International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.4., Issue.2, 2016
(Mar.-April.)

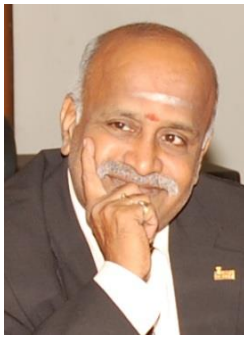
RESEARCH ARTICLE

ISSN: 2321-7758

# INDUSTRY-INSTITUTION INTERACTIONS AND EMPLOYABILITY OF ENGINEERING GRADUATES

**L RAMANAN[1*], Dr. M. KUMAR[2], Dr.K.P.V RAMANAKUMAR[3]**

[1]Member – SJ Centre for Advanced Research & Research Scholar – SCSVMV University
[2]Department of Mechanical Engineering, SCSVMV University, Kanchipuram
[3]Dean, Faculty of Management Studies, SCSVMV University, Kanchipuram
* Corresponding author – raise@LRamanan.com



**L RAMANAN**

**ABSTRACT**

Advancements in technology, enhancements in computing speed, information flow due to internet etc., are some of the factors that make the customers to have an ever increasing expectation from the products, which makes the industry to upgrade technology in their products in every industry segment and at the same time cost competitive for survival. This ever increasing demand of customers and continuous upgrades to the products by the industry has to be reflected and linked to the engineering educational process in enhancing the engineering students' employability on a continual basis. Effective industry-institution interaction plays a vital role in this link and there has to be a strategy in continual improvement. This research work traces the factors that are considered as important in this link, as perceived by the employers for the strong bonding. This research study is a portion relating to industry-institution interactions, from the research work on lower employability of mechanical engineering graduates in India.

**Keywords:** Industry-Institution Interaction, Make in India, Skill Development, Employability, Engineering Graduates, ANOVA, Regression, Six Sigma



## I INTRODUCTION

Industrial growth of India in the last few decades due to least cost of work-force and globalization has attracted many MNCs (Multi-National Companies), thus providing many opportunities in employment across sectors. This opportunity in employment has resulted in phenomenal growth of engineering educational institutions in the last few decades. This trend is continue to grow [1] under the governmental policies like 'Make in India' for industrial growth. However, the demand and supply of skilled work force from engineering institutions is a concern for the employers, as they find employable engineering graduates are ~25% [2 to 4]. Some of the industries have attempted to build this gap by 'tailor making' the skills for their needs through institutional collaborations, which results in skills build for the specific industry need. Ramanan et.al [5] have brought-out the factors that are considered as important in enhancing employability of engineering graduates which was followed by a survey across regions and industrial sectors of India [6], thus covering 540 respondents between 2013 – 2015 through interviews and surveys. This research work

relates to one of the five factors [5] and its attributes related to industry-institution interactions.

Employability skills cannot be attributed to set of skills that can be attributed under one category, there exists an interaction between various factors [7]. Ramanan et. al [5] have brought out five factors that are important in addressing the employability of mechanical engineering graduates in applying theoretical knowledge to practice. They have also brought-out the interactions between various factors through transfer function. They further dealt in detail [6,8 and 9] on the attributes relating to soft skills, analytical skills and quality skills. Focus of this work is to deal with the factor and their attributes that are considered significant in enhancing the applied knowledge through institution-industry interactions, from employers' perspective in impactful employability of mechanical engineering graduates in India.

## II RESEARCH METHODOLOGY

### Samples, Size, Distribution and Approach

Six Sigma quality management approach demonstrated with derived benefits and success by the industry has been leveraged in this research work. Details of respondents like, industry segments and regions of India are as detailed in [6]. Integration of research study with DMAIC approach related to this work was dealt with a schematic model in [9].Results in this work presented are from multi-stage sampling through survey covers 352 respondents from all the four regions of India and various industry segments, thus the views of respondents covers heterogeneous segment and not constrained with a specific industry or region.

