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Towards A Methodology for the Pre-Stage of Implementing a Reengineering Project

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Abstract

In order to reduce cost, improve functionality and gain competitive advantages, organizations resort to reengineering projects by developing and making changes to organizational processes. The absence of a unified methodology and appropriate analytic approaches prior to the implementation of reengineering projects has made authorities not to adopt correct decision making approaches in this respect. The objective of this paper is to propose a methodology that has to be adopted prior to the implementation of reengineering projects. The statistical population here consists of 25 expert analysts with MA and PhD degrees who are subject to answering a questionnaire. In this proposed methodology the Multi Criterion Decision Making model is applied to allow the analysts to select appropriate models for better and accurate implementation through the least failure coefficient. The Neyriz White Cement Corporation is selected as the subject and the obtained results are compared with the results obtained from similar implemented projects.

Keywords: Business Process Reengineering, Redesigning Processes, Improvement Process, Multiple-criteria decision-making, Analytical Hierarchy Process.

Introduction

The beginning of reengineering is traced back to the 1980s. For decades, many American firms have expressed dissatisfaction with their failure to gain a high rate of added value from information technology (IT). Though they made huge investments in developing IT, they could not increase their efficiency or improve performance.

In order to tackle this problem, various theories are proposed by the experts and researchers, with Michael Hammer's theory being one of them (Hammer, 1990. Based on his theory, three forces lead to competitive advantage. These forces consist of customers, competitors and changes, known as the "3C"s.

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The principle of division of labor, developed by Adam Smith, which was an essential component in setting up organizations, is no longer applicable and effective. Firms should be arranged and organized in a process-oriented manner (Hammer, 1996).

Almost all managers apply various mechanisms to boost internal efficiency in order to cope with the challenges of business competition. There are two key human factors that can highly affect the competition in organizations: the customers and the staff. The common prevailing belief in every organization is that accomplishing ultimate objectives depends on effective and efficient human resources.

Human resources constitute the most significant factor in promoting the comprehensive quality and efficiency of organizations and are considered as the basis for economic, social, and cultural development of every country. The quality of the employees' work, the quality of their cooperation, and their role in decision making are the factors through which the superiority and the competitiveness of an organization are determined.

According to developed essential reengineering concepts introduced by Davenport and Short (1990) and Hammer (1990), many organizations have reported on their significant advantages due to the gained experiences through successful implementation of reengineering projects. Despite the importance of Business Process Reengineering, either in theoretical, academic, or in real practice contexts, the obtained results have not been outstanding, and in some instances the failure rate in this practice is reported to be as high as 70% (Grint &Willcocks, 1995).

The conclusions reached from the available studies indicate that the incompatibilities between expectations and Business Process Reengineering are practically ignored by the firms involved in reengineering projects (Yetton, Johnston, & Craig, 1994). Recently, due to the risks and costs involved in reengineering project implementation, the need for prior analysis of the subject organization has made the role of the analyst significant (Mohammad Ali, Tavakoli Moghadam, & Jafari Harandi, 2006).

Without a doubt, the more Business Process Reengineering is explored, the more essential the analysis becomes. The multi-criteria decision making challenges which include lack of a standard rate in speed and accuracy of decision making, make process analysis greatly dependent on the decision-maker.

According to the preliminary studies run at Neyriz White Cement Corporation, factors like organizational independence, outsourcing the activities, and the change in management standard editions highlight the importance of the issue and the necessity of the process review.

In this study, after a review of the measures taken prior to the reengineering project implementation, attempt is made to introduce different aspects of the issue, identify the management subprocesses, and develop the organization's human resources. The reason why the organization selected the 6-stage methodology, and also the shift in management and staff attitude, will be explained.

By applying the experiences of the organization's managers and the analysts, who are aware of processes and the Analytical Hierarchy Process (AHP), attempt is made to adopt an appropriate strategy. Consequently, when this methodology been applied, there is no need to update the methodology whenever objectives change.

Literature Review

Reengineering the business processes is a basic revision and redesign in order to achieve remarkable improvements with respect to the essential indications such as performance assessment, costs, quality, and service and work speed (Hammer, 1996). Davenport and Short (1990) defined

reengineering as "the analysis and redesign of inter- and intra-organizational processes work-flow".

Accomplishing the ultimate objectives of an organization is subject to efficient and capable human resources. In order to cope with changes at hand, all organizations need to apply measures in modernizing and reforming human resources, equipment, technology, and regulations and their organizational culture.

The increasing significance of Business Process Reengineering is studied by scholars and researchers from different perspectives. Some of the most outstanding studies are the following: implementation methodology for reengineering (Dickinson, 1997; Wastell, White, & Kawalek, 1994); the connection with other organizational approach (Currie, 1999, Dickinson, 1997); IT and reengineering (Whitman, 1996; Wu, 2002), quality management and re-engineering (Gingele, Childe & Miles, 2002; Macdonald, 1995); implementing experiences and the outcomes thereof (Belmiro, Gardiner, Simmons, & Rentes, 2000; Guimaraes & Bond, 1996)

The point worth mentioning here is the difference among the concepts of improvement, redesign, and reengineering (Figure 1).

