the mutual interactions of factors can be identified. The results of ANOVA were also conducted to determine the significant/insignificant effects and associations so that the best regression equation for significant data can be achieved.
In fact, the quality of the developed model was determined by the coefficients of determination (R), while the analysis of variance (ANOVA), normal probability plot, and residual analysis were used to evaluate the statistical significance of the model by the values of regression and mean square of residual error and to prove the adequacy of the predictive models. The results of the ANOVA for all the financial measures (response variables) are shown in Table 2.
The significance of each coefficient was determined by the same way. The larger the magnitude of F-test value and smaller the P-value, the more significant is the corresponding coefficient (Khuri, 2006).

Table 2. Statistical analyses of response variables in the financial perspective (ANOVA)

Response	Source	Sum of Squares	Df	Mean Square		F Value	p-value, Prob > F
ROE (F_1)	Model	1.030E+006	9	1.717E+005		1562.96	< 0.0001
	Residual	988.65	6	109.85			
	R-Squared	0.9990	Adj R-Squared		0.9990	Pred R-Squared	0.99
	C.V. %	1.80	Adeq Precision		116.752		
EVA (F_2)	Model	0.044	9	5.289E-003		1400.34	< 0.0001
	Residual	2.777E-004	8	4.121E-005			
	R-Squared	0.999	Adj R-Squared		0.998	Pred R-Squared	0.9999
	C.V. %	0.18	Adeq Precision		147.756		
EPS (F_3)	Model	3.49	9	0.48		97.85	< 0.0001
	Residual	0.024	7	3.965E-003			
	R-Squared	0.9932	Adj R-Squared		0.9831	Pred R-Squared	0.90
	C.V. %	4.90	Adeq Precision		36.608		

The results of ANOVA were also conducted to determine the significant/insignificant effects and associations so that the best regression equation for significant data can be achieved. The quality of the developed model was determined by the coefficients of determination (R), while the analysis of variance (ANOVA), normal probability plot, and residual analysis were used to evaluate the statistical significance of the model by the values of regression and mean square of residual error and to prove the adequacy of the predictive models.

The results of the statistical analysis for all response variables in the financial perspective according to Table 2 show that the values of R^2 coefficients for all the responses reflect the observation that more than 99% of the variability in the responses is attributable to the independent variables and also indicate that less than 0.1% of the variations is not explained by the models in the same order. This 0.1% variation is accounted for by the factors and variables that were not considered by the experts in the model in the same order. The values of the adjusted determination coefficients (adjusted R^2 for all the responses) are also sufficiently high to support a high significance of the models (Montgomery, 2017). Therefore, at this stage, the model can be improved by inserting other variables into the model and eliminating those that have less effect.

The values of R-Squared and Adjusted R-Squared for all the responses also support the significance of the models. It is noteworthy that the coefficients of variation had almost low values (C.V = 1.80%, 0.18%, and 4.90% respectively, for F1, F2, and F3) which indicates the precision and reliability of the models. Also the difference between adjusted R^2 and predicted R^2 for all responses (F1, F2 and F3) is <0.1.

The adequate precision measures the signal to noise ratio which is computed by dividing the difference between the maximum predicted response and the minimum predicted response by the average SD of all predicted responses. A ratio greater than 4 is desirable which means that the model is able to give a reasonable performance according to the prediction (Montgomery, 2017). The adequate precisions of the models are 116.752, 147.756, and 36.608 for F1, F2, and F3, respectively which indicate that the models are adequate. Similar results of R^2 and Adjusted R^2 are also observed for the responses.

The normal probability plots of the residuals for F1, F2, and F3 responses were checked and revealed that the residuals generally fall on a straight line implying that the errors are distributed normally according to Figure 5.

