

Research Article

Modeling the Success Factors of Kaizen using Structural Equation Modeling - A Survey of Industrial Professionals and Academicians

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A B S T R A C T

Continuous Improvement or Kaizen approach is a management approach of achieving major enhancement in the process through small incremental improvements in the organizations. This study is an attempt to assess the different success factors of Kaizen for performance improvement of the organizations by obtaining different benefits. Structural Equation Modeling has been applied to ascertain the important benefits of implementing Kaizen issues. Results indicated that small incremental improvements are capable of improving the economic performance followed by competitive performance and environmental performance.

Keywords: Kaizen, Structural Equation Modeling, Performance Parameters

Introduction

Globalization has significantly impacted production operations worldwide, on account of several fronts, viz Product Quality, Life Cycle imperatives, workers productivity etc. Cut throat competition, across the Supply Chain processes, is one of the many threats being faced by the managers of manufacturing organizations, requiring manufacturing organization devise and work out new plans to stay afloat. The customers require products and services with higher utility and within the desired timeframe, for which the manufacturing industry is constantly researching new methodologies in order to stay ahead of competition (Kumar et al, 2015). The production process is complex because of integration and constrained by sustainability issues, both ecological and financial (Thareja 2014).

Quality Guru Philip Crosby advocates Zero Waste culture is the possible solution to invigorate processes and people, and remove non-value adding activities (Thareja, 2012). Teece (2007) recommends they need to implement Continuous improvement or concept of Kaizen at all levels in their respective units.

The term Kaizen has been derived from two Japanese words "Kai" which refers to change and "Zen" which refers to the better which collectively signify incremental improvements. The change for better implied driving improvements, on the significant few areas of opportunities, that will "move the needle" on competitiveness, through the supply chain or customer service etc (Fast 2016). These initiatives require the "total employee involvement" in the manufacturing unit right from the top management down to blue collar workers collectively working towards higher performance

targets. (Maarof and Mahmud, 2016). As a prerequisite of managing “total employee involvement”, Thareja, (2012) argues that the Competence and Culture are prerequisites to facilitate working for desired objective realization, which is better than merely assigning work. The present work reports the perspective of the Industry Professionals and Academicians of Northern India about the significance of different success factors of Kaizen towards improving organizational sustainability. To uncover different benefits of Kaizen statistical analysis viz. correlation and t test have been performed to frame the hypotheses and structural equation modeling has been employed to validate the hypotheses.

Literature Review

Arya and Choudhary (2015) represented Kaizen implementation in a machine vice manufacturing company. Fishbone diagrams have been used to represent cause and effects. Inventory access time is reduced up to 87 per cent and total distance traveled and total time taken by product is reduced up to 43.75 and 46.08 per cent, respectively. A habit to maintain a clean workplace has been developed in workers. Bessant and Caffyn (1997) reports on a five year research programme exploring implementation issues in CI and presents a framework model for the development of CI which draws upon extensive case study work. In particular it identifies a series of levels of CI performance and the blocks and enablers associated with them. The paper has introduced a model framework that helps explain the apparently diverse set of experiences of CI implementation reported in the literature. It suggests that CI can be characterized as an evolutionary learning process associated with acquiring key behavioural patterns, putting these patterns into practice so that they then become routines and diffusing them across the whole organization. Malik and YeZhuang (2006) define that Kaizen calls for an effort for improvement involving everyone in the industry. Kaizen successful implementation results in healthy atmosphere where everyone in the organisation is aware of key goals, objectives and measure of success. Kaizen is considered to be more than just a continuous improvement process as it represents daily struggle occurring in the workplace and the manner in which these struggles can be overcome.

Gupta and Jain (2014) categorized, analysed, and reviewed methodically the extant literature as applied to a number of the small scale manufacturing units to increase efficiency and productivity using 5S and Continuous Improvement strategies. They conclude by 5S and continuous improvement paradigms enable significant. Improvements in effectiveness and efficiency in the production plan, reducing delays, and saving time. These helped improve safety of the workforce, avoiding dangerous conditions, boosting morale and increasing transparency in the system,

Argues Thareja. Kaizen requires a cultural change calling for wor(k)ship and devotion. For re-engineering good results – both from work, and/or worship – a comprehensive system understanding and plethora of process knowledge is mandatory (Thareja, 2009).