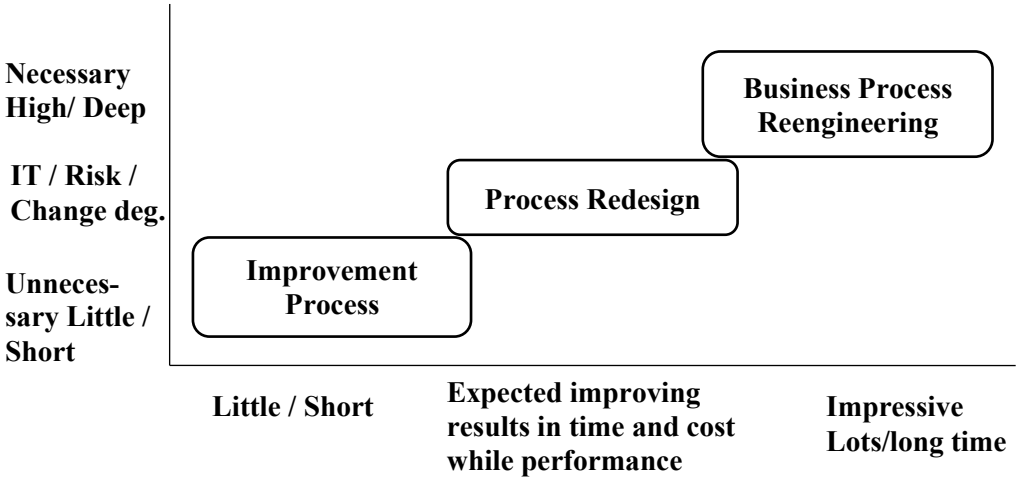

Figure 1: The approach of processes renovation (Hammer, 1996).

Redesigning the processes is a response to the technical problem(s); that is, the necessity to develop a new process which is better than the existing one with respect to the prevailing factors. It is clear that each Business Process Reengineering can contain one or more redesigning processes within it (Limam Mansar & Reijers, 2007).

The number of exclusively conducted studies on selecting the appropriate objectives based on the options provided are few: Mansar and Reijers (2005), Limam Mansar and Reijers (2007), Reijers and Mansar (2005) focused on the best solution to deal with the technical problems and analyzed the options in terms of cost, quality, time and flexibility based on their own experiences. Limam Mansar and Reijers (2007) conducted a survey to explore and analyze the best solutions.

The three key factors to be applied at the beginning of reengineering activities consist of expense reduction, high-quality service, and evolution in organizational culture change.

Business Process Reengineering integrates and aligns the human resources' responsibilities, which consequently lead to a powerful competitive advantage (Yeung & Brockbank, 1995). There exist many studies on the essential factors affecting the successful implementation of reengineering in organizations. In general, the factors of success or failures are categorized in five categories (Al-Mashari & Zairi, 1999).

- The changes in human resources management and applying social communications and cultural adjustment techniques, which are the necessities in order to facilitate changes in structures, running new processes, and introducing effective interactions, are the focus of the following studies:

  The fear of failure and not gaining proper results among the staff (Hlupic, Choudrie, & Patel, 2000), lack of enough planning to make changes (Grover, Jeong, Kettinger, & Teng, 1995; Hammer & Champy, 2009), insufficient authority of managers to make change (Jackson, 1997), the fear of losing job security (Jackson, 1997), the fear of changes (Hlupic et al., 2000), insufficient understanding of managers from changes (Grover et al., 1995), lack of clear image of changes among the staff (Grover et al., 1995), lack of proper definition of changes (Grover et al., 1995), lack of order in substituting the thinking methods of staff involved in reengineering projects (Muthu, Whitman, L., & Cheraghi, 2006).

- Since the range of changes in organizations following the implementation of Business Process Reengineering is vast, a vigilant, committed, powerful, and supportive leader can ensure the successful implementation of reengineering. This concept has been the subject of study by the following researchers with various concentrations:

  Improper understanding of manager(s) about Business Process Reengineering (Arora & Kumar, 2000), poor management insight and lack of strategic viewpoint (Arora & Kumar, 2000; Grover et al., 1995), lack of senior manager's support (Arora & Kumar, 2000; Bergey, Smith, Tilley, Weiderman, & Woods, 1999; Grover et al., 1995; Hlupic et al., 2000; Sarker & Lee, 1999; Sung & Gibson, 1998), lack of managerial skills and motivations in making basic changes (Arora & Kumar, 2000), lack of managerial commitment and proper leadership (Arora & Kumar, 2000; Sung & Gibson, 1998), expanding conservative culture among senior managers (Sung & Gibson, 1998), lack of powerful persons in leading positions (Grover et al., 1995; Sung & Gibson, 1998), holding on to previous technical decisions (Bergey et al., 1999), lack of existing foreign consultant(s) (Grover et al., 1995), improper choice of supporters and sponsors (Davenport, 2013), improper duplication of foreign consultants' and contractors' procedures (Bergey et al., 1999).

- In business process reengineering, the organizational structure must be shaped based on the newly adopted mission and processes. This category is partially assessed by the following researchers according to their personal scientific views:

  Lack of enough motivation in staff, i.e., lack of a proper rewarding and encouraging system (Hammer & Champy, 2009; Grover et al., 1995), insufficient correlation between the reengineering group and staff (Grover et al., 1995), hierarchical levels and challenges thereof (Sung & Gibson, 1998), lack of a top-down approach (Hlupic et al., 2000; Sung & Gibson, 1998), lack of team work among the staff (Hlupic et al., 2000).

