JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

IDENTIFYING AND PRIORITIZING KEY SUCCESS FACTORS IN THE IMPLEMENTATION OF BUSINESS INTELLIGENCE SYSTEMS BY TOPSIS (CASE STUDY: IRANIAN SMALL AND MEDIUM ENTERPRISES)

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Abstract
In this Research we investigate and prioritize the critical success factors in implementing business intelligence systems in small-medium companies.There are various studies in different situations about CSF on BI systems but in this paper we try to investigate and find the most efficient factors which could affect small-medium Iranian companies.
In this paper CSFs will be investigated through three aspects; organization, process and technology. The related indicators to each factors recognized then the survey which reliability was tested got distributed, finally the result collected and using tools and free resources indicated as the most important CSFs. After them the financial support of CEOs got the second place in importance of CSF. Precisely expression of the system implementation benefit and creating a realistic view against the performance and system functionality was the closest options to the ideal solution in process factors and easy user access to the required business data got the most points in technology factors.
Keywords: Key Success Factors, Business Intelligence Systems, TOPSIS.

Introduction

The commercial and technical problems inherent in old systems and the acquisition of new business opportunities for managers make them look for new ones. As the most important need for a decision-making and decision maker for the organization, the business intelligence systems that analyze a huge amount of information and help to all levels of management to help decision-making are the best option. Meanwhile, the implementation of business intelligence, in turn, has some barriers that, by knowing the correctness and understanding the importance of each critical success factor and finding the right solution to eliminate them and minimize these barriers. Given the increasing amount of data and the difficulty of analyzing them with older systems, the need for business intelligence systems is increasing every day. However, comprehensive research on the critical success factors in this kind of systems for Iranian organizations, with a valid mathematical method is important and this has led us to step in this direction and carry out studies in this field.
The most important benefit of business intelligence for an organization is the creation of a competitive advantage with the possession of new information in the shortest possible time. As larger companies may eliminate small and medium enterprises, this will be reduced by the availability of new information from competitors as well as their business environment. On the other hand, due to their small size, they can implement and use the benefits of less costly business intelligence systems.
In addition, small and medium-sized enterprises often lack the ability and resources to obtain the right information in a timely manner or in order to adequately use this information, and the cost of obtaining this information is a hindrance, which in this case the business intelligence can help them a lot. It can be said that medium-sized companies can achieve more and faster profits from business intelligence than large organizations. The reason for this assessment is that the transformation in large organizations is inevitably a slow and multi-layered process even if these organizations have good order and hierarchy, and their senior and middle executives have unsuccessful ideas. However, medium-sized companies, mostly, have a simpler structure; they have easier decision-making processes, which makes them more likely to achieve business success. The purpose of this research is to prioritize the impact of variables, including senior management support, experienced managers and teamwork, clear vision and planning, adequate budget, effective management of changes, well-defined problems and work issues, alignment

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of the business intelligence solution with user expectations, quality of the data, tools and technologies that are appropriate, user-friendly on the success of business intelligence projects.

Methodology

Statistical population

In this research, 120 samples have been selected. Our target community is Tehran Stock Exchanges, which reaches 83 in the year 2018. A total of 130 questionnaires were distributed among those working in the Information Technology sector of these brokers. Of these, 120 questionnaires were answered and returned. They were selected by random sampling method.

Independent and dependent variables

Independent variables include senior management support, experienced managers and teams, clear vision and planning, adequate budget, effective management of changes, well-defined problems and work issues, alignment of business intelligence solutions with user expectations, data quality, tools and the right technologies. The dependent variable is the success rate of business intelligence projects. The purpose of this research is to prioritize the impact of each of these factors on the success of the project.

Hypotheses and suggested research model

Hypothesis 1: The most important critical success factor from an organizational perspective is the organization's senior management support index.

Hypothesis 2: The most important factor of success in terms of the process is the effective management indicators of change.

Hypothesis 3: The most important critical success factor in terms of technology is data quality indicators.

Proposed research model

The proposed model of research is presented in Figure 1 in terms of organizational, process and technical factors.

