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# Identifying Control Factors for Business Process Improvement in Telecom Sector Using Taguchi Approach

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**ABSTRACT** Business Process Improvement (BPI) projects open avenues of success for organizations in this highly competitive era. However, most of these projects are not completed due to various reasons identified in past studies making it an area of active research. Using the Taguchi method, this paper identifies industry relevant factors that are most critical to success of a BPI Project in the Telecom sector. Data collected from business process managers and teams was used in evaluating the factors that significantly affect BPI project success through Taguchi Method. The experimental results and findings enable the managers of Telecom organizations to conduct successful BPI projects by guiding them about the factors that are determined to be highly critical to success. Vision, skills, resources, incentives and action plan were determined as critical factors that lead the BPI project towards success. The primary contribution of this research is the proposed methodology and the design of experiment based on the Taguchi Method to determine levels of critical factors in the services sector where this has limited application as compared to the manufacturing industry. The practical implications of this research relate to providing concise directions to ensure success of BPI Projects in the Telecom sector prior to execution of the project. A significant contribution of the research is its practicability in implementation across different industries.

**INDEX TERMS** Business process improvement (BPI), critical success factors (CSFs), change accelerated process (CAP), Taguchi, robust design, orthogonal array (OA).

## I. INTRODUCTION

This era of rapid technological growth and global markets calls for adaptable and continuously improving organizations and their business processes. This adaptability to change and improvement becomes more important for technology driven industries [1], [2]. Telecom industry worldwide and specifically in Pakistan is facing challenges in view of rapidly changing technology, evolving customer requirements and varying business dynamics. The competition is becoming fierce day by day, demanding that the organizations improve continuously to pace up with the challenges and demands. Consequently, business process management departments in the telecom organizations strive to meticulously plan and undertake business process improvement (BPI) projects and business process redesign (BPR) where radical redesign of the process is required. However, BPI projects are a risky proposition owing to cost, time, resources constraints and risks [3], [4]. The subject of BPI has been researched extensively due to the fact that 60-70% of the improvement projects fail and are not completed [4]–[6]. The key problems identified behind failure of BPI projects are the lack of acknowledgement of the risks that potentially confront organizations for successful implementation. These risks identified lie in the people, process and product paradigm [7]. Other factors include ill-defined scope, lack of planning, management support and engagement by resources. Specifically for the services sector, the problem has some additional dimensions like the quality of service, response time and performance enhancement [8]. Generally, the main focus has been on process design, configurations of information systems and process enactment based on information and communication technologies (ICT). The areas involving intangible factors related to employees and customers have not been extensively

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explored in literature. Moreover, the impact of culture, motivation, and people side of BPI needs further exploration specifically with respect to services sector [9].

To the best of the author's knowledge, no BPI application for the services sector exists that is based upon the Taguchi Method. Current implementations of Taguchi method are on customer satisfaction [10] and quality of service [11] yet there is lack of work done for BPI implementation using Taguchi.

The objective of this research is to apply Taguchi method in the service sector (Telecom industry) for ascertaining levels of enabling factors required for successful implementation of BPI projects. An industry relevant robust design for BPI implementation in the telecom industry is presented. The literature on contributing factors for the success of BPI projects was studied. These factors were grouped together under the five elements of change identified by GE's Change Acceleration Process (CAP) which is a widely implemented CAP model that ensures the success of change management projects [12]. BPI projects are essentially change management projects and are uniquely critical since they impact the domains of multiple business functions [5].

A significant feature of this research is the use of primary data collected from business process managers (BPMs) and team leads in the telecom industry. This data was used for design of experiments and application of Taguchi method to determine levels of the key factors that contribute in the success of a BPI project.

The key contribution of this research are:

1. An application of Taguchi Method in the services sector.
2. Industry relevant robust design for BPI implementation to support success of BPI projects in the Telecom industry.

The paper is organized as follows. The next two sections provide the literature review and identify research gaps. Experimental setting is briefly discussed in section IV. The research methodology adopted for designing the Taguchi experiment is explained in section V followed by the analysis and results of experiments in section VI and discussion on the results is presented in section VII. Finally, the paper is concluded along with a description of its practical implications and future work in section VIII.