- Improper management and planning is among the other key factors in failure of reengineering projects, a major concern for the authors below:

  Lack of proper planning to implement projects (Davidson, 1993; Grover et al., 1995), lack of enough time and improper time management (Grover et al., 1995), lack of budget and expense control (Arora & Kumar, 2000), inefficient resources and their management (Arora & Kumar, 2000, Grover et al., 1995), challenges in the assessment of project performance (Grover et al., 1995), insufficient understanding of customers' needs with respect to reengineering (Hlupic et al., 2000), lack of proper instruments to evaluate the effects of designed solutions prior to implementation Arora & Kumar, 2000, Grover et al.,

1995, Hlupic et al., 2000; Irani, Hlupic, & Giaglis, 2001; Sung & Gibson, 1998), lack of deduction and evaluation of necessities (Bergey et al., 1999), improper planning and decision making in actualizing the plan(s) (Bergey et al., 1999), non-systemic attitude towards the topic (Hahm & Lee, 1994), gradual and non-basic change in processes (Grover et al., 1995; Willcocks & Smith, 1995), insistence on substantial changes in processes *(In other words there are two types of changes: a) minor changes which can be applied during a short period of time, and b) major, basic and fundamental changes which should be implemented over a long period in order to not collapse the system.)* (Davenport, 2013; Grover et al., 1995), lack of proper methods to implement BPR (Davenport, 2013; Grover et al., 1995), insistence on adopting the White Page approach (an approach with a detailed analysis of existing processes) (Bergey et al., 1999), spending extra time to analyze the current processes (Grover et al., 1995; Hammer & Champy, 2009), focusing on designing the processes prior to implementation (Davenport, 2013), insufficient focus on the key processes (Arora & Kumar, 2000), unintentional and intentional choice of imperfect leaders in reengineer the organization (Bergey et al., 1999), lack of serious contribution on Business Process Reengineering (Bergey et al., 1999), lack of serious contribution on how the processes and the organization objectives are interconnected (Davidson, 1993).

- One of the features of Business Process Reengineering is the emphasis on redesigning. Thus, a technology proportional to the project should support the new task. IT, as an example, is one of the most significant approachs for reengineering. For this category the following studies are of concern:

  Making mistakes in IT's role in Business Process Reengineering (Sung & Gibson, 1998), inefficient use of IT and its tools (Sung & Gibson, 1998), negative attitudes towards IT, spending extra time and money, lack of proper IT devices to related staff training, lack of ability in combining technologies (Arora & Kumar, 2000; Davenport, 2013), insufficient perception of IT's existing foundation (Davenport, 2013; Dennis, Carte, & Kelly, 2003; Grover et al., 1995; Hlupic et al., 2000; Hoffman, 1995; Jackson, 1997; Sung & Gibson, 1998; Teng, Jeong, & Grover, 1998; Terziovski, Fitzpatrick, & O'Neill, 2003), lack of creative usage of IT (Sung & Gibson, 1998), non-approval of simultaneous approaches of IT and BPR (Bergey et al., 1999: Willcocks & Smith, 1995), adopting the old models in mechanizing the current processes (Arora & Kumar, 2000; Hammer & Champy, 2009; Jackson, 1997), work force's dependence on the old technologies and improper training schedules (Bergey et al., 1999), Business Process Reengineering is not considered enough in software architecture (Bergey et al., 1999).

Since the engineering processes failure prior to the project implementation is a fact, rational analysis of the organization processes should be conducted in a manner that the best solution is found to prevent the project failure. The weight and the influence of the mentioned factors make the solution selection a difficult task for the managers and analysts. Consequently, a newly developed methodology must be adopted in organizing the affairs, since selection of a methodology prior to the project implementation makes these challenges easier.

Methodology

Reengineering methodology consists of a set of coordinated, compatible techniques and guidelines that enable the management to reengineer activities and business processes in an organization (Valiris & Glykas, 1999).

There is no single methodology to be adopted in implementing reengineering project(s), thus, different organizations apply their own customized methodologies which are mostly derived from the general implementation methodology introduced by Kettinger, Teng, and Guha (1997).

The applied methodologies adopted by the most known and credible consulting management firms are listed in Figure 2.

This is the most notable innovation that enables analysts to make the best decisions on the quality of the project implementation in organizations.

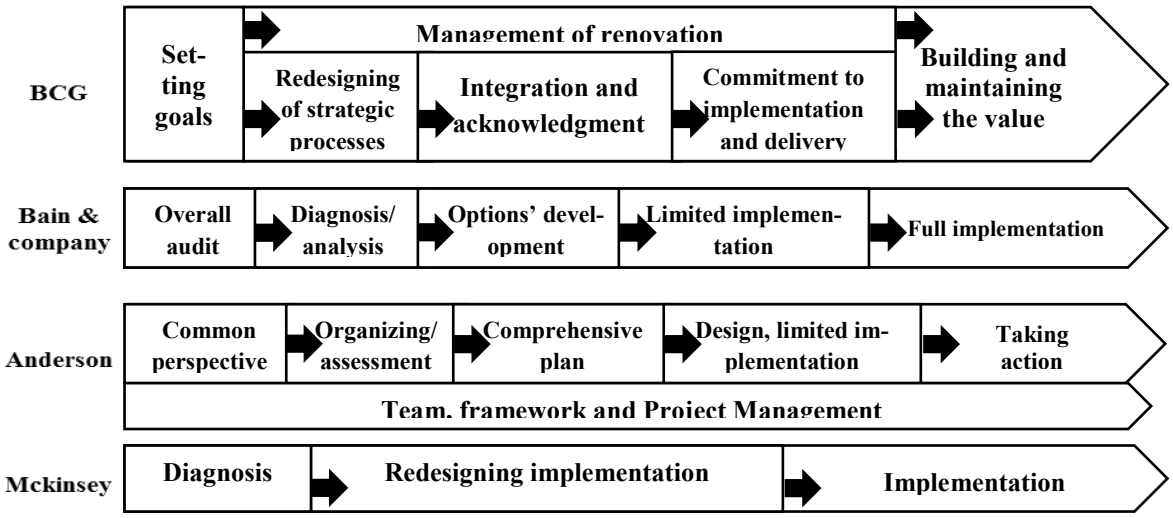

Figure 2: Methodologies of the credible managing consultation firms.