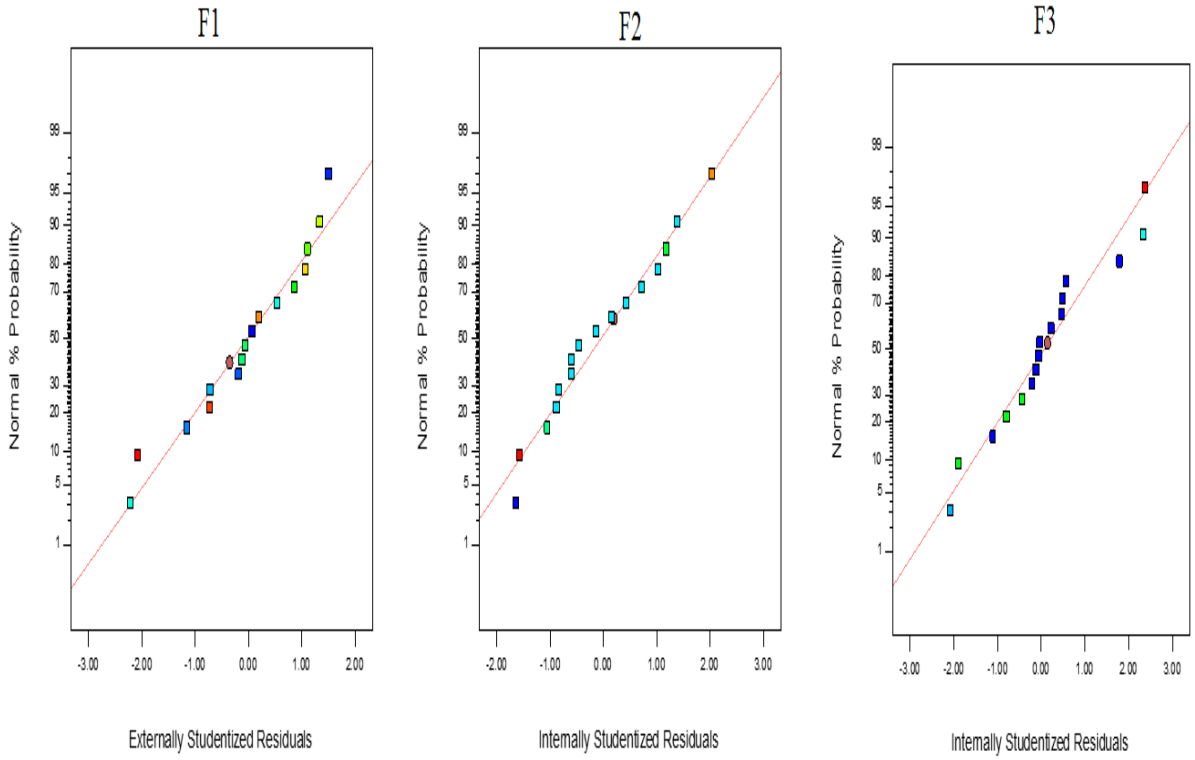

Figure 5. Normal probability plots of residuals for financial perspective responses

For selecting the best predicting model, a set of different polynomial models were compared. The best model was chosen according to a good balance among the highest coefficient of determination and the lowest standard deviation, p-value, and degree of freedom. Due to the aforementioned reasons, quadratic, 2 Factor Interaction (2FI), and linear models were selected. Therefore, mathematical models for the desired responses as a function of selected variables were developed by applying the multiple regression analysis on the historical data. For example, the ANOVA of linear model of response F1 has been reported in Table 3.