## II. LITERATURE REVIEW

There is rich literature on the implementation of BPI projects which identifies critical success factors (CSFs) or critical failure factors (CFFs) along with implementation strategies and approaches. Other research includes case studies, knowledge management, culture, organizational BPI fit, models and frameworks to facilitate BPI and post implementation organizational impact [13]. This has provided grounds for enlisting many potential CSFs that contribute towards successful implementation of a BPI project.

We have attempted to summarize the CSFs found in the literature over the period of last two decades. The literature on the contributing factors has matured and evolved in presence of global competition, rapidly changing business environment, developing technologies and tools. One of the earliest studies [14] suggests that BPI initiatives are successful if they are aligned with organizational strategy. Some papers identified other CSFs like appointment of process owners, organizational leaders and leadership and communication [15]–[19].

Other studies have shed light on people training, empowerment, supporting organizational structure and performance measurement as the CSFs [20], [21]. Resource management was also identified in some papers [22], [23]. Focus on customer needs was identified as a CSF [24], [25]. The use of BPI software tools was considered critical to success [26]–[28]. In some recent studies, environment has emerged as a CSF [22], [29], [30].

This analysis of the literature provided an extensive list of CSFs determined over the last couple of decades. In an effort to finalize the most significant CSFs, the factors identified were filtered using the frequency method setting the threshold to minimum of four citations. To categorize the identified factors and align them with an existing model, the Change Acceleration Process Model (CAP) was selected. This model provides a set of principles for accelerating the implementation process; ensuring success [12]. CAP mainly focuses on the people and culture aspects of the process. Vision, skills, incentives, resources and action plan are the five key elements of change that contribute to accelerating the implementation. The researchers have grouped the CSFs into these elements, named as the ''control factors''. A group of five experienced business process managers (BPMs) also verified the grouping which conformed with literature references as presented in Table 1 below.

The design of experiment presented in this paper incorporates these control factors and their impact on BPI implementation success.

## III. IDENTIFICATION OF RESEARCH GAP

There is a lack of robust approaches for BPI implementation [58], [59]. Taguchi provides a robust approach [60] by identifying controllable factors (vision, skills, resources, incentives and action plan) that minimize the effect of the uncontrollable (noise) factors. During experimentation we determine optimal control factor settings that make the process or product robust, or resistant to variation from the noise factors [61]. As already suggested, Taguchi based process improvement models for the services sector have not been extensively studied in literature and primary focus has been on manufacturing sector only. It has been recommended to apply Taguchi's technique for the improvement of various parameters in service sector also [62]. This research addresses the identified gap. The next section discusses the parameters for the Taguchi experimental design.

## IV. PARAMETERS FOR THE DESIGN OF EXPERIMENTS

In order to develop a robust design for BPI project implementation that ensures success, the design of experiments (DOE)

**TABLE 1.** The five control factors critical to success of a BPI project.

| Element Name | Critical Factor | Link to literature |
|---|---|---|
| Vision | Understanding of Process | [31], [32], [33], [34], [35] |
| | Value Realization | [36], [37], [35] |
| | Communication | [38], [35], [39], [40] |
| | Resource Allocation | [31], [32], [34],[35] |
| | Inv. Of organization Stakeholders and Leadership | [31], [32], [38], [33], [35] |
| Skills | Appointment of Process Owners | [41], [42], [43] |
| | People Change Management | [41], [44], [45] |
| Incentive | Performance Measurement | [46], [47] |
| Resources | Supporting Organizational Structure | [48], [49] |
| | People Training and empowerment | [50], [51], [52] |
| Action Plan | Customer Focus | [53] |
| | Process Improvement Road Map | [54], [55] |
| | Scope change Management | [56], [57] |

methodology was adopted which makes use of purposeful changes to the input factors, in order to monitor the changes in the response. DOE is proven to be cost effective since it provides focus and deliberative directions to the activity under study [63].

This research incorporates the Taguchi method as a static optimization problem where the best levels of control factors have been identified. The optimization approach adopted in this research uses the signal-to-noise ratio to identify those control factors that reduce variability. The signal-to-noise ratio measures how the response varies relative to the nominal or target value under different noise conditions. This section mentions different parameters that were chosen for conducting the experiments. For this purpose the research has used the five elements of change finalized from the literature as the control factors which are expected to desensitize the impact of other (noise) factors. A systematic overview of necessary parameters is presented below:

### A. FACTORS AND LEVELS

The five factors identified as the result of the literature review are selected as the control factors, which are vision, skills, resources, incentives and action plan. Each of these factors were experimented with their levels according to the data collected on the 5 point Likert scale [64] (strongly disagree to strongly agree). Further explanation of these factors and levels is in the next section.

