A Structural Equation Model (SEM) Evaluation of Lean Practices for Small & Medium Scale Manufacturing Enterprises Within Gujarat State

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***Abstract*—The purpose of this paper is to empirically test a framework (operational performance Model) which identifies the relationships between lean practices critical success factors, organizational performance Measurement of Gujarat's manufacturing firms. Specifically, this study examines the direct effects of lean practices success factors on organizational performance and whether the relationship between lean practices success factors and organizational performance measures is confirmed or not using confirmatory factor analysis. A structural equation model (SEM) is estimated using data provided by 152 manufacturing firms Small & Medium Scale Enterprises. The results show that lean practices success factors have a direct and significant impact on organizational performance of manufacturing firms.**

Keywords— SEM (Structural Equation Modeling), Lean practices, critical success factors, Organizational performance measures

I. INTRODUCTION

The successful implementation of lean practices has become accepted by Toyota as source of competitive advantage (Doolen and Hacker, 2005; Womack et al. 1990). There are several studies that have examined the effects of lean on performance. The results showed that lean practices might not be universally valid in all organizational contexts (Boyle et al., 2011, Cooney, 2002). Many researchers confirmed that the relationship of lean on financial performance is mixed (York and Miree ,2004; Boyd et al., 2006; Wayhan and Balderson, 2007). The study of Furlan et al. (2011) indicated that not all the plants implement lean manufacturing bundles show the improvement on operational performance. This paper investigates the relationship of lean practices on organizational performance and innovation performance, and the relationship of innovation performance on organizational performance of manufacturers in Gujarat using a structural equation model (SEM). This allows us to evaluate whether the lean practices that are effective in advanced economies like Japan are also Effective in a developing country like Gujarat. The next sections of the paper review existing literature, explain the research methodology and the data analysis. The final section examines the results and provides conclusions and suggestions for future research.

II. LITERATURE REVIEW

The research model of this study is shown in Figure 1. The model proposed that lean practices implemented by Gujarat manufacturers to improve their organizational and innovation performance. Also the improvement of innovation performance will improve the organizational performance. The lean practices, organizational performance and innovation performance are discussed in the next subsection.

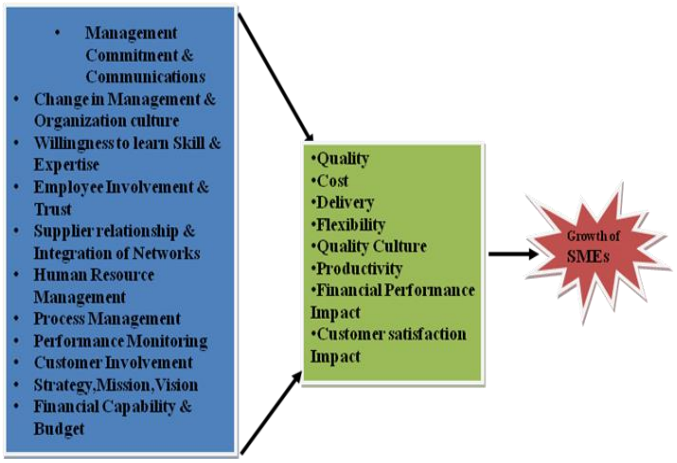

Fig.1 Research Model

The above research model will explore the relationship existing between critical success factors and performance measures of lean manufacturing practices cited by various authors in literature in context with small and medium scale manufacturing enterprises across the global. The theoretical framework is also derived from various study related to performance measures of lean and structured equation modeling methods has been used by various authors as discussed in next section , total seven different lean models have studied for analyzing theoretical framework

The performance measurement model has a crucial role for continuing improvement and growth of SMEs to make efficient and effective management in the manufacturing sectors (Kennerley & Neely 2002, Garengo 2005). Kennerly & Neely (2002) defined performance measurement as the

process of quantifying the efficiency and effectiveness of action. While this definition does not involve strategies development and improvement action, which can be carried out by the existing results of performance measurement In terms of strategy and performance measurement, the various frameworks have been introduced by many researchers such as the

1. Balance Score Card (BSC) (Kaplan & Norton, 1996),
2. Strategic Measurement and Reporting Technique (SMART) (Cross & Lynch, 1989),
3. Performance Measurement Questionnaire (PMQ) (Dixon, 1990),
4. Performance Prism (Kennerley & Neely 2002, Dixon et al. 1991),
5. Integrated Performance Measurement System (IPMS) (Bititci, 1997),
6. Integrated Dynamic Performance Measurement System (IDPMS) (Ghalayini, 1997)
7. European Foundation for Quality Management (EFQM) Model (The EFQM Excellence Model 1999, EFQM, 2003).

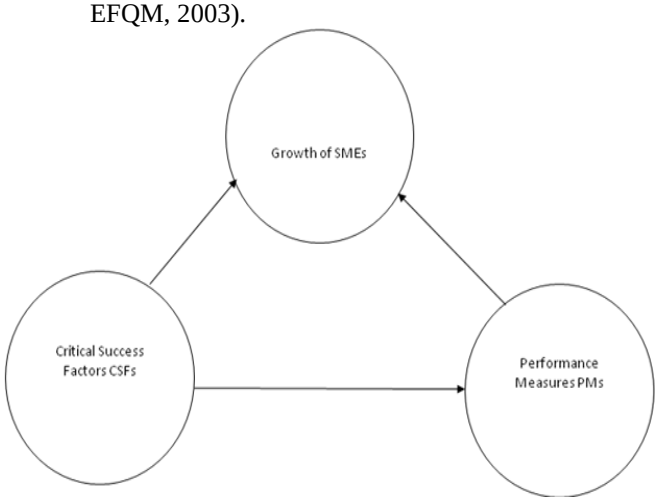

Fig.2 Theoretical Research linkages – A Model

Based on a review of the literature, the research model in the level of variables is shown in Figure 2. The hypotheses of this study are based on Figure 2 as following:

H1: A lean mindset and attitude amongst all levels of employees will result in Reduction of operating costs.