Table 3. ANOVA for Response Surface Reduced 2FI Model (Response: F1)

Source	Sum of Squares	Df	Mean Square	F Value	p-value Prob > F	
Model	3.49	9	0.39	97.85	< 0.0001	Significant
C1	9.662E-003	1	9.662E-003	2.44	0.1696*	Not Significant
C2	0.019	1	0.019	4.73	0.0726*	Not Significant
C3	0.019	1	0.019	4.88	0.0693*	Not Significant
C4	0.071	1	0.071	18.02	0.0054	Significant
C5	0.19	1	0.19	48.82	0.0004	Significant
I1	0.012	1	0.012	2.95	0.1364*	Not Significant
C1C2	0.017	1	0.017	4.28	0.0840*	Not Significant
C1C3	0.013	1	0.013	3.25	0.1213*	Not Significant
C4C5	0.063	1	0.063	15.78	0.0003	Significant
Residual	0.024	6	3.965E-003			
Cor Total	3.52	15				

* Insignificant variables (p-value> 0.05)

As shown in Table 3, the ANOVA of the regression model demonstrates that the model is highly significant as evident from the calculated F-value (97.85) and the very low probability value ($P \leq 0.0001$). It should be noted that C1, C2, C3 and I1 are the variables with no influence on the response variable of F1 and have a weak effect on predicting F1. However, the effects of other variables are significant. By removing the effect of insignificant variables, the regression equation for performance measure F1 is determined.

In the same way, the regression equations are determined based on the statistical analysis mentioned for the other performance measures corresponding to the strategic objectives. Due to space constraints, the detailed description of the applied method for all strategic objectives is avoided.

Table 3 shows that the main parameters affecting the F1 response are respectively C4 & C5, and the term C4C5 represents the only effective interaction on the F1 response. Other equations are also interpreted in the same way. It is noteworthy that a low value of coefficient of variation was observed according to Table 2 (C.V = 1.8%, 0.18% and 4.9% respectively, for F1, F2 and F3) which indicates the precision and reliability of the models.

4.2.Using Multi Response Regression Analysis for Customer and Market Perspective

Similar to the above-mentioned approach where for the strategic objectives the highest perspective of the BSC (i.e. financial perspective measures) was done, the same approach was undertaken for the strategic objectives of the customer and market perspectives as the response variables and the strategic objectives associated with them are defined as independent variables. Therefore, according to Figure 4, the customer perspective measures (with C index) can be considered as response variables for internal processes perspective with index I (factors or input variables I1, I2, I3, I4, I5 and I6).

The results of the ANOVA related to customer perspective measures as response variables are also shown in Table 4. The significance of the models was calculated by the F test. The models are significant at 95% level and that the P-value is less than 0.05 confirms this result. Also, R^2 and Adjusted R^2 coefficients confirm the major changes in response variables (i.e. customer performance measures) and indicate that less than 0.1% of the factors are associated with noise.

Table 4. ANOVA Results of Customer Perspective

Response	Source	Sum of Squares	Df	Mean Square	F Value	p-value, Prob > F
Loans market share (C1)	Model	1.192E-003	4	2.979E-004	389.68	< 0.0001
	Residual	8.409E-006	11	7.645E-007		
	R-Squared	0.9930	Adj R-Squared		0.9904	
	C.V. %	0.7	Adeq Precision		519.187	
Deposits market share (C2)	Model	4.425E+010	7	6.321E+009	47617.86	< 0.0001
	Residual	1.062E+006	8	1.328E+005		
	R-Squared	1.0000	Adj R-Squared		1.0000	
	C.V. %	4.48	Adeq Precision		16.786	
Foreign exchange market share (C3)	Model	17900.97	2	8950.49	1571.76	< 0.0001
	Residual	74.03	13	5.69		
	R-Squared	0.9959	Adj R-Squared		0.9952	
	C.V. %	6.58	Adeq Precision		100.168	
NPS (C4)	Model	1.689E+005	8	21106.91	78.42	< 0.0001
	Residual	1884.14	7	269.16		
	R-Squared	0.9890	Adj R-Squared	0.9764	Pred R-Squared	0.90
	C.V. %	6.29	Adeq Precision		31.099	
Number of VIP & Premier Customers (C5)	Model	343.86	7	49.12	40.00	< 0.0001
	Residual	9.82	8	1.23		
	R-Squared	0.9722	Adj R-Squared		0.9479	
	C.V. %	4.98	Adeq Precision		19.293	

The normal probability plots of the residuals for customer measure responses were checked and revealed that the residuals generally fall on a straight line implying that the errors are distributed normally.