The practitioners therefore need to Simultaneously evolve a thinking that reframes all activities as learning activities at every level of the organization (Thareja, 2019), say, (i) standardized work and kaizen at the individual level, (ii) system kaizen at the managerial level, or (iii) higher level kaizen that enables fundamental strategic decisions at the corporate level.

Marin-Garcia et al. (2009) explores the possibility of improving production indicators by implementing Kaizen Events. The teams are composed of both managers and operators with the aim of developing and/or implementing improvements in three to five days. The empirical research consists of the description of the results obtained in 11 industrial companies from the automotive components industry. In each company, they have followed up different interventions over a 9–12 month period. The authors presents the initial situation, the activities carried out by the companies and the evolution of manufacturing performance approximately three months after the activities were finished and qualitative conclusions on the carrying out of Kaizen Events.

Research Methodology and Research Instrument

This research has been developed in two different steps. First, literature from different case studies, surveys and concept has been reviewed to identify that are considered to be key issues for the business performance in Indian context. This information was used to develop a questionnaire which contains issues related to Kaizen and performance parameters of Organizational Sustainability. Structured interview along with filling of Questionnaire have been conducted with the respondents of the Industrial Professionals and Academicians in order to assess how they value these factors, how factors effects the organizational sustainability. For conducting case study, a questionnaire on five point Likert scale has been designed which consists of two different sections:

- First Section includes questions related to general information about the company, respondent characteristics
- Section-A shows important issues related to Kaizen (1= Not at all, 2= to some Extent, 3= to a moderate Extent, 4= to a large Extent, 5= To a Extremely Large Extent).
- Section-B indicates the role of Kaizen issues on Organizational Sustainability (1= Not at all, 2= to some Extent, 3= to a moderate Extent, 4= to a large Extent, 5= To a Extremely Large Extent).

The Research Methodology is shown in figure 1.

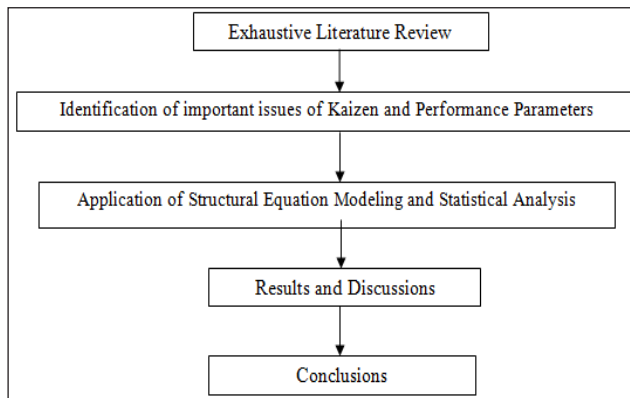


Figure 1. Research Methodology

To ensure the relevance and effectiveness of the questions of the Questionnaire is pre-tested on a representative sample of industry and experienced researchers. A total of 46 Questionnaire has been filled to ascertain contributions made by Kaizen issues in the Indian context towards realization of performance improvement. The selection of manufacturing Industry is done on convenient sampling technique.

Data Analysis

This section includes the detailed description of statistical analysis performed to validate the questionnaire and meet the objectives of the study.

Reliability Analysis and Hypotheses

The reliability of data is measured from factor loading and cronbach's alpha and hypotheses has been framed using correlation analysis. Table 1. Cronbach's Alpha for various variables.

The Pearson correlations have been worked out to formulate the hypotheses of the study. The positive value of Karl Pearson Coefficient of Correlation depicts that each issue has positive effect on the performance parameters of continuous improvement. Table 2, shows the values of Karl Pearson coefficient of Correlation calculated for Kaizen issues and organizational sustainability through performance parameters.

Further, *t* test has been conducted for investigating and validating the contributions of Kaizen issues towards