### Survey Design and Instrument

Self-Administered research questionnaire covers the attributes taking into account, literatures and the opinions expressed during initial survey [5] as expressed by the employers. Importance of industry-institution interactions and its positive impact on the institutions from the trends as reported in [10 to 13] strengthens the perceived opinions heard from the respondents on the need for strong industry-institution interaction. The survey questionnaire structured into two components 1) rating on the importance and need and 2) ranking based on the skills of applied knowledge from fresh engineering undergraduates due to the impact of industry-interaction as perceived by employer. Both of these components are used in quantifying gap and used in research recommendations. The dependent and Independent variables are as in Table 1 and the simplified questionnaire is as Table 2.

Table 1. Dependent and Independent Variable

| Independent Variable | Dependent Variable |
|---|---|
| Industrial Professionals as Faculty in Institution | Industry-Institution Interactions |
| Sabbaticals of Students and Faculty in Industry | |
| Mini Projects / Industry Visits | |
| Mentoring Practical awareness | |
| Infrastructure | |

| Question Code | Simplified Question from the description of survey questionnaire | Pl. rate the importance of the Need | Pl. rank the status from the skill of fresh graduate |
|---|---|---|---|
| | | Strong Agree - 5<br>Agree - 4<br>Neither agree nor Disagree - 3<br>Disagree - 2<br>Strong Disagree - 1 | Good - 5<br>Above Ave - 4<br>Average - 3<br>Below Ave - 2<br>Bad - 1 |
| III | Industry-Institution Interaction – Influence on practical knowledge (applied | | |

| | | | |
|---|---|---|---|
| | knowledge) | | |
| III-1 | Industry Professionals' engagement as faculty for appropriate theoretical Subjects and labs – Practical knowledge Enhancement | | |
| III-2 | Student & Faculty Sabbaticals in Industry – Application of Theoretical research to Applied Research & Innovation | | |
| III-3 | Mini Industry Projects (Over Industrial Visits) - Applied knowledge focused on functions like design, manufacturing | | |
| III-4 | Mentoring – for awareness of Practical Needs of Industry | | |
| III-5 | Lab Infrastructure based on current Industry need / trends | | |

Table 2 – Simplified Survey Questionnaire for Industry-Institution Interaction and its attributes

As detailed in [2] the questionnaire was color coded to distinguish the scores for rating of importance and ranking of skills availability as perceived. The ratings and rankings are received on Likert scales as shown in Table 2.

**Research Hypothesis**

Following research hypothesis (null-hypothesis) were developed for the research questions related to the industry institution interactions and consequent knowledge on practical applications.

Hiii-a – Industry - Institution interaction and its influence on reducing the practical knowledge gap amongst mechanical graduates is not perceived significantly different across regions, by the employers.

Hiii-b– Industry - Institution interaction and its influence on reducing the practical knowledge gap amongst mechanical graduates is not perceived significantly different by the employers across industry segments.

Hiii-1a–Sabbaticals in industry to reduce practical knowledge gap is not perceived significantly different across regions.

Hiii-1b– Sabbaticals in industry to reduce practical knowledge gap is not perceived significantly different across industry segments

Hiii-1c– Sabbaticals in industry shall not influence practical application knowledge.

Hiii-2a–Mini industry projects will reduce practical knowledge gap is not perceived significantly different across regions.

Hiii-2b–Mini industry projects will reduce practical knowledge gap is not perceived significantly different across industry segments

Hiii-2c– Mini Industry Projects shall not have not significant impact on practical application knowledge.

Hiii-3a–Mini industry projects will reduce practical knowledge gap is not perceived significantly different across regions.

Hiii-3b–Mini industry projects will reduce practical knowledge gap is not perceived significantly different across industry segments

Hiii-3c– Mini Industry Projects shall not have not significant impact on practical application knowledge.

Hiii-4a– Gap in awareness of practical needs of industry is not perceived significantly different across regions.