Using the previous approach, the results of the ANOVA were also employed to determine the significant and insignificant effects of response variables of customer and market perspective so that the best regression equation for significant data for each response be achieved. Due to space constraints, the detailed description of the applied method for C1, C2, C3, C4 and C5 responses is avoided. Therefore, the response equations are determined based on the statistical analyses mentioned above for the other performance measures.

4.3. Using Multi Response Regression Analysis for Internal Business Processes Perspective

At this stage, internal processes measures with I indexes are taken as dependent variables for learning and growth measures with L indexes. The ANOVA of observations was also conducted to determine significant/insignificant dependent variables within internal processes perspective according to Table 5. Consequently, the most relevant regression equations for significant results were obtained. As Table 5 shows, the R^2 and Adjusted R^2 coefficients for all responses confirm the major variations in the response variables.

Table 5. The ANOVA Results of Internal Processes Perspective

response	Source	Sum of Squares	Df	Mean Square	F Value	p-value Prob > F
Cost-to-income ratio (I1)	Model	4.39	9	0.49	1.971E+005	< 0.0001
	Residual	1.237E-005	5	2.475E-006		
	R-Squared	0.9900	Adj R-Squared	1.0000		
	C.V. %	0.79	Adeq Precision	34.986		
Customers' waiting time (I2)	Model	1.286E-004	10	1.286E-005	2709.90	< 0.0001
	Residual	2.373E-008	5	4.745E-009		
	R-Squared	0.9998	Adj R-Squared	0.9994		
	C.V. %	1.95	Adeq Precision	153.161		
Collecting the debts ratio (I3)	Model	88.50	8	11.06	633.22	< 0.0001
	Residual	0.12	7	0.017		
	R-Squared	0.9986	Adj R-Squared	0.9970		
	C.V. %	0.25	Adeq Precision	291.388		
Branch satisfaction index from the headquarters (I4)	Model	4.156E-005	4	1.039E-005	109.36	< 0.0001
	Residual	8.550E-007	9	9.500E-008		
	R-Squared	0.9798	Adj R-Squared	0.9709	Pred R-Square	0.9220
	C.V. %	0.79	Adeq Precision	34.986		
The ratio of electronic transactions (I5)	Model	3.914E+011	8	4.893E+010	2739.27	< 0.0001
	Residual	1.250E+008	7	1.786E+007		
	R-Squared	0.9997	Adj R-Squared	0.9993	Pred R-Squared	0.9603
	C.V. %	1.95	Adeq Precision	153.161		
Number of new services (I6)	Model	5.115E-005	5	6.300E-008	1.009E-005	109.36*
	Residual	7.050E-006	9	7.300E-008		
	R-Squared	0.2733*	Adj R-Squared	0.2214*	Pred R-Squared	0.2200
	C.V. %	0.78	Adeq Precision	35.69		

* Insignificant values

The relationships and interactions presented above lead to a better clarification and understanding of all the associations between various strategic objectives of lower perspectives of the BSC to the higher ones, in the bank under investigation, so that these associations can be used for designing strategy map and identification of significant relationships between various strategic objectives.

According to the ANOVA results in Table 5, the R^2 and Adjusted R^2 coefficients for all responses, except for the I6 index, confirmed the major variations in the response variables.