### B. DEGREES OF FREEDOM

It refers to the number of ways a system can independently vary when a constraint is imposed [65].

$$\text{Degrees of Freedom} = (\mathrm{D_f} = \mathrm{S} - 1)$$

*where S is the number of levels*

$$\text{Total DoF} = \sum_{i=1}^{k} [S_{\mathrm{k}} - 1]$$

In this case the there are five factors at five levels so the degrees of freedom are 20.

### C. NUMBER OF EXPERIMENTAL RUNS

The number of experimental runs are derived using the following formula:

$$T_{\text{experiments}} = 1 + \sum_{i=1}^{k} [S_{\mathrm{k}} - 1]$$

In this case the minimum number of experimental runs is 21.

### D. ORTHOGONAL ARRAYS

Taguchi method uses orthogonal arrays (OA) to enable the study of a large number of factors with smaller number of experimental runs. The use of OA radically reduces the number of experimental runs without compromising validity of experiments thus reducing costs and time [63]. Using Minitab software (version 18), the appropriate Orthogonal Array (OA) for our experiment was $L^{25}$ which should be greater than or equal to the number of experimental runs derived. The $L^{25}$ array with 5 factors and 5 levels is presented in TABLE 2 as follows:

**TABLE 2.** Orthogonal array Taguchi, P = 5, L = 5.

| Run# | 1 Vision | 2 Skills | 3 Incentive | 4 Resources | 5 Action Plan |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 2 | 2 | 2 | 2 |
| 3 | 1 | 3 | 3 | 3 | 3 |
| 4 | 1 | 4 | 4 | 4 | 4 |
| 5 | 1 | 5 | 5 | 5 | 5 |
| … | … | … | … | … | … |
| … | … | … | … | … | … |
| … | … | … | … | … | … |
| 21 | 5 | 1 | 5 | 4 | 3 |
| 22 | 5 | 2 | 1 | 5 | 4 |
| 23 | 5 | 3 | 2 | 1 | 5 |
| 24 | 5 | 4 | 3 | 2 | 1 |
| 25 | 5 | 5 | 4 | 3 | 2 |

The advantage of using orthogonal arrays is that each factor can be evaluated independently without influence from other factors, i.e. the factors do not affect each other during estimation.

### E. SIGNAL TO NOISE RATIO

Process parameter optimization in Taguchi Method uses Signal-to-Noise (S/N) Ratio. It keeps the mean value of the signal closer to the target by detecting control factors and neglecting the impact of uncontrollable factors. When higher response factor is desired for the process e.g. quality, efficiency, reliability etc, ''larger the better'' as represented by eq (1) is used. Since the research goal was to increase success probability of BPI projects, therefore, larger the better was used for analysis [65]. This ensured robustness, minimum impact of noise factors and reduction of response variability.

Formula:

$$[S/N]_{\mathrm{L}} = -10\log_{10}[\mathrm{MSD}] = -10\log_{10}\sum(1/\mu^2)/n \tag{1}$$

where:

MSD is mean standard deviation

$\mu$ is signal mean

n is number of trials

## V. METHODOLGY

This research uses a quantitative approach involving design of experiments using primary data collected through a self-administered questionnaire [11], [64], [66]. Further details about the research instrument and sample are discussed below:

### A. QUESTIONNAIRE DESIGN

The questionnaire (provided in Appendix) was adapted from literature to assess the impact of the five control factors mentioned above [13], [29]. The respondents were asked to form their opinion on the basis of BPI projects they had executed in the past when responding to the questionnaire and rate the presence of the key elements using a five point Likert Scale (representing the five levels for each control factor respectively).

### B. FACE VALIDITY

After careful selection of questions from the literature, face validity of the questionnaire was checked [67].The procedure for face validity was adopted from the guidelines derived from the review of the literature [68]. Questionnaire items were presented to experts who reviewed each item and marked them in terms of their relevance to the construct intended to be measured. The items were marked ''1'' if they were not relevant, ''2'' if they were somewhat relevant and ''3'' if they were totally relevant. The questions that had 80% of responses as totally relevant were then included in the questionnaire. The final questionnaire had 39 items (questionnaire attached as Appendix).