Table 1. Cronbach's Alpha for various variables

| Factor Name | Variables | Cronbach's Alpha |
|-----------------------------|---|------------------|
| TPM Issues (p) | Does your organization has achieved the benefit of preventive Maintenance? | 0.764 |
| | Does small group activities are capable of performing better results? | |
| | Does equipment restoration really help in maintenance activities? | |
| TQM Issues (q) | Are the quality practices helpful in implementing KAIZEN activities? | 0.863 |
| | Removing Operator Mistakes are really helpful? | |
| | DMAIC methodology is helpful in making small innovative changes | |
| 5S issue (r) | Have you obtained benefit of categorized lean 5S activities? | 0.863 |
| | Did the Percentage rating of 5S activities really helpful | |
| | On floor housekeeping are really helpful in incremental change | |
| JIT issues (s) | Did workflow analysis really helpful? | 0.873 |
| | Removing Constraints in the process is helpful in implementing KAIZEN. | |
| | Removing Unnecessary Material Movement is helpful in reducing waste | |
| | Organization promotes the application of JIT Practices | |
| | Maintained equipment and tools well at workplace | |
| Environment Performance (m) | To enhance and maintain the biophysical systems that sustain all life on Earth that includes structure and function of natural ecosystems and the interactions between them and people and calls for guardianship of our environment. | 0.843 |
| | To incorporate waste management of the organization | |
| | To reduce waste resulting from operations | |
| | Cutting down on waste resulting from pollution | |
| | To recycle the waste products | |

| | | |
|-----------------------------|---|-------|
| Economic Performance (n) | Improve the final Cost of the Product(Power) | 0.763 |
| | Improvement in operational efficiency of the organization | |
| | Improves the profit of the organization | |
| Competitive Performance (o) | Increased Productivity | 0.734 |
| | Improvement in quality | |
| | Overall customer satisfaction | |
| | Eco-friendly operations by Govt. or Non Govt. Employees | |
| | Improvement in competitive image of the organization | |

Table 2. Correlation between Kaizen issues and performance parameters

| | Environmental Performance | Economic Performance | Competitive Performance |
|------------|---------------------------|----------------------|-------------------------|
| TPM issues | 0.486* | 0.551* | 0.352* |
| TQM issues | 0.459* | 0.576* | 0.513* |
| 5S issues | 0.505* | 0.532* | 0.584* |
| JIT issues | 0.681* | 0.705* | 0.693* |

*Correlation is significant at 5% level

realization of significant performance enhancements which will leads to success of Kaizen issues .The t value can be calculated by using relation:

$$t = \frac{R\sqrt{n-2}}{\sqrt{1-r^2}} \geq t_{n-2}$$

Where $n-2$ is the degree of freedom for the calculation of table value of t .

Table 3. t values for validating correlation coefficient

| | m | n | o |
|---|------|------|------|
| p | 3.68 | 4.37 | 2.49 |
| q | 3.43 | 4.67 | 3.97 |
| r | 4.49 | 4.17 | 4.77 |
| s | 6.16 | 6.61 | 6.17 |

Table value of $t=2.031$

From the above statistical Analysis the following Hypotheses has been framed for the Research:

- H1:** TPM Issues are positively associated with performance parameters
H2: TQM issues are positively associated with performance parameters
H3: 5S issues are positively associated with performance parameters
H4: JIT issues are positively associated with performance parameters

Validation of Hypotheses

To ascertain the role of Kaizen issues towards performance improvement, structural equation modeling technique has been applied to the different independent and dependent variables. To assess the performance of these lean strategies,

an individual model and mixed model has been prepared to ascertain the relationship between latent variables with each other and also on measured variables assigned to each latent variable. The error variables depicting measurement error are also included in relation to measurement variables. The variance of all the error variables has been fixed in software AMOS 24. In the present research Kaizen issues are exogenous variable and performance parameters are endogenous variables.

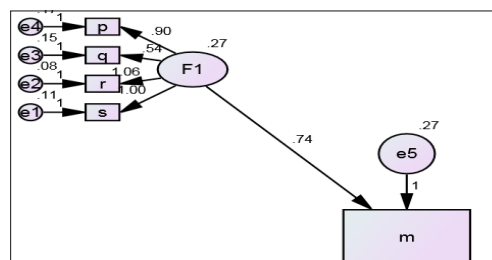


Figure 2. Impact of Kaizen issues on environment performance

Table 4. Various indices of model fit

| Indices | Calculated Values | Standard values |
|---------------------------------|-------------------|-----------------------------|
| Chi-Square/ Degree of Freedom | 0.539 | Value should be less than 3 |
| GFI (Goodness of Fit Index) | 0.976 | $0 \leq GFI \leq 1$ |
| CFI (Comparative Fit Index) | 1.000 | $0 \leq CFI \leq 1$ |
| TLI (Tucker Lewis Index) | 1.000 | $0 \leq TLI \leq 1$ |
| AGFI (Adjusted Goodness of Fit) | 0.927 | $0 \leq AGFI \leq 1$ |
| Probability level | 0.002 | < 0.05 |