This implies that none of the performance measures of the learning and growth perspective affect I6 index. Thus, in order to achieve the strategic objective, "Development of products portfolio for different segments of customers", the bank should define a strategic objective in learning and growth perspective with influence over this strategic objective.
Table 6 presents a summary of all influential and significant factors on strategic measures of various perspectives of strategy map. The effectiveness of these factors has been confirmed by response regression method. The strategy map of the bank under study was drawn again using the factors influencing measures in each perspective of BSC. In fact, by considering the significant relations among the variables, the associations among strategic objectives of BSC were specified in the strategy map.
By identifying and assessing the relationship between strategic objectives in BSC perspectives, it will be possible to enable dependent strategic objectives by improving influential strategic objectives. In addition, using this method will help managers and experts to have a more accurate description of the relations between different strategic objectives and to draw a more accurate strategy map.

Table 6. A Summary of the Influential Factors on Each Perspective of Strategy Map

Performance Measures	Influential factors (Expert Opinions)	Significant Influential Factors	F Value	Model p-value	R^2	Adj R^2
ROE (F_1)	C1, C2, C3, C4, C5, I1	I1	1562.96	< 0.0001	0.9990	0.9990
EVA (F_2)	F1, C2, C3, C4, I1	C4, I1	1400.34	< 0.0001	0.999	0.998
EPS (F_3)	F1, F2	F1	97.85	< 0.0001	0.9932	0.9831
Loans market share (C1)	I2, I4, I6	I4	389.68	< 0.0001	0.9930	0.9904
Deposits market share (C2)	I2, I4, I6	I4	47617.86	< 0.0001	1.0000	1.0000
Foreign exchange market share (C3)	I4	I4	1571.76	< 0.0001	0.9959	0.9952
NPS (C4)	I4, I5, I6	I5, I6	78.42	< 0.0001	0.9890	0.9764
Number of Customers (C5)	I2, I4, I6	I5	40.00	< 0.0001	0.9722	0.9479
Cost-to-income ratio (I1)	I3, I4, I6, L3	I3, L3	1.971E+005	< 0.0001	0.9900	1.0000
Customers' waiting time (I2)	L2	L2	2709.90	< 0.0001	0.9998	0.9994
Collecting the debts ratio (I3)	L3	L3	633.22	< 0.0001	0.9986	0.9970
Branch satisfaction index from the headquarters (I4)	L3	L3	109.36	< 0.0001	0.9798	0.9709
The ratio of electronic transactions to total transactions (I5)	L1, L4	L1, L4	2739.27	< 0.0001	0.9997	0.9993
Number of new services (I6)	L2	-	1.009E-005*	109.36*	0.2733*	0.2214*

* Insignificant values

By considering the significant associations among the factors in each perspective of BSC of the bank under study, the relations between strategic objectives of BSC were specified in the strategy map. The relationships and associations presented above lead to a better understanding of all the interactions among various strategic objectives of lower perspectives of the BSC to the higher ones, in the bank under investigation, so that these associations can be used for designing strategy map and identification of significant relationships between various strategic objectives. The final strategy map of the studied bank was drawn again using the factors influencing strategic objectives in each perspective.
For example, the main factor affecting the F1 response (Return on Equity) is I1 (Cost-to-income ratio) while the main factors affecting the F2 response (Economic added value) are C4 (NPS indices) and I1 (Cost-to-income ratio).
According to Table 6, I2 index has no effect on C1, C2, and C5 responses.

This implies that although the experts of the bank believed that the "Customers' waiting time" indicator affects "Foreign exchange market share", "Net promoter score (NPS)" and "Number of VIP & Premier Customers" indices, it does not actually impact these indices. This issue was raised with bank experts and specialists and they believed that the "Customers' waiting time" index is very important for customers. Therefore, this index will have a great effect on performance measures of the customer perspective in the BSC.

Thus, in order to achieve the objective, "Increasing the speed of customer service", the bank should define an accurate performance measure in customer and market perspective and also improve the "Customers' waiting time" index. Other associations are also interpreted in the same way. Therefore, taking into account the other relations according to Table 6 and the significant associations among factors, the relationships between the strategic objectives of the different perspectives of the BSC for the bank under investigation are illustrated in the form of a strategy map in Figure 6.