### C. SAMPLE AND SAMPLING COMPOSITION

The sample for the research was business process managers (BPMs) and BPI team leads who had the experience of participating in at-least three successful BPI projects in major telecom organizations in Pakistan. Purposive sampling technique was used to collect data. A pilot study was conducted first and 38 responses were collected. The reliability analysis was performed and Cronbach alpha was 0.929 which was considered adequate indicating reliability of the research instrument. Data collection efforts were launched after which 104 out of the 123 designated managers responded with a response rate of 84%.

## VI. ANALYSIS AND RESULTS

This section presents the results of the analysis conducted on the collected data. The Taguchi method is performed using Minitab 18. Experiment is performed in services related scenario, where instead of a tangible and physically measureable product, an ongoing process is to be analyzed and experimented. Therefore, an improvised approach is used ensuring all the 21 experimental runs are administered [11], [69], [65]. Thus a coding sheet given in Table 3 was developed that ensures execution of each experimental run. The percentage of responses based on the count of responses under each category were calculated. This provided the score for each variable in each category.

**TABLE 3.** Code sheet.

| Factors | 1 (0 < 1.5) | 2 (1.5 < 2.5) | 3 (2.5 < 3 .5) | 4 (3.5 < 4.5) | 5 (4.5 ≤ 5) |
|---|---|---|---|---|---|
| Vision | 0% | 3.85% | 16.35% | 75% | 4.81% |
| Skills | 0% | 0% | 17.31% | 58.65% | 24.04% |
| Incentive | 1.92% | 3.85% | 27.88% | 54.81% | 11.54% |
| Resources | 0% | 0% | 38.46% | 53.85% | 7.69% |
| Action Plan | 0% | 0% | 5.77% | 65.38% | 28.85% |

The Orthogonal array $L^{25}$ provides the guidelines for each level of control factor. The Signal to Noise ratio (eq 1) and mean is calculated for each experimental run. The results are shown in Table 4.

As discussed in the methodology ''larger the better'' approach has been used for calculation of the signal to noise ratio. Experimental run # 4 provided the best result with the signal to noise ratio of 47.33. In an attempt to find the best levels of performance of each factor, the signal to noise ratios were further analyzed.

The ranking of the process parameters was obtained from S/N ratio table. This order was determined by comparison of delta values which is equal to the difference between maximum and minimum values for levels of each factor. Table 5 shows the order of importance or rank of each factor for the success of a BPI project according to S/N ratio. It shows that vision is most important factor for the success of a BPI project, while skills is the second most important factor and resources being the third most important factor followed by incentives and lastly action plan.

The response table for means given in the Table 6 shows the rankings as vision being the most important factor.

**TABLE 4.** Signal to noise ratio calculations.

| Run | Vision | Skills | Incentive | Resources | Action Plan | Success | SNRA | MEAN |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1.92 | 5.666025 | 1.92 |
| 2 | 1 | 2 | 2 | 2 | 2 | 3.85 | 11.70921 | 3.85 |
| 3 | 1 | 3 | 3 | 3 | 3 | 89.42 | 39.02869 | 89.42 |
| 4 | 1 | 4 | 4 | 4 | 4 | 232.69 | 47.33555 | 232.69 |
| 5 | 1 | 5 | 5 | 5 | 5 | 72.12 | 37.16111 | 72.12 |
| 6 | 2 | 1 | 2 | 3 | 4 | 111.54 | 40.94861 | 111.54 |
| 7 | 2 | 2 | 3 | 4 | 5 | 114.43 | 41.1708 | 114.43 |
| 8 | 2 | 3 | 4 | 5 | 1 | 83.66 | 38.45036 | 83.66 |
| 9 | 2 | 4 | 5 | 1 | 2 | 74.04 | 37.38933 | 74.04 |
| 10 | 2 | 5 | 1 | 2 | 3 | 35.58 | 31.02412 | 35.58 |
| 11 | 3 | 1 | 3 | 5 | 2 | 51.92 | 34.30669 | 51.92 |
| 12 | 3 | 2 | 4 | 1 | 3 | 76.93 | 37.72191 | 76.93 |
| 13 | 3 | 3 | 5 | 2 | 4 | 110.58 | 40.87353 | 110.58 |
| 14 | 3 | 4 | 1 | 3 | 5 | 144.23 | 43.18111 | 144.23 |
| 15 | 3 | 5 | 2 | 4 | 1 | 98.09 | 39.83249 | 98.09 |
| 16 | 4 | 1 | 4 | 2 | 5 | 158.66 | 44.00935 | 158.66 |
| 17 | 4 | 2 | 5 | 3 | 1 | 125 | 41.9382 | 125 |
| 18 | 4 | 3 | 1 | 4 | 2 | 148.08 | 43.40993 | 148.08 |
| 19 | 4 | 4 | 2 | 5 | 3 | 150.96 | 43.57724 | 150.96 |
| 20 | 4 | 5 | 3 | 1 | 4 | 192.3 | 45.67959 | 192.3 |
| 21 | 5 | 1 | 5 | 4 | 3 | 75.97 | 37.61284 | 75.97 |
| 22 | 5 | 2 | 1 | 5 | 4 | 79.8 | 38.04006 | 79.8 |
| 23 | 5 | 3 | 2 | 1 | 5 | 54.82 | 34.77878 | 54.82 |
| 24 | 5 | 4 | 3 | 2 | 1 | 91.34 | 39.21322 | 91.34 |
| 25 | 5 | 5 | 4 | 3 | 2 | 122.12 | 41.73574 | 122.12 |