The Six Stages in Methodologies

- **Here, a few factors to be considered in realizing this methodology:** 1) project executive manager's attendance in meetings with directors, 2) studying the organizational documents and theoretical studies related to the activities, and 3) collecting data on organizations similar to their own (Lashkar Bolouki, 2003; Safari, 2003;Tarokh & Sharifi, 2005).
- **Realizing the environment and the correlations thereof, within the organization:** to reflect a good image of the firm, it is necessary to analyze and consider the organization's commercial stance and the interactions within its environment (Hesselbein, Goldsmith, & Beckhard, 1997). To realize this, the analyst(s), must study the features that affect and are affected. Exploring the inter-organizational processes can contribute to the understanding of the extra-organizational environment. What matters here is the environment's impact on the organization (Tarokh & Sharifi, 2005).
- **Understanding the units:** most of the organizations are characterized as task-oriented; that is, they are based on units; thus, in order to understand these units, their activities must be explored in a precise manner (Hapson, Logari, Morgatid, Eskali, & Simpson, 2005). It is obvious that by this explanation, only a part of the organizational weaknesses would be identified; therefore, the organization should avoid providing overall solution(s) to the challenges, but merely focus on the identification of the subject unit's task, the staff involved, the related laws and regulations, the applied technology, and the intra-unit interactions. To gain a general overview of the current situation, it is recommended that the required data be collected through the units' managers and directors as to avoid unnecessary details (Tarokh & Sharifi, 2005).

- **Assessing customers' needs and the organization's IT:** customer relations management is the core of the organization and a major effective factor in coordinating the organizational growth, progress, and the managerial and customer-oriented processes (Bull, 2003). The organization's customers and their requirements need to be identified and realized. For this purpose, the statistical population relevant to the customers should be explored by analysts. IT is considered as an applicable complementary device in reengineering projects and the driving force which would support the business processes. Any process should be designed in correspondence with IT capacities (Broadbent, Weill, & St. Clair, 1999).
- **Defining the main and secondary criteria:** the most significant step after the analysis of the firm is defining the key criteria according to which the decisions should be drawn. The influences of these criteria have great impacts on the failure or success of reengineering; thus, the analysts should explore the available collected documents related to the subject organization. The analysts should consider both the main and the secondary criteria and the internal managers and consultants can have a major contribution in defining these two.
- **Applying multi-criteria decision making:** the main challenge here is to develop a scientific approach to promote such a conduct. By applying this approach, the best choice will be defined prior to reengineering implementation. AHP (Analytical Hierarchy Process) is an approach through which the multi criteria decision making, whether qualitative or quantitative, is organized. The effective criteria and the order of options will be defined and ranked with respect to the given problem. By applying this approach, the decision-making process will be quantized (Aghtaei, Ghorbani, & Karami, 2010).

The Stages of a Hierarchical Evaluation

- Defining the purpose of the issue
- Defining the possible options
- Defining the criteria and the appropriate indexes
- Comparing the criteria and defining the priorities
- Pair-wise comparison of the possible options, in each criterion
- The analysis of the conclusions followed by determining the best choice

A total of 25 experts with MA and PhD degrees employed in private or academic sectors constitute the statistical population of this survey and are served with a questionnaire. All participants are involved in reengineering projects, with sufficient knowledge and experience in this field.

The Likert scale (Oppenheim, 2000) is applied as one of the common devices in designing the questionnaire. The experts rated each one of the factors, which are illustrated in Table 1, based on the factors potentially playing a role in the Business Process Reengineering failure as follows: 9 = extremely significant, 7 = significant, 5 = medium, 3 = low and 1 = extremely low.

To facilitate things, each one of the criteria and options is abbreviated and tabulated in Table 1.

Table 1: Symbolization.

criteria and option	Abbr.	criteria and option	Abbr.
Process Renovation Strategy	PRS	Change management	CM
Redesigning Process	RP	Senior management support	SMS
Business Process Reengineering	BPR	Organizational structure	OS
Improvement Process	IP	Project Management	PM
Information Technology Infrastructure	II		

Characteristics

We have named and defined the three most significant parameters of AHP which help us in final decision making.

Being analytical: using numbers and digits in deductive analysis

Being hierarchical: segmenting the complicated situations based on the priorities, objectives, criteria and options.

Being process-oriented: decision making needs the thorough analysis of different analysts during the meetings and their attitudes towards their implementation (Salehi Sadeghiani, 2001).

Following the study and exploration of reengineering methodologies and experiences, the organizations proceeded to arrange a methodology prior to the project implementation. The clockwise stages regarding this methodology are shown in Figure 3.

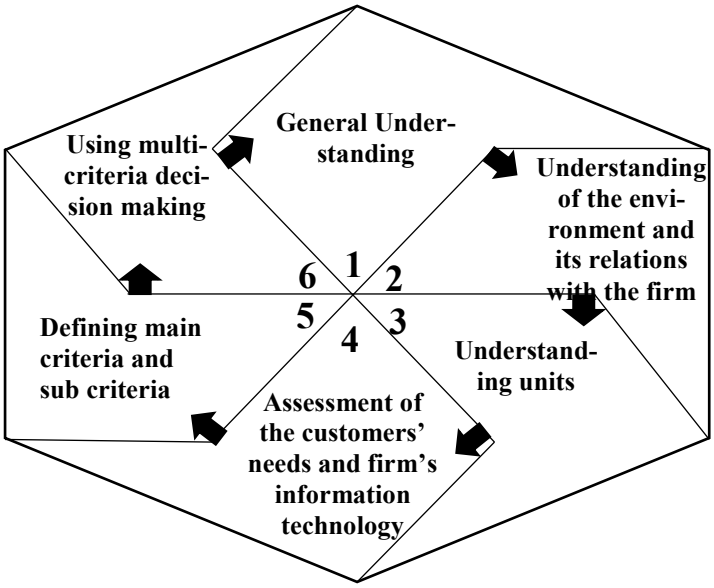

Figure 3: Developed methodology prior to reengineering implementation.