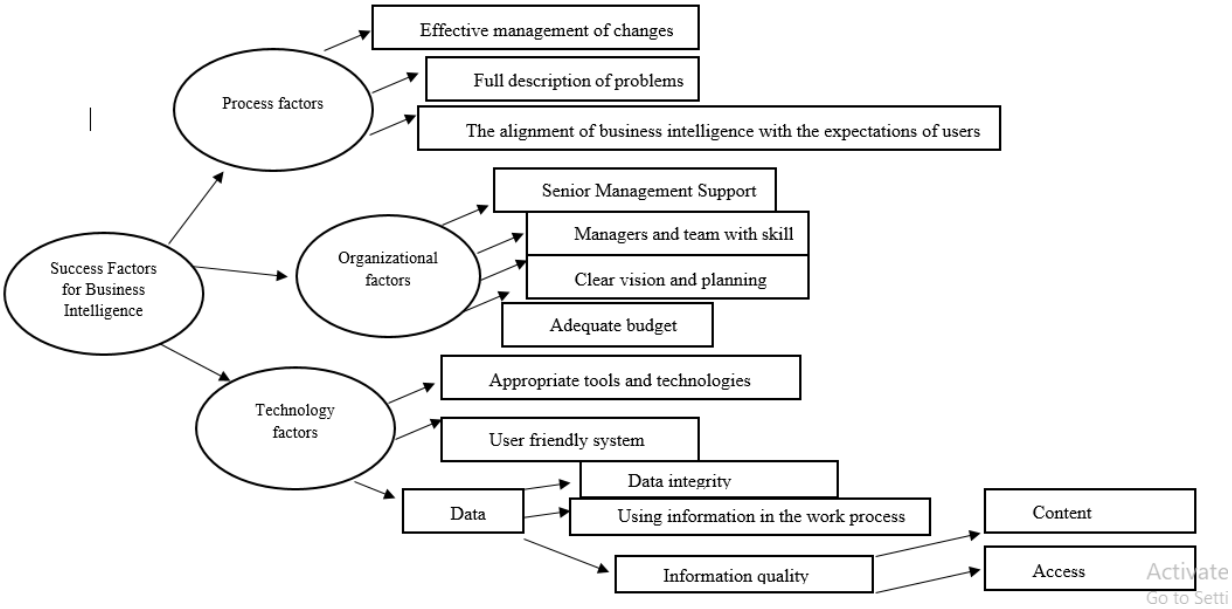

Figure 1. Proposed research model

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Adaptation of the algorithm and proposed model

In the proposed algorithm, we have M option and N benchmark. The suggested options for this study are the critical success factors in Iranian small and medium organizations, which are divided into three groups, organizational factors, process and technology, according to the proposed model. According to the proposed model, critical success factors are divided into three groups. In the proposed algorithm, the critical success factor for each group of proposed model groups is individually achieved, and ultimately the most important factor for success will be from each group.

Data Analysis

Considering that this research is a descriptive study, it can be used to analyze the data using TOPSIS method and SPSS software. In this study, using the preferred approach based on the similarity of the ideal solution, critical success factors in the implementation of business intelligence systems are prioritized. This is done by forming a decision matrix. In the rows of this matrix, there are rival options, and in the columns; criteria of decision-making are mentioned. The matrix elements are the result of measuring and evaluating rival options by the decision maker based on criteria and criteria for decision-making.

Result

Descriptive analyzes

This section describes the descriptive statistics of respondents to the questionnaire. In the Table 1, the level of education of respondents has been determined to be divided into 4 grades of undergraduate and graduate degrees, bachelors', masters' and doctorate degrees. In Table 2, the criterion is the record of respondents' activity or their familiarity with business intelligence, and in Table 3, the field of activity of the respondent is identified.

Demographic characteristics

In each research, demographic characteristics can have a significant impact on the research results. In Tables 1 through 3, one can see the variables of the statistical community and its frequency and percentage

Table 1: Level of education

Education level	frequency	percentage
Diploma	8	6.7
Bachelor	65	54.2
MA	36	30
P.H.D	11	9.2
Total	120	100.0

Table 2: A History of Business Intelligence

Time of acquaintance	frequency	percentage
Less than 2 years	90	75
Between 2-4 years	25	20.8
Between 4-7 years	4	3.3
More than 8 years	1	0.8
Total	120	100.0

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Table 3: Field of activity

Field of activity	frequency	percentage
Manager	3	2.5
Expert System Analysis	17	14.2
technical expert	39	32.5
Researcher	61	50.8
Total	120	100.0

Inferential statistics

In this section, the Topsis method has been used to prioritize variables and to examine the hypotheses of the problem.

The results of the first hypothesis

According to the following tables, the surveys is done with the Topsis method, the option of using tools and resources is free; the least distance to the ideal option and the greatest distance from the ideal option is negative.

Frequency distribution table

There are 4 variables in the organizational factors section, in which 11 indicators are considered for measuring these variables. See the variables in the table below. The first step in the Topsis method is to form the decision matrix. The table below shows the raw data that is obtained from the answer to the questionnaire. This table is the first step in the Topsis method.