H2: A lean Soft issues & Hard Issues amongst all levels of employees will result in growth of SMEs & performance.

H3: Lean CSFs are positively associated with Performance measures for growth in SMEs.

Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. As there are 7 performance measures and 11 critical factors, multiple linear regression models will be tested for assessing fit

1. $Y_1=\alpha+\beta_0X_1+\beta_1X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+e_1$
2. Y2=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e2
3. Y3=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e3
4. Y4=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e4
5. Y5=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e5
6. Y6=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e6
7. Y7=α+β0X1+β1X2+β3X3+β4X4+β5X5+β6X6+β7X7+β8X8+β9X9+β10X10+β11X11+e7

Where,
Y= Performance Measures or Dependent Variables
X= Critical Success Factors or Independent Variables
α & β = Regression constants, e = error

III. SAMPLE AND DATA COLLECTION

A survey instrument was developed in order to test the research model. The items and questions in the proposed questionnaire were adopted existing studies. The questionnaire was pre-tested with several senior executives from a manufacturing firm to ensure that the wording and format of the questions were appropriate. Data for this study were collected using a self-administered questionnaire that was distributed to 400 manufacturing firms. The sample was selected randomly from the CII. The data collections took six months and were collected from May 2015 to December 2015. The survey was completed by senior officer/Managers/Auditors/Consultants in the firms. Out of the 400 surveys sent out, 248 were returned, yielding a response rate of 38 per cent.

IV. DATA ANALYSIS

To test the research hypotheses, structural equation modeling was performed using AMOS 20 software. Compared with conventional analytical techniques in the literature on lean practices, organizational performance and innovation performance such as correlation analysis, structural equation modeling (SEM) has the following advantages (Anderson and Gerbing, 1988). First, it can estimate relationships among latent constructs indicated by observed variables. Second, it can measure recursive relationship between constructs. Third, it can allow for correlations among measurement errors

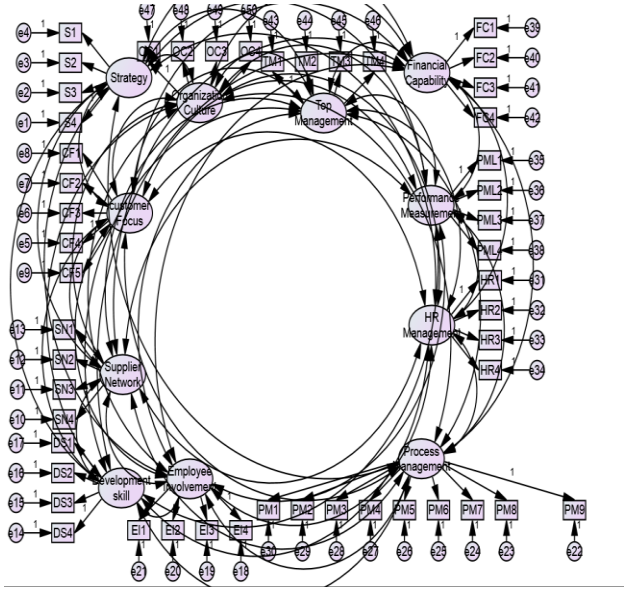

Fig.3 SEM for Critical Success Factors

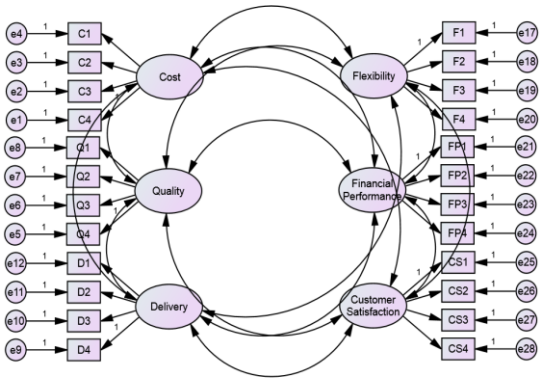

Fig.4 SEM for Performance Measures

SEM used several goodness-of-fit indices, including Chi-Square statistics divided by the degree of freedom (x2 /df) was recommended to be less than 3, Goodness-of –fit (GFI), Adjusted goodness-of –fit (AGFI, Comparative Fit Index (CFI), Tucker-Lewis (TLI) were recommended to be greater than 0.90; and Root Mean Square Error of Approximation (RMSEA) was recommended to be 0.05 up and acceptable up to 0.08

V. RESULTS

Overall, the model had a very good fit with the data (x 2 /df = 1.174 GFI 0.761, AGFI = 0.826, RMSEA = 0.087, TLI = 0.886, CFI = 0.776) and all of the paths were significant at the level of 0.001.

VI. CONCLUSION

This study has provided empirical justification for the proposed research model which investigates the relations between lean practice critical success factors, organizational performance and among manufacturing firms. Previous studies have suggested that lean practices had significant positive effect on organizational performance (Rosemary 2008; Motwani 2003; Krafcik 1988; Rahmai et al. 2010). Extending, this study has empirically examined how lean practices influenced organizational performance for growth of manufacturing firms.

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