Creation of Hierarchical Structures

Prioritization of strategic options in process renovation is arranged according to the following three components:

- The purpose: the prioritization of strategic options in the process renovation.
- The criteria: consists of the effective factors in preventing project failure such as the IT foundations, the project management, organizational structure, the senior management support and management of change.
- The options: consist of Business Process Reengineering, Redesigning Processes, and the continual improvement of processes (as described in Figure 1).

In all processes, assessment is considered as one of the key axioms; that is, after defining the general purpose and planning and providing the different options, the assessment must be made, followed by selecting the best option by comparing the outcomes of different choices (Roberts, 1975).

Determination of Criteria Significance Rate

To calculate the criteria significant rate the criteria of each level is compared to corresponding criteria in other levels in pairs and their weight is calculated.

Thus, to determine this rate, a pair-wise comparison should be made. For example, to determine which one of the redesigning, reengineering or the process improvement is the most significant criteria in prioritizing the organizations' process evolution strategy, Saati's 9-quantity scale will rank this significance (Table 2).

Table 2: Saati's 9-quantity scale for pairwise comparison (Tofiq 1994).

Scale	Definition	amount of significance in the research
1	Equal significance	The significance of two criteria is equal
3	Significance a little more	i significance is a little more than j
5	More significance	i significance is a lot more than j
7	Much more significance	i significance is much more than j
9	Absolute significance	Higher significance of i compared to j has been absolutely proven
2,4,6,8		There is a middle way

Pair-wise comparisons are registered in a n*n matrix which is named the Criteria Pair Wise Matrix A=[a_{ij}]n*n. The elements of this matrix are positive and with respect to the "Reciprocal Conditions" principle in the analytical hierarchy process, in each pair-wise comparison, there exist two numeric amounts of a_{ij} and 1/ a_{ij}.

To calculate the criteria's significance ratio, one of the following four approximate methods introduced by Prof. Saati can be applied: 1) sum of the rows 2) sum of the columns 3) the arithmetic mean 4) the geometric mean.

Determining the Essence of Substitute Option(S) Coefficient

After determining the criteria's significance ratio, the alternatives' significance ratios should be determined as well, where, the preference of each option is judged based on Saati's 9-quantity scale table criteria, while, in comparing options the only important point of concern is "Which one of the options is preferable in relation to criteria and to what extent?" (Table 2).

Determining Scores or Final Priority

The criteria significance ratio in relation to the objective and determination of the options' significance ratio in relation to each criterion are assessed and combined in order to calculate the final weight of the options. To accomplish this task, Saati's hierarchical combination is applied through which a priority vector is yielded with respect to all judgments in all three hierarchical levels; thus, the final score of the j^{th} option is computed as follows:

$$P = \sum_{k=1}^{n} \sum_{i=1}^{m} W_k W_i(g_{ij})$$

Where, W_k is the criteria significance ratio and W_i is the option's significance ratio in relation to criteria.

Exploration of Consistency in Judgments

The advantages of analytical hierarchy process consist of 1) the possibility to explore consistency in the judgments made on determining the criteria, 2) the sub-criteria significance rate, and 3) examining the extent to which the consistency in judgments is considered in constructing the criteria pair wise matrix. The method applied by Prof. Saati to examine the consistency in judgments embodies the calculation of a ratio named Inconsistency Ratio (IR), where the Inconsistency Index (II) is divided by the Random Index (RI). If the obtained ratio is less than or equal to 0.1, then the consistency in judgments is acceptable; otherwise, the judgments should be revised or the criteria pair wise matrix should be reconstructed.

$$I.I = \frac{\lambda_{max} - n}{n - 1}$$

With respect to the number of criteria *(n)*, the random index can be extracted from Table 3.

Table 3: Random Index (RI) (Bowen, Klosterman & Brail, 1998).

n	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

In the geometric mean method, which is approximate, instead of λ_{max} (especial maximum amount) L will be applied through the following equation:

$$L = \frac{1}{n}\left[\sum_{i=1}^{n}\left(\frac{AW_i}{W_i}\right)\right]$$

Where, AW_i is a vector computed by the criteria pair wise matrix rate in W_i vector (criteria significance rate vector). The objective of exploring the consistency of judgments in criteria pair wise matrix is to take the consistency in judgments into account or assign a weight to them (Khani, 2001).

Case Studies

Changing a problem into hierarchical structure is the most important part in analytic hierarchy process. The AHP model is adopted for this purpose, since through this manner the complicated problems are simplified, hence, comprehensible for humans. With respect to the necessity in planning and prioritizing the option of processes' renovation strategy, such prioritization is an attempt in developing a proper framework through which the most efficient solutions will be extracted (Lee, 2013).

By defining the overall objectives, statements of intentions, such as planning and providing the different options to achieve the objectives, an assessment is made through which the appropriate choice can be determined based on the relative appropriateness of each choice. The decisions should be made in a multi-dimensional sphere, where, the multi-criteria assessment method will be applied. In such assessments each one of the criteria is considered as a separate dimension (Tofiq, 1994).

The hierarchical structure illustrates the prioritization of the option in the process renovation strategy (Figure 4).