**TABLE 5.** Response table for signal to noise ratios (larger is better).

| Level | Vision | Skill | Incentive | Resources | Action Plan |
|---|---|---|---|---|---|
| 1 | 28.18 | 32.51 | 32.26 | 32.25 | 33.02 |
| 2 | 37.80 | 34.12 | 34.17 | 33.37 | 33.71 |
| 3 | 39.18 | 39.31 | 39.88 | 41.37 | 37.79 |
| 4 | 43.72 | 42.14 | 41.85 | 41.87 | 42.58 |
| 5 | 38.28 | 39.09 | 39.00 | 38.31 | 40.06 |
| Delta | 15.54 | 9.63 | 9.59 | 9.63 | 9.56 |
| **Rank** | **1** | **2** | **4** | **3** | **5** |

**TABLE 6.** Response table for means.

| Level | Vision | Skill | Incentive | Resources | Action Plan |
|---|---|---|---|---|---|
| 1 | 80.00 | 80.00 | 81.92 | 80.00 | 80.00 |
| 2 | 83.85 | 80.00 | 83.85 | 80.00 | 80.00 |
| 3 | 96.35 | 97.31 | 107.88 | 118.46 | 85.77 |
| 4 | 155.00 | 138.65 | 134.81 | 133.85 | 145.38 |
| 5 | 84.81 | 104.04 | 91.54 | 87.69 | 108.85 |
| Delta | 75.00 | 58.65 | 52.89 | 53.85 | 65.38 |
| **Rank** | **1** | **3** | **5** | **4** | **2** |

Action plan was the second important factor followed by skill, resources and incentive.

The Main effects plot for SN ratios (Figure I) also show the most optimum levels of each factor for robust result. The figure clearly depicts that vision, skill, incentive resources and action plan are important and should be present for the success of a BPI project.

The next step towards finalizing the findings is to perform analysis of variance on the data in order to find the contribution of each factor to BPI project success. The results thus achieved are presented in the table 7:

Results show that the p-value for all five factors is less than 0.05 indicating a significant relation of the factors

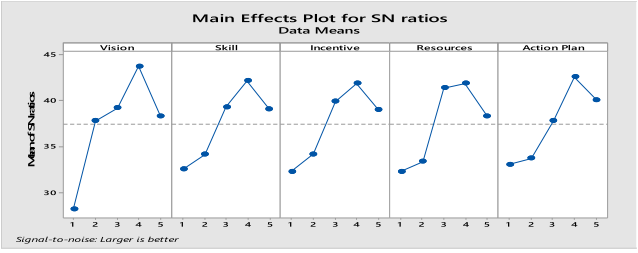


**FIGURE 1.** Main effects plot for s/n ratio.

with project success. The contribution of each factor can be observed in Table 7 which shows that vision has the maximum contribution of 29.63%, followed by action plan

**TABLE 7.** Analysis of variance for transformed response.

| Source | DF | Seq SS | Contribution | Adj MS | F-Val | P-Val |
|---|---|---|---|---|---|---|
| Vision | 4 | 407.43 | 29.63% | 101.86 | 463.22 | 0.0 |
| Skill | 4 | 224.24 | 16.31% | 56.06 | 254.95 | 0.0 |
| Incen | 4 | 187.06 | 13.60% | 46.76 | 212.68 | 0.0 |
| Res | 4 | 249.29 | 18.13% | 62.32 | 283.42 | 0.0 |
| Action Plan | 4 | 306.23 | 22.27% | 76.56 | 348.16 | 0.0 |
| Error | 4 | 0.88 | 0.06% | 0.22 | | |
| Total | 24 | 1375.14 | 100.00% | | | |

having 22.27%, and resources, skills and incentives each contributing 18.13%, 16.31% and 13.6% respectively.