Hiii-4b–Gap in awareness of practical needs of industry, is not perceived significantly different across industry segments

Hiii-4c– Awareness of practical needs of industry shall not have significant impact on practical application knowledge

Hiii-5a– Gap in lab infrastructure based on industry need / current trend is not perceived significantly different across regions.

Hiii-5b–Gap in lab infrastructure based on industry need / current trend is not perceived significantly different across industry segments

Hiii-5c– Gap in lab infrastructure based on industry need / current trend shall not have significant impact on practical application knowledge

**III RESEARCH FINDINGS**

Data collected from the respondents are used in commuting the gap as an employer perception. Statistical analysis was carried-out using the multipurpose commercial statistical algorithm Minitab version 17 [15].

**Industry-Institution Interaction Importance and Gap**

The perceived opinion and view of the individual respondents on the importance of industry-institution interaction and the current status of engagements resulting in practical application (applied) knowledge gap. Fig. 3 explains the gap with the means of the dependent and independent variables, through interval plot, related to analytical and problem solving skills for this research paper.

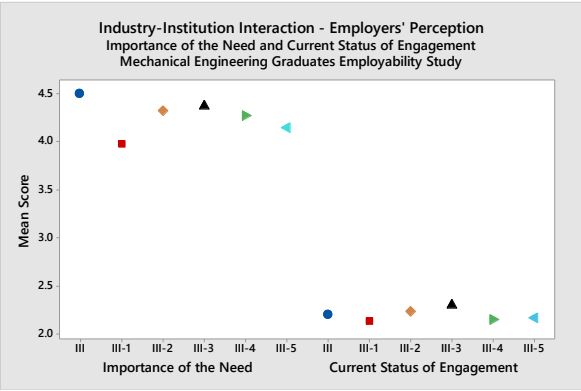



Fig. 3 Employers' Perception on Importance and Current Status of Industry-Institution Interactions and its Attribute – A factor in Employability Skills of Mechanical Engineering Graduates

As could be seen from Fig 3, employers perceive the importance for industry-institution interaction is high (mean score of 4.5) for enhancing the practical application (applied) knowledge, while they perceive the current level of engagements is at a mean of 2.2 on a 5 point rating scale, implying the gap of 46%. To close this large gap, industry professional feel:

1. Importance of engaging the industrial professionals as faculty in teaching theoretical subjects (an example: Quality Management) and engagements in laboratory practical as relevant, scores a mean rating for importance of 4.0, while current status gets a score of 2.1.
2. Importance of student and faculty sabbaticals in the industry for gaining not only the practical knowledge and also in innovation by applying the theoretical knowledge has a mean score of 4.3, which is a win-win situation for both industry and institution. However, from the industries' perception on current level of engagement gets a score of 2.2
3. Industry feels the engagement of students and faculty with industries by doing Mini-Projects in smaller team and more devoted with functions like manufacturing, design, quality analytics etc., instead of industrial visits which they feel is more of a ritual than a value addition, hence they rate this need with an importance of 4.4 on a scale of 5. While they perceive the current level of engagement as 2.2.
4. Awareness on practical needs of Industry by the institutions gets a mean score of 4.3, which the industry professionals feel can be achieved through mentoring during sabbaticals, mini-projects and lectures by industry professionals. The current level of their assessment on practical awareness of industries needs with faculty and students of institutions is 2.3, a score little higher when compared to all other attributes and their status.

5. Lab infrastructure and its upgrades based on the industry needs and current trends gets a mean score of 4.2 for its importance towards enhancing applied knowledge, while perceived current status of institutions gets a score of 2.2. Reduction of gap for this factor is largely to be addressed from the education institutions and their managements. Employers' quote the reference of finishing schools [13] after graduations to build the practical knowledge; they further explain actions of this nature [13] are both taxing on students and also on the parents who fund the education. Employers are of the opinion that it could be part of the educational process with right infrastructure.

The above observations from the mean score prompted to analyze the gap for dependent and independent variables for their mean and spread, as captured in Fig. 4.