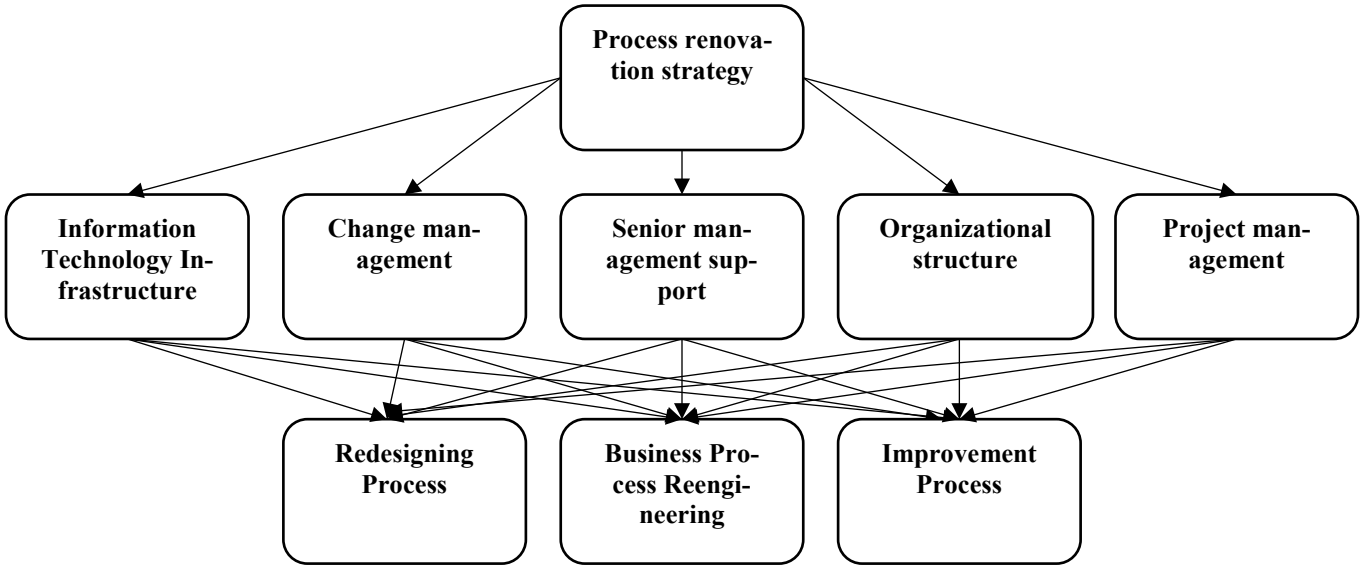

Figure 4: Hierarchical Structure of prioritization.

For this instance, the criteria pair wise matrix is expressed as follows:

$$\begin{array}{c} \\ \text{SMS} \\ \text{PM} \\ \text{CM} \\ \text{II} \\ \text{OS} \end{array} \begin{array}{c} \begin{array}{ccccc} \text{SMS} & \text{PM} & \text{CM} & \text{II} & \text{OS} \end{array} \\ \begin{bmatrix} 1 & 2 & 4 & 3 & 3 \\ 1/2 & 1 & 3 & 2 & 3 \\ 1/4 & 1/3 & 1 & 1/4 & 1/2 \\ 1/3 & 1/2 & 4 & 1 & 2 \\ 1/3 & 1/2 & 2 & 1/2 & 1 \end{bmatrix} \end{array}$$

In this study, the geometric mean method, with more accuracy than the other three methods, is applied. To calculate the criteria significance ratio, first, the geometric mean of the criteria matrix rows is calculated and normalized and next, the weight of each criterion in relation to the objective is accounted for (Table 4).

$$\mu_G = \left(\prod_{i=1}^{n} a_i\right)^{1/n} = \sqrt[n]{a_1 . a_2 \dots a_n}$$

$$W = {\mu_G}/{\sum_{i=1}^{n}(\mu_{G_i})}$$

The criteria significance ratio total equals 1, proving the relativity of their significance.

Table 4: The criteria's weight in proportion to the research's objective.

Geometric mean	Normalized weight
$\mu_{G_{SMS}} = 2.352$	W_{SMS}=0.39
$\mu_{G_{PM}} = 1.551$	W_{PM}=0.26
$\mu_{G_{CM}} = 0.401$	W_{CM}=0.07
$\mu_{G_{II}} = 1.059$	W_{II}=0.18
$\mu_{G_{OS}} = 0.107$	W_{OS}=0.11
$\sum \mu_{G_{SMS}}, \mu_{G_{PM}}, \mu_{G_{CM}}, \mu_{G_{II}}, \mu_{G_{OS}} = 6.01$	$\sum W_{SMS}, W_{PM}, W_{CM}, W_{II}, W_{OS} = 1$

The pair wise comparison based on Saati's 9-quantity scale is applied in judging the options' preference in relation to the criteria, the results of which are registered in the pair wise comparison matrix's criteria or options. By normalizing the matrix rows' and the columns' sum, the significance ratio is calculated. The pair wise matrix for criteria consists of:

$$\begin{matrix} CM & RP & BPR & IP \\ RP \\ BPR \\ IP \end{matrix} \begin{bmatrix} 1 & 1/8 & 1/5 \\ 8 & 1 & 3 \\ 5 & 1/3 & 1 \end{bmatrix} (3$$

$$\begin{matrix} PM & RP & BPR & IP \\ RP \\ BPR \\ IP \end{matrix} \begin{bmatrix} 1 & 1/3 & 1/5 \\ 3 & 1 & 1/4 \\ 5 & 4 & 1 \end{bmatrix} (2$$

$$\begin{matrix} SMS & RP & BPR & IP \\ RP \\ BPR \\ IP \end{matrix} \begin{bmatrix} 1 & 1 & 9 \\ 1 & 1 & 7 \\ 1/9 & 1/7 & 1 \end{bmatrix} (1$$

$$\begin{matrix} OS & RP & BPR & IP \\ RP \\ BPR \\ IP \end{matrix} \begin{bmatrix} 1 & 6 & 1 \\ 1/6 & 1 & 1/6 \\ 1 & 6 & 1 \end{bmatrix} (5$$

$$\begin{matrix} II & RP & BPR & IP \\ RP \\ BPR \\ IP \end{matrix} \begin{bmatrix} 1 & 1/7 & 1/8 \\ 7 & 1 & 1 \\ 8 & 1 & 1 \end{bmatrix} (4$$

Accordingly, the options' significance ratio in relation to the criteria is calculated through the normalization of the geometric mean of the rows in the pair wise comparison matrix.