	Very few	few	Average	much	Very much
Financial support of senior executives from business intelligence projects	3	14	44	39	20
Management's assurance of staffing information needs	11	28	33	28	20
The existence of experienced managers and expertise in the implementation group	6	25	32	38	19
Assess the knowledge and expertise of the project team before starting work	7	25	39	38	11
Applying the schedule of the implementation group	2	18	32	39	29
Justify the necessity of implementing the project by the implementation team	23	33	34	18	12
Mention the deficiencies and disadvantages of the system to management and staff	18	29	33	24	19
Balancing and logic users	9	9	23	48	31
Detailed planning for funding, budget expenditures and additional costs	1	10	24	45	40
Identify sources of funding and the amount of funding allocated to the project before the start	0	9	21	49	41
The use of free tools and resources	3	9	36	46	26

Table 4: Frequency distribution table

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The first hypothesis solving method

The decision matrix is made in accordance with Table 4. The second step of the topsis method is the normalization of the table, which is obtained according to Formula Nij = $\frac{xij}{\sqrt{\sum_{i-1}^{m} xij^2}}$. Then, in the third step, we should weigh the normalized matrix, using the entropy method. To do this, we will need a standard deviation, which, according to Appendix 3, has been calculated with the help of Topsis software. In Step 4, the ideal or non-ideal solution or option is calculated in accordance with the following formula, so that the furthest option can be found from the ideal solution and the closest option to the positive ideal to prioritize the options.

$A^{+}= \{(\max vij \mid j \in J), (\min vij \mid j \in J')|i = 1,2,\dots,m\}$

$A^{-}= \{(\min vij \mid j \in J), (\max vij \mid j \in J')|i = 1,2,\dots,m\}$

In step 6, the calculation of the size of the distance based on the Euclidean soft velocity for the ideal positive and negative solution was performed according to the following table.

	Di+	Di-	Cli+
Financial support of senior executives from business intelligence projects	0.072655	0.025005	0.743963
Management's assurance of staffing information needs	0.041523	0.050598	0.450742
The existence of experienced managers and expertise in the implementation group	0.0575	0.036456	0.611987
Assess the knowledge and expertise of the project team before starting work	0.058237	0.027061	0.682746
Applying the schedule of the implementation group	0.07004	0.028651	0.709691
Justify the necessity of implementing the project by the implementation team	0.031733	0.080905	0.281725
Mention the deficiencies and disadvantages of the system to management and staff	0.025926	0.068632	0.274181
Balancing and logic users	0.057975	0.041108	0.585114
Detailed planning for funding, budget expenditures and additional costs	0.077824	0.03471	0.691559
Identify sources of funding and the amount of funding allocated to the project before the start	0.081487	0.02828	0.742367
The use of free tools and resources	0.074168	0.024429	0.752236

Table 5: Distance Based on Euclidean Soft

Prioritizing Organizational Factors Based on Topsis Method

At this stage, the relative proximity to the ideal option has been calculated, and thus an option that has a relatively close proximity to the ideal solution is chosen as the best option. According to the systematic calculations, the use of free tools and resources has a relatively close proximity to other options and is considered as the most important factor in the success of the implementation of business intelligence systems in the Iranian small and medium organizations from the perspective of process factors.

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	Cli+
The use of free tools and resources	0.752236
Financial support of senior executives from business intelligence projects	0.743963
Identify sources of funding and the amount of funding allocated to the project before the start	0.742367
Applying the schedule of the implementation group	0.709691
Detailed planning for funding, budget expenditures and additional costs	0.691559
Assess the knowledge and expertise of the project team before starting work	0.682746
The existence of experienced managers and expertise in the implementation group	0.611987
Balancing and logic users	0.585114
Management's assurance of staffing information needs	0.450742
Justify the necessity of implementing the project by the implementation team	0.281725
Mention the deficiencies and disadvantages of the system to management and staff	0.274181

Table 6: Prioritizing Organizational Factors

The results of the second hypothesis

According to the following tables the studies carried out with the Topsis method, the exact expression of the benefits of system implementation is the least possible distance to the ideal option and the maximum distance from the ideal option. Accordingly, the second hypothesis is not approved.

Frequency distribution table

There are 3 variables in the process variables section, with a total of 9 indicators for measuring these variables. See the variables in the table below. The first step in the Topsis method is to form the decision matrix. The table below shows the raw data that is obtained from the answer to the questionnaire. This table, is the first step in the Topsis method. Effective management of changes, well-defined problems and work issues, alignment of business intelligence solution with user expectations; three variables identified among the process factors that are considered for measuring these three variables are 9 indicators as follows

	Very few	few	Average	much	Too much
Conducting user familiarization sessions	9	25	34	34	18
Encourage users to provide ideas	27	34	30	20	9