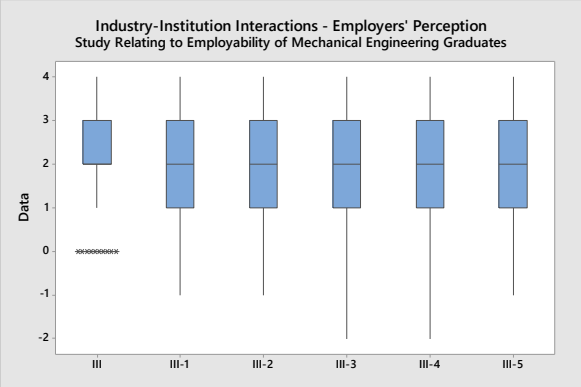



Fig.4 Perception of Employers on Gap in Industry-Institution interaction and Consequent Practical Application Knowledge Gap

As could be visualized from Fig 4., 97% of the respondents felt there exists a gap in the industry-institution interaction (III in Fig 4) that results in practical application knowledge gap, while a very smaller percentage (3%) finds there is no gap. 75% of the respondents above first quartile feel this gap is high and ranges between 40% to 80%, which is indicative of needing attention. Interestingly, all the independent variables also has an opinion from 75% of the respondents that the gap ranges between 20% to 80% which could attract the interests of the stakeholders in educational reforms and the institutions themselves for appropriate action at the respective levels.

**Anova and Regression Analysis**

To confirm the attributes' statistical relevance with respect to regions of India, segments of Industry and its significance in relationship to the factor (independent variables significance with dependent variables) statistical analysis was carried-out with the confidence interval of 95%.

Hypothesis testing was carried-out for the attributes and the factor to statistically quantify whether there is a significant difference by segments of industry and by regions of India one-way ANOVA was used.

Linear regression analysis is carried out to establish the relationship of the independent attributes (variables) to the dependent variable. Regression was also useful in testing the hypothesis as stated earlier in testing the relationship with dependent variable to quantify the importance of individual attribute statistically. The details of the hypothesized codes of questions with relevant statistical tools applied and the p values are tabulated in Table 3

| Hypothesis | Statistical Tool | p Value | Details |
|---|---|---|---|
| Hiii-a | One Way Anova | 0.439 | Regions of India |
| Hiii-1a | | 0.887 | |
| Hiii-2a | | 0.206 | |
| Hiii-3a | | 0.076 | |
| Hiii-4a | | 0.187 | |
| Hiii-5a | | 0.382 | |
| Hiii-b | | 0.167 | Industry Segments |
| Hiii-1b | | 0.618 | |
| Hiii-2b | | 0.248 | |
| Hiii-3b | | 0.808 | |
| Hiii-4b | | 0.428 | |
| Hiii-5b | | 0.539 | |
| Hiii-1c | Linear Regression | 0.067 | Relation of Independent variables with dependent variable |
| Hiii-2c | | 0.000 | |
| Hiii-3c | | 0.002 | |
| Hiii-4c | | 0.783 | |
| Hiii-5c | | 0.000 | |

Table 3.Hypothesis Testing and P Value

As perceived by the employers and as found from the statistical analysis and hypothesis testing, the gap in industry-institution interaction is across regions of India and industry segments. With 95% confidence the null-hypothesis Hiii-a and Hiii-b for the regions and industry segments are accepted (respective P values for Hiii-a and Hiii-b are greater than 0.05). Similarly the attributes or independent variables related to industry-institution interaction and their gap from the perception of the employers on importance to the current status is not significantly different from the industry segments and also from the regions of India. (Null Hypothesis of Hiii-1a to Hiii-5a and Hiii-2b to Hiii-5b are accepted as respective p values are greater than 0.05 for the confidence interval of 95% as presented in Table 3). Fig. 5, captures the gap from the respondents perception and the range for the confidence interval of 95%.