The results of described prioritization are tabulated in Table 5.

The ranking order of priority criteria are as follows:

- **Senior management support (0.39):** 1) Improvement Process (0.17) 2) Business process reengineering (0.06) 3) Redesigning Process (0.03).
- **Project management (0.26):** 1) Improvement Process (0.17) 2) Business process reengineering (0.06) 3) Redesigning Process (0.03).
- **IT Infrastructure (0.18):** 1) Improvement Process (0.08) 2) Business process reengineering (0.08) 3) Redesigning Process (0.01).
- **Organizational structure (0.11):** 1) Improvement Process (0.05) 2) Redesigning Process (0.05) 3) Business process reengineering (0.01).
- **Change management (0.07):** 1) Business process reengineering (0.04) 2) Improvement Process (0.02) 3) Redesigning Process (0.00).

Table 5: Conclusions of prioritizing.

criteria	Geometric mean	Normalized weight	Conclusions of prioritizing
Senior management support W_{SMS}=0.39	$\mu_{G_{RP}} = 2.08$	$W_{RP} = 0.49$	$P_{SMS,RP}$=0.19
	$\mu_{G_{BPR}} = 1.91$	$W_{BPR} = 0.45$	$P_{SMS,BPR}$=0.18
	$\mu_{G_{IP}} = 0.25$	$W_{IP} = 0.06$	$P_{SMS,IP}$=0.02
	$\sum \mu_{G_{RP}}, \mu_{G_{BPR}}, \mu_{G_{IP}} = 4.24$	$\sum W_{RP}, W_{BPR}, W_{IP} = 1$	$\sum P_{SMS,RP}, P_{SMS,BPR}, P_{SMS,IP} = 0.39$
Project Management W_{PM}=0.26	$\mu_{G_{RP}} = 0.41$	$W_{RP} = 0.1$	$P_{PM,RP}$=0.03
	$\mu_{G_{BPR}} = 0.91$	$W_{BPR} = 0.23$	$P_{PM,BPR}$=0.06
	$\mu_{G_{IP}} = 2.71$	$W_{IP} = 0.67$	$P_{PM,IP}$=0.17
	$\sum \mu_{G_{RP}}, \mu_{G_{BPR}}, \mu_{G_{IP}} = 4.03$	$\sum W_{RP}, W_{BPR}, W_{IP} = 1$	$\sum P_{PM,RP}, P_{PM,BPR}, P_{PM,IP} = 0.26$
Change management W_{CM}=0.07	$\mu_{G_{RP}} = 0.29$	$W_{RP} = 0.07$	$P_{CM,RP}$=0.0
	$\mu_{G_{BPR}} = 2.88$	$W_{BPR} = 0.66$	$P_{CM,BPR}$=0.04
	$\mu_{G_{IP}} = 1.19$	$W_{IP} = 0.27$	$P=_{CM,IP}$=0.02
	$\sum \mu_{G_{RP}}, \mu_{G_{BPR}}, \mu_{G_{IP}} = 4.36$	$\sum W_{RP}, W_{BPR}, W_{IP} = 1$	$\sum P_{CM,RP}, P_{CM,BPR}, P_{CM,IP} = 0.07$
Information Technology Infrastructure W_{II}=0.18	$\mu_{G_{RP}} = 0.26$	$W_{RP} = 0.06$	$P_{II,RP}$=0.01
	$\mu_{G_{BPR}} = 1.91$	$W_{BPR} = 0.46$	$P_{II,BPR}$=0.08
	$\mu_{G_{IP}} = 2$	$W_{IP} = 0.48$	$P_{II,IP}$=0.08
	$\sum \mu_{G_{RP}}, \mu_{G_{BPR}}, \mu_{G_{IP}} = 4.17$	$\sum W_{RP}, W_{BPR}, W_{IP} = 1$	$\sum P_{II,RP}, P_{II,BPR}, P_{II,IP} = 0.18$
Organizational Structure W_{OS}=0.11	$\mu_{G_{RP}} 1.82$	$W_{RP} = 0.46$	$P_{OS,RP}$=0.05
	$\mu_{G_{BPR}} = 0.3$	$W_{BPR} = 0.08$	$P_{OS,BPR}$=0.01
	$\mu_{G_{IP}} = 1.82$	$W_{IP} = 0.46$	$P_{OS,IP}$=0.05
	$\sum \mu_{G_{RP}}, \mu_{G_{BPR}}, \mu_{G_{IP}} = 3.94$	$\sum W_{RP}, W_{BPR}, W_{IP} = 1$	$\sum P_{OS,RP}, P_{OS,BPR}, P_{OS,IP} = 0.11$

The total value of each one of the options of each criterion is calculated and the relevant prioritizations are made.

The final prioritization of process renovation strategy options in Neyriz White Cement Corporation are tabulated in Table 6, based on the responses to the questionnaire described earlier.