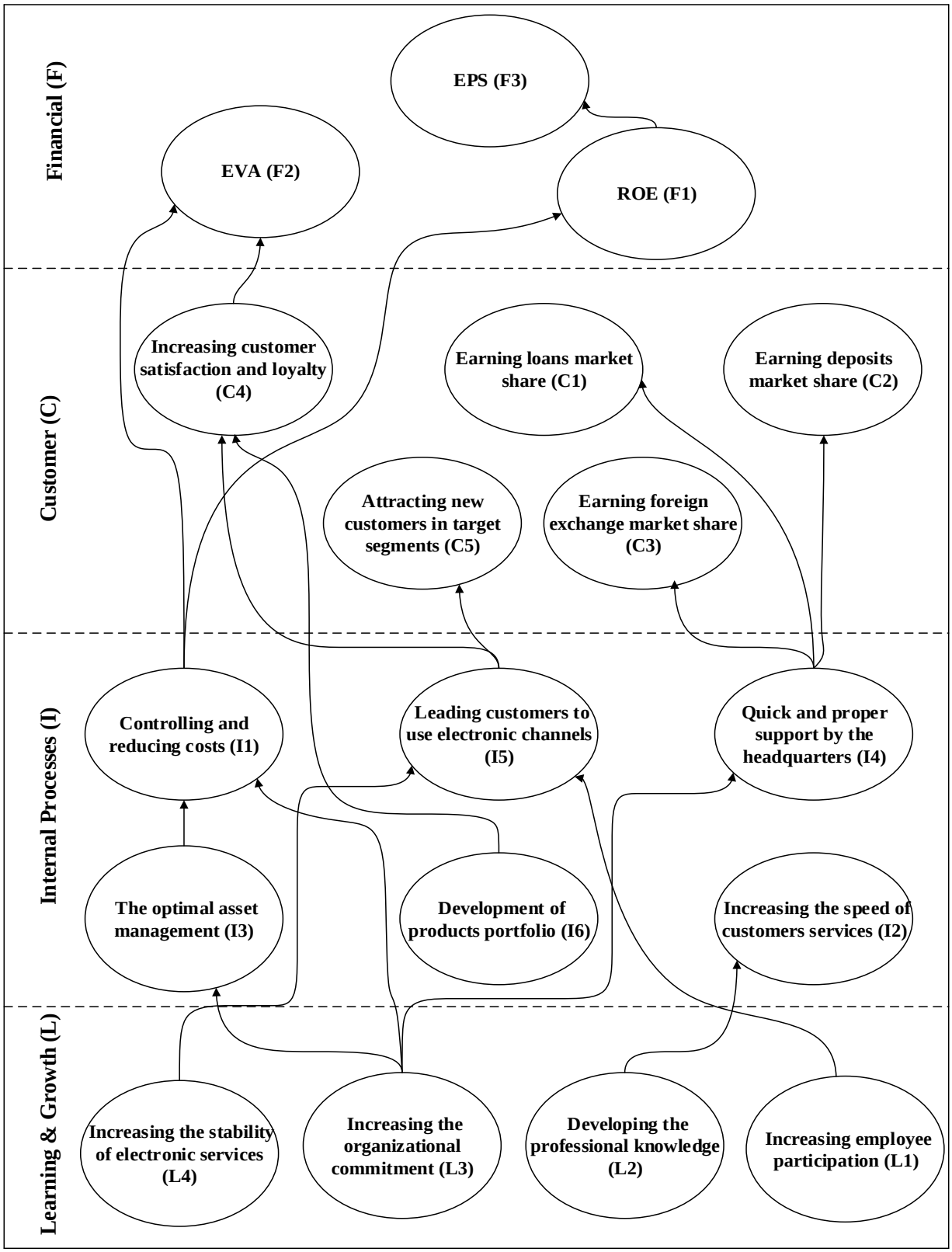

Figure 6. The final strategy map with significant relationships

It should be noted that, according to Table 6, strategic objectives that do not have a link with each other are not included in the associations of the strategy map. By identifying and assessing the relationships between strategic objectives in BSC perspectives, it will be possible to enable

dependent strategic objectives by improving influential strategic objectives. In addition, using this method will help managers and specialists to have a more accurate description of the associations between different strategic objectives and to draw a more accurate strategy map.