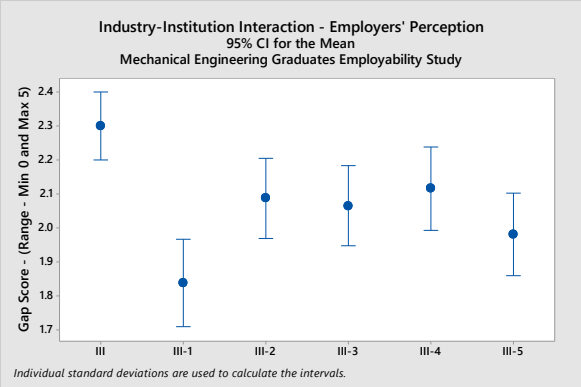



Fig. 5 Knowledge Gap in Risk Prediction Approaches

The relationship between independent variables with dependent variables has been established through linear regression. It is observed from the regression R-Sq value of 48.87% and R-Sq(adj) of 48.13% and R-Sq (pred) 46.94% for the fit and the graphical plot of residual fits are as captured in Fig. 6, which explains the decent fit for residuals. The percentage of fit ~50% explains there are other factors which are not explained by this regression, is meaningful as all the factors are not considered in the analysis, since the focus of research is restricted to implementable solution from institional level.

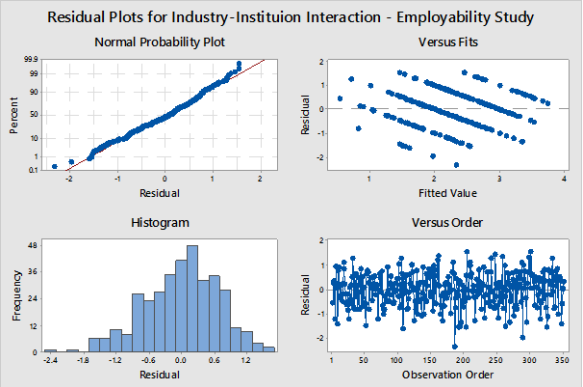



Fig. 6. Residual Plots

The corresponding transfer function from the regression is as follows:

III = 0.8228 + 0.0755*III-1 + 0.3113*III-2 + 0.1558*III-3 - 0.0126*III-4 + 0.1991*III-5

From the observed P values (<0.05 for the confidence inetrval of 95% - Hiii-2, Hiii-3 and Hiii-5 null-hypotheses are rejected) of the regression as tabulated in Table 3., independent variables (attributes) Hiii-2, Hiii-3, Hiii-5 are found to be statistically significant in their relationship with the dependent variable (indudustry-institution interactions). Practical awareness of the industry need can not be achieved by mentoring (Hiii-4), it could be achieved from sabaticals and mini-projects (Hiii-2 and Hiii-3) during which mentoring for practical awareness for industry needs can be achieved. Hence from the practical stand point and also from the statistical significance (P>0.05, null-hypothesis of Hiii-4 is accepted) the term Hiii-4 from the transfer function is dropped. However, it has been found to be useful to retain Hiii-1 (though P value is > 0.05 in Table. 3) as it would bring industry interaction aspects with the institutions more and it has been found industry-institution interaction is practically significant and beneficial [10, 11 & 12]. Further the importance of industrial experience in accounting for career advancement schemes(CAS) of faculty and recruitment process by all India council of technical education (AICTE) as detailed in point 14 of [14], strengthens the researchers' view of considering Hiii-1 in transfer function.

## IV. APPROACH TO SOLUTION IN REDUCING GAP

### Predictive Modeling– A Two Step Approach

In step 1, developed transfer function (with-out the Hiii-4 term) from the regression is used to predict the present status of gap and its spread with a larger sample size of 50,000 respondents, by using mean and standard deviation from the survey for the independent variables (attributes) through predictive simulation using Monte-Carlo approach in Devize [16]. Considering the low level of industry-institution interaction (10, 11 and 12) and for a gap of 40%, the current status of industry-institution interaction as perceived by the employer is captured in Fig.7, which is indicative of 77% fall outside the considered gap of 40%. The range as found the predictive simulation is 0.5 to 4 for the gap, with a mean of 2.3344 and a standard deviation of 0.465.