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Exact expression of the benefits of system implementation	4	16	31	35	34
Unambiguous expression of problems in the implementation path	29	32	26	21	12
Create a realistic view of the performance and performance of the system	4	5	24	41	46
Predict potential problems and provide solutions that are appropriate to it	10	22	36	34	18
Select a senior representative from among users to transfer information	22	29	32	26	11
Precise identification of work processes	3	16	31	29	41
Close communication between the implementation team and the users	14	31	34	18	20

Table 7. Prioritizing Process Factors

The method of solving the second hypothesis

The decision matrix is made in accordance with Table 7. The second step of the topsization method is the normalization of the table, which is obtained according to Formula Nij = $\frac{xij}{\sqrt{\sum_{i-1}^{m} xij^2}}$. Then, in the third step, we should weigh the normalized matrix, using the entropy method. To do this, we will need a standard deviation, which, according to Appendix 3, has been calculated with the help of Topsis software. In Step 4, the ideal or non-ideal solution or option is calculated in accordance with the following formula, so that the furthest option can be found from the ideal solution and the closest option to the positive ideal to prioritize the options.

$$A^{+} = \{(\max vij \mid j \in J), (\min vij \mid j \in J') \mid i = 1,2, \dots, m\}$$

$$A^{-} = \{(\min vij \mid j \in J), (\max vij \mid j \in J') \mid i = 1,2, \dots, m\}$$

In step 6, the calculation of the size of the distance based on the Euclidean soft velocity for the ideal positive and negative solution was performed according to the following table.

	Di+	Di-	Cli+
Conducting user familiarization sessions	0.062325	0.042049	0.59713
Encourage users to provide ideas	0.048089	0.072568	0.398557
Exact expression of the benefits of system implementation	0.071056	0.041385	0.631942
Unambiguous expression of problems in the implementation path	0.041573	0.065851	0.387001
Create a realistic view of the performance and performance of the system	0.080636	0.047624	0.628693
Predict potential problems and provide solutions that are appropriate to it	0.061986	0.040533	0.604626
Select a senior representative from among users to transfer information	0.046602	0.061526	0.430988
Precise identification of work processes	0.072466	0.047828	0.602407
Close communication between the implementation team and the users	0.050582	0.058651	0.463066

Table 8: Euclidean Soft Distance Size

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Prioritization of process factors based on the TOPSIS method

At this stage, the relative proximity to the ideal option has been calculated, and thus an option that has a relatively close proximity to the ideal solution is chosen as the best option. According to the systematic calculations, the precise expression of the benefits of system implementation is more closely related to other options and is considered as the most important factor in the success of the implementation of business intelligence systems from the perspective of the process in the Iranian small and medium organizations.

	Cli+
Exact expression of the benefits of system implementation	0.631942
Create a realistic view of the performance and performance of the system	0.628693
Predict potential problems and provide solutions that are appropriate to it	0.604626
Precise identification of work processes	0.602407
Conducting user familiarization sessions	0.59713
Close communication between the implementation team and the users	0.463066
Select a senior representative from among users to transfer information	0.430988
Encourage users to provide ideas	0.398557
Unambiguous expression of problems in the implementation path	0.387001

Table 9: Prioritizing process factors

Conclusion

Research findings suggest that investing in new technologies enables organizations to become tough competitors in their respective industries. In the meantime, business intelligence systems play a special role, which justifies the exact recognition of critical success factors in implementing these systems. According to the studies such factors as easy access of the user to business data from the perspective of the organizational factors and the exact expression of the benefits of system implementation from the perspective of process factors and the use of tools and resources from the perspective of the technical components of the component are the most important success factors in the implementation of business intelligence systems in Iranian small and medium enterprises.

Since data plays a key role in business intelligence systems and in a large global data world, users are faced with a huge amount of data, easy access to their business data, and the timeliness of these data, play an essential role in their competitive presence on the scene. In addition, viewing graphical reports and quick conclusions from the information viewed from other needs of people in brokers.

Usually, users behave to variations of resistance, and these resistors are formed for a variety of reasons. In order for the system to be successfully implemented and the opposition of the users does not interfere with the project's progress, they should consider the solution to reduce their resistance to change. According to the research, the exact expression of the benefits of implementing the system in advancing the goals of the company and their interests can be very effective. Among the benefits of users that can be mentioned are improving work quality, better performance, easy access to data, quick conclusions, and other things that can be lessened by mentioning these issues.

Small and medium sized enterprises, at a much lower cost than large organizations, can set up business intelligence systems in their organization. However, due to lack of funding, they have managed to solve this problem with proper planning for budgeting and identifying sources of funding and the use of free resources and tools published

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on the Internet and in the newspapers. Identified factors are considered the most important critical success factors in implementing business intelligence systems in Tehran Stock Exchange brokers and are prioritized using TOPSIS.

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