5. Conclusion

Compared to traditional models of performance measurement, BSC has many advantages. However, it has some defects as well, so that few organizations are able to implement this model. In 2008, a study was conducted on the organizations that had used the BSC, and it was found that only 10% of such organizations were able to execute and implement this model in their organizations. The major reasons for the failure of organizations in its implementation were their incorrect understanding of their vision and goal and the lack of a proper and logical connection between their objectives and strategies in the strategy map framework (Kaplan & Norton, 2008).

Indeed, one of the challenges involved in the implementation of the BSC as the most common performance evaluation model is how to determine the link between strategic objectives and designing and developing the strategy map. According to what has been studied in previous research, there is a gap in how to map out strategies using a quantitative and reliable method. Accordingly, in recent years, researchers have attempted to develop the BSC method and quantify the qualitative concepts in the model.

According to the literature review, it can be concluded that some researchers have described the relationships between objectives and indices of the strategy map through statistical techniques, while some other researchers have used multi-criteria decision making techniques. Review of past research often indicates the areas of improvement in determining the relationship and weighting the performance objectives as the components of strategy map. However, quantitative modelling shows part of the interaction and mutual influence between the objective network in BSC and is not able to describe completely and simulate accurately the model of relationship between objectives and performance indicators with the strategies and goals of the organization. Proposing a quantitative method can offer a more complete description of the relationships between the networks of objectives in the strategy map on the one hand, and provide the possibility of monitoring performance measures and the ultimate goals of the organization on the other. It can also improve and verify experts' opinions.

The main goal of the present research is to draw causal relationships between strategic objectives in the strategy map with an accurate and quantitative method that is not merely intuitive and judgmental. The use of a quantitative method has been based on the judgment of experts in this research. Since there is a potential for error in the judgment of people, it is necessary to use an exact method based on the information available on the organization to design the strategy map.

Therefore, based on the proposed method in this study, after determining the strategic objectives in the BSC framework of the investigated bank, banking experts and specialists judged the relationships between strategic objectives of the higher perspectives of BSC with those of the lower layers to determine the response surface equations on BSC on the basis of key performance measures. Considering the response regression equations obtained from strategic objectives, causal relationships of these objectives are drawn within an accurate strategy map. In fact, in the proposed method, the relationships among strategic objectives and their impact on each other in different perspectives are specified more precisely. Considering the accurate and reliable relations obtained from the strategy map, the reason for the weakness of the influenced strategic objectives can be the inadequacy of the influencing strategic objectives. In addition, the improvement of influencing strategic objectives leads to the improvement of influenced strategic objectives. For this purpose, by defining the plans related

to the influencing strategic objectives obtained from the accurate strategy plan, an improvement in the influenced strategic objectives is expected in the future.
For future researches, in order to select the effective factors in different perspectives of the balanced scorecard for modeling the system's performance and designing the strategy map, it is recommended to investigate Ridge regression more precisely.
It is also suggested that further studies be carried out on the definition of methods for finding the most suitable and accurate combination of independent variables for Ridge regression and for selecting Ridge parameters in modeling such performance systems.
In addition, the delay of the effect of independent variables on the performance measures of the system and measuring this delay and considering it in the model are other areas that need more study and research.
Future research can also focus on enriching and adapting the proposed method to other kinds of organizations. Additional studies can also be done on the comparison of the results obtained in this research with those of other methods. The proposed method has been applied in the BSC framework and assures traceability between strategic objectives for identifying and quantifying the existing relationships between them. Future research can focus on enriching and adapting the proposed method to other cases.

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