## VII. DISCUSSION

The purpose of this research was to apply Taguchi method for determining levels and impact of the factors that significantly impact the success of the BPI implementation. The factors were meticulously extended from the change acceleration process that is being widely use as a change management tool. Change acceleration process primarily focuses on cultural change relying on people; performers and communication to achieve desired results [12]. The key finding of this research supports the initial proposition that BPI implementation with CAP involving control factors related to people management is more likely to result in a successful implementation. This finding linked with CAP is a different view from the prevalent success factors frequently found in literature [52]. The use of Taguchi method to determine the factors critical to successful implementation adds to its uniqueness. The design and execution of Taguchi method for service scenarios where every control factor cannot be controlled at different levels is an additional impact of the study. After wide application in manufacturing industries, a visible research trend using design of experiments now exists in improving the service lifecycle in service sector. Some examples include application in the hotel industry for improving service quality by focusing customer satisfaction [70], optimization of user experience in mobile applications by studying subjective and subconscious quality characteristics of user experience [71], identification of healthcare service quality dimensions and their effects on patients using a Taguchi experiment [72], proposal of an improved framework based upon quality and reliability engineering and its application to study and evaluate existing airport services and generate new service design for ensuring customer satisfaction [73]. The common thread in these applications is improvement is customer experience and satisfaction regardless of the application domain. This research identifies skills and incentives as critical factors which relate to employee development, however, these factors indirectly contribute to customer satisfaction.

The research also implies that the contribution of all the control factors analyzed in terms of the defined criteria is necessary for successful implementation of BPI projects. Vision encompasses the concepts of realizing value of the BPI intervention throughout the organization, along with complete understanding of the process. It also involves ample emphasis on communication (both upward and downward), prioritized resource allocation for BPI projects, involvement of stakeholders and leadership to enable continuous improvement. Skillful appointment of process owners and people change management focusing on the skill set of the employees is also essential for BPI implementation. Performance measurement when tailored to incentivize the employees participating in the BPI project facilitates the implementation. Supporting organizational structure, people training and empowerment are major resources that need to be considered for BPI implementation. The action plan for BPI implementation must focus on customer needs and requirements with active scope change management thus designating a comprehensive improvement road map.

Success factors were also ranked based upon S/N ratio and means according to their impact on BPI success. The S/N ratio ranked vision as top factor with maximum contribution towards successful BPI implementation. The second most important factor was skill development and resources was the third most important factor for successful BPI implementation. The mean rankings rated vision as the top factor, while a comprehensive action plan was the second most important and skills being the third most important factor for successful implementation. The contribution of each of these factors to BPI success was determined. It was found that contribution of vision in successful implementation is very critical having about 30% of impact on the project. Complete and comprehensive action plan contributes around 22% to the successful implementation. Similarly skills have 18% contribution in successful implementation. Thus 70% of the implementation success is ensured if the practitioners focus entirely on these three critical factors. This is a significant finding as it complements the existing literature dealing with BPI implementation as a process; placing importance on the focus and control, rather than relying on the people centric factors [74], [75].

Skills and incentives both are directed towards employee development. This requires top management focus in investing in these areas to ensure implementation success and customer satisfaction as suggested in past studies [41], [76].

The research finally suggests two factors that are most critical to success of a BPI initiative as vision and skills. Shared vision for improvement within the organization creates a learning culture promoting the improvement implementations. Investing in employees and improvement centric skill development also benefits the organizations by ensuring successful implementation of BPI projects.

## VIII. CONCLUSION

The robust BPI project implementation factors determined in this research guide the business process manager with directions enabling BPI project implementation success by making it insensitive to other uncontrollable factors.