Table 6: The final Prioritization of process renovation strategy options in Neyriz White Cement Corporation

Prioritization	Prioritization of process renovation strategy options
1	Business Process Reengineering ($\sum P_{SMS,BPR}, P_{PM,BPR}, P_{CM,BPR}, P_{II,BPR}, P_{OS,BPR}$ =0.37)
2	Improvement Process ($\sum P_{SMS,IP}, P_{PM,IP}, P_{CM,IP}, P_{II,IP}, P_{OS,IP}$ =0.35)
3	Redesigning Process ($\sum P_{SMS,RP}, P_{PM,RP}, P_{CM,RP}, P_{II,RP}, P_{OS,RP}$ =0.28)

The exploration of consistency in judgments is provided to determine the criteria significance rate (Table 7).

Table 7: Exploration of judgments consistency.

criteria	Calculation of L	Calculation of Consistency Index $\mathbf{C.I = \frac{L-n}{n-1}}$	Calculation of Consistency Rate $\mathbf{C.R = \frac{C.I}{R.I}}$
Process Renovation Strategy	5.17	0.04	0.04
Senior Manager Support	3.01	0.00	0.01
Project Management	3.09	0.04	0.07
Change Management	3.04	0.02	0.04
Information Technology Infrastructure	3.00	0.00	0.00
Organizational Structure	3.00	0.00	0.00

As observed, the consistency rate is less than 0.1 which proves that consistency is taken into account in judgments.

Discussion

In order to compare this study to similar studies in this model, some specified parameters in the pre-stage of implementing a reengineering project (illustrated in Table 8), common in different implemented projects nationwide, are used. These parameters are essential in proportional perception and identification of the nature and the formation of the project. These data indicate that selecting appropriate objective(s) prior to project implementation is a great step taken in preventing reengineering project implementation failure(s). By comparing the factors of each one of the projects and confirming them through reengineering projects addressed in the available literature it could be deduced that the manner of selecting the objective directly influences the success in reengineering project implementation (Table 8) (Amin Naseri, 2002; Amin Naseri & Anvari Rostami, 1995; Amin Naseri, & Sepehri, 1995; Anvari Rostami, 2005, 2006, 2007; Anvari Rostami & Zareie, 2005).

Table 8: Reengineering Projects Comparison.

Organization	Pre-Stage of Implementing the Reengineering Project					The determined objective for the project	Situation of the project with respect to the selected objective.
	General Understanding	Understanding of the environment and its relations with the firm	Understanding units	Assessment of the customers' needs and firm's information technology	The assessment index in proper objective selection		
Deputy of Research and Technology-Ministry of Health and Medical Education	◕	◔	●	◑	⊕	Redesigning Process	⊕
Ministry of Cooperatives Labour and Social Welfare	◔	⊕	●	◑	⊕	Redesigning Process	⊕
Ministry of Foreign Affairs	◑	⊕	●	◑	⊕	Redesigning Process	⊕
Ministry of Roads & Development	◕	◔	●	⊕	⊕	Redesigning Process	◑
Agricultural Research, Education and Extension Organization	◕	◕	●	⊕	⊕	Redesigning Process	⊕
Iran Khodro Industrial Group	◕	◕	●	◑	⊕	Improvement Process	◑
Civil Aviation Organization	●	◑	●	⊕	⊕	Redesigning Process	⊕
Association of Industrial	◕	◕	●	◑	⊕	Business Process Reengineering	◑
Butane Industrial	◕	◕	●	⊕	⊕	Business Process Reengineering	◑
Ministry of Science, Research and Technology	◕	◕	◕	◕	◕	Business Process Reengineering	◕
Iranian Research Institute for Information Science and Technology	◕	◕	◕	◕	◕	Business Process Reengineering	◕
Neyriz White Cement Corporation	◕	◕	●	◕	◕	Business Process Reengineering	●

The circles show the proportion of good performance of each parameter, e.g., a filled circle equals excellent performance. Results of some of projects were measured by numbers, while others were given qualities (poor, proper, perfect, etc.). These were changed into a scale from 0-4 and displayed in the circle to enable comparison.

With respect to Table 8, it is observed that the projects in organizations, such as 1) Deputy of Research and Technology-Ministry of Health, 2) Ministry of Cooperatives Labour and Social Welfare, and 3) Ministry of Foreign Affairs, are not accomplished because the problem was due to

not setting proper objectives. On the contrary, the objective of this study is accomplished in 10) the Ministry of Science, Research and Technology 11) the Iranian Research Institute for Information Science and Technology, and 12) the Neyriz White Cement Corporation.

Conclusion

In the process of the planning reengineering project for Neyriz White Cement Corporation, with the objective to provide a proper framework to achieve an efficient solution, each one of the options' competencies was assessed in order to yield the best or most efficient option, as it was discussed in the case study section, and prioritization results were illustrated in Table 6. In this study, in order to prioritize the process of renovation strategy options in different sections of Neyriz White Cement Corporation, the criteria of Table 1 are applied.

The results obtained in this article are to be deliberated on two levels:

1) In the pre-stage of implementing reengineering projects in Neyriz White Cement Corporation, the prioritization for improvement of process renovation strategy options for each one of the sections should be through senior management support, project management, IT infrastructure, and change management.

2) In a local sense, the sequence of priorities is to process reengineering, redesigning the processes, and process optimization, in that order (see Table 6).

To solve prioritizing the factors, according to many complex criteria, AHP can be used in the field of development and determination of a specific scientific route. The hierarchical process can be applied here with its simple and specific features in most fields.

In this study, the significance of analysis prior to the Business Process Reengineering implementation is highlighted. After the implementation of this project, the organization experienced a reduction in expenses, an increase in quality, service, and speed in operations.

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