Table 5.Various indices of model fit

| Indices | Calculated Values | Standard values |
|---------------------------------|-------------------|------------------------------|
| Chi-Square/Degree of Freedom | 2.189 | Value should be less than 3. |
| GFI (Goodness of Fit Index) | 0.924 | $0 \leq GFI \leq 1$ |
| CFI (Comparative Fit Index) | 0.947 | $0 \leq CFI \leq 1$ |
| TLI (Tucker Lewis Index) | 0.894 | $0 \leq TLI \leq 1$ |
| AGFI (Adjusted Goodness of Fit) | 0.773 | $0 \leq AGFI \leq 1$ |
| Probability level | 0.049 | <0.05 |

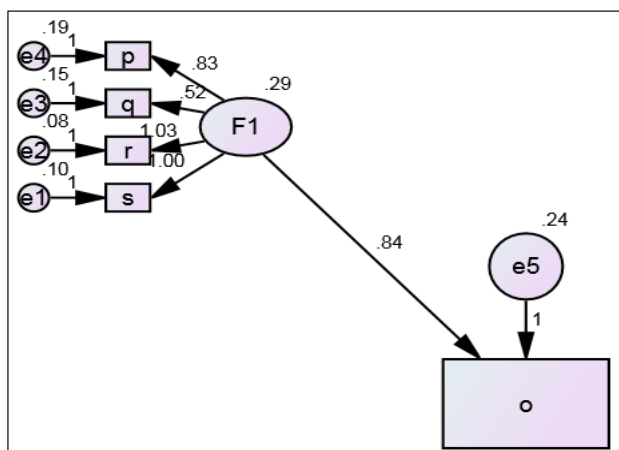


Figure 4.Impact of Kaizen issues on competitive performance

Table 6.Various indices of model fit

| Indices | Calculated Values | Standard values |
|---------------------------------|-------------------|------------------------------|
| Chi-Square/ Degree of Freedom | 1.881 | Value should be less than 3. |
| GFI (Goodness of Fit Index) | 0.934 | $0 \leq GFI \leq 1$ |
| CFI (Comparative Fit Index) | 0.959 | $0 \leq CFI \leq 1$ |
| TLI (Tucker Lewis Index) | 0.918 | $0 \leq TLI \leq 1$ |
| AGFI (Adjusted Goodness of Fit) | 0.803 | $0 \leq AGFI \leq 1$ |
| Probability level | 0.000 | <0.05 |

Figure 2, 3 and 4 shows measurement model showing the impact of various exogenous variables on endogenous variables. The value of standard path coefficients (SPC)

between these variables has been calculated to ascertain the significance of Kaizen issues on Organization Sustainability through environmental performance improvement. Table 4, 5 and 6 indicate the model conformity prepared for improving the Organizational Sustainability. The variables assigned to each of the dimensions have been subjected to factors analysis to ensure that they are reliable indicators of those constructs.

Result Discussion of Validation of Hypotheses

Results of investigation(structural equation modeling) recommended that with unity improvement in Kaizen issues there is improvement in environmental performance by a factor 0.74 through enhancement and maintaining the biophysical systems that sustain all life on Earth that includes structure and function of natural ecosystems and the interactions between them and people, and calls for guardianship of our environment, incorporating waste management of the organization, reduction of waste resulting from operations, cutting down of the waste resulting from pollution and recycling the waste products; improvement in economic performance by a factor 1.04 through improvement in the final cost of the product, improvement in operational efficiency of the organization and improving profit; and improvement in competitive performance by a factor 0.84 through increased productivity, improved quality, customer satisfaction, Eco-friendly operations by Govt. or Non Govt. Employees and improvement in competitive image of the organization. The hypotheses framed for this research is significantly supported in Indian Context as the values of SPC are highly positive or there is high significant improvement after implementing Kaizen issues which leads to organizational sustainability.

Conclusion, Benefits to the Society and Limitations

From the results, it is concluded that small incremental in the organization are capable of improving the economic performance followed by competitive performance and environmental performance of the organization. Organizational sustainability is significantly improved after implementing Kaizen issues through various benefits. With the improvement in environmental aspects, the life of the living things on earth can be easily maintained by enhancing biological system that sustains life o earth. The environmental waste can be reduced by making incremental changes in the pollution releasing systems of the organizations. The study has some limitations as shown below:

- The data is self-reporting in nature.
- Scope of subjectivity might be there because Industrial Professionals and Academicians have responded according to their own perceptions.
- There is possibility of method variance.

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