**TABLE 8.** Research questionnaire.

| | *(Respondents were asked to rate these questions on a five- point likert scale)* |
|---|---|
| **Vision** | Project team members engaged in open and honest communication.<br>The quality of project communication was poor.<br>The outcome of the BPI project added value to the business operations.<br>Compared to other projects at the firm, this project was of high value<br>There was a poor understanding of key process issues of BPI project.<br>Sufficient decision authority existed regarding resource allocation for BPI project by BPM manager<br>Team members participated in decisions regarding resource allocation of BPI project.<br>All project members agreed to the commitment of their time as per the project plan.<br>There was commitment and support from the top management during the BPI implementation process<br>Leadership was effective and creative in taking decisions. |
| **Skills** | BPI project included process owners throughout the BPI effort<br>BPI project identified process owners who were responsible for the entire business process.<br>Any change or modification in BPI project was ethically guided.<br>The change management support was available whenever needed.<br>The change management consultants understood problems well.<br>The change management consultants resolved the problems.<br>Changes suggested by management were well informed and had valid reasons |
| **Incentives** | Adequate system of reward or punishment based on rigorous management of BPI project members<br>performance existed in project.<br>Staff were allowed to set their goals, monitor their own performance, in relation to their work targets. |
| **Resources** | Application of the BPI project rapidly changed the organization structure<br>The hierarchical relationship of the BPM/BPI function to the overall organizational structure was adequate.<br>Different organization structures were integrated as a result of the BPI project implementation.<br>Training required to perform the BPI project was readily available in manuals.<br>There was difficulty in providing training to employees in the skills required for this project.<br>Training people to deal with the BPI project involved substantial commitments of time and money. |
| **Action Plan** | The planning team briefed senior management about the scope of the BPI project<br>The scope of the project was clearly defined.<br>The BPI intervention really focused on customer.<br>BPI project contributed significantly to establishing strong and continuous relationship with customers<br>Customers' complaints, lost customer analysis and feedback was used to improve the product/ service<br>The project plan and estimates were realistic.<br>Corrective action was taken proactively when actual results deviated from the project plan.<br>The project's actual results on the project plan were compared regularly with estimates in the project plan.<br>BPI intervention quality was assessed and compared to the quality goals in the project plan. |
| The items in the questionnaire were collected from the following papers: [77], [78], [79], [80], [81], [82], [83], [84], [85] | |

The findings of the research have equipped the BPI project actor with levels of the key factors that play a vital role in the success of a BPI project. This is a fresh perspective, shedding light on people management rather than the prevalent process approach towards BPI implementation.

BPI project actor should ensure that the BPI initiative is aligned with the shared vision of the organization. The vision setting must involve the organizational stakeholders and leadership. Complete communication plan and resource allocation plans must be shared amongst all the stakeholders of the BPI Project and the leadership.

The next action item to be put in place is the development of the skillset that will further expedite and enable the BPI project. This is achieved when a skillful BPI manager is appointed and complete focus is on people change management. The next step is incentivizing the BPI project members by devising proper performance management tools. Supporting organizational structure, ample training and empowerment are powerful resources that should be allocated and accounted for in order to ensure BPI success. Consequently, a complete and concise action plan must be put in place that should account for the process improvement roadmap along with scope change management.

### A. PRACTICAL IMPLICATIONS

This research identifies the pre-requisite control factors which if taken care of before launching the BPI project ensure BPI success. The benefit of using Taguchi approach is to minimize the chances of losses in terms of cost and time over-runs since these experiments have identified the conditions for success in advance, well before launching the initiative. The framework is designed with the help of telecom industry BPMs, teams and consultants making it applicable and relevant to this industry. The telecom industry is unique in terms of the technological advances and fierce competition it faces due to multiple external and internal factors. These findings provide directions to BPM teams to ensure project success.

### B. LIMITATIONS AND FUTURE WORK

The research is limited to the telecom industry of Pakistan which is a rapidly evolving industry facing challenges on technological, political, financial and human resource aspects. For a telecom organization to survive it must adapt rapidly undergoing constant improvements by executing continuous BPI projects. The control factors thus identified can be studied and verified for use in different industries facing similar challenges and also for different geographical locations. This research can be extended in future to incorporate additional factors including noise factors as well in the design of the experiment. The application of Taguchi method in a lesser researched service sector provides researchers a fresh perspective for future work.

## APPENDIX

See Table 8.

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