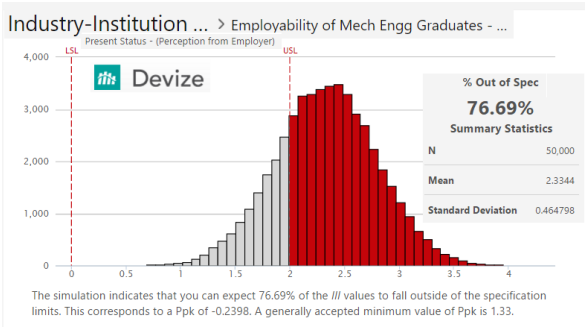



Fig.7. Predictive Model of Current Status of Gap in industry-institution interaction

Second step of the research recommendations focusses on solution development. It largely focuses on shifting the output (dependent variable) mean to zero and also reducing the variation in the gap predicted by controlling the variations in the independent variables (attributes), by focusing on the strengths and weakness of the attributes relevant to the individual institutions. Considering the difficulty in engaging the practicing industry professionals as faculty (III-1) for teaching subjects of relevance, the predictive simulation has been performed by retaining the current status for the independent variable. The other independent variables (III-2, III-3 and III-5) which are related to sabbaticals, mini-projects and lab infrastructure development can be driven as an institutional initiative to reduce the variation in the input. Optimized simulation through predictive approach brings-out the current status can be brought down to 3% from 77% (Fig. 8.)

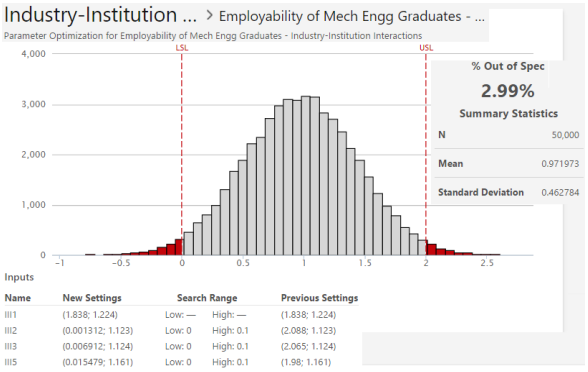



Fig. 8 Predictive Simulation - Reducing Input Variation

As brought-out in [6, 7, and 9], through QFD it has been studied to identify most significant factors from trivial many, that shall have a large influence on all the factors (dependent variables) that are related to the employability of mechanical engineering graduates relevant to this study. However, one interesting thing more specific to industry-institution interaction that has come-out from QFD is on reduction of administrative work load of faculty in the institutions, in order to earn their time from administrative works and to spend in sabbaticals, mini-projects instead of industrial visits etc., and is captured in Fig. 8.

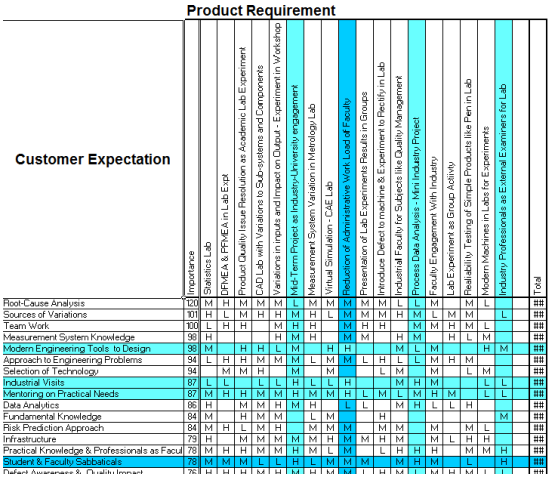



Fig. 8 Factors Relevant to Industry-Institution Interaction (Partial portion QFD from the research).

A separate study through exploratory survey has been conducted to understand the relevance to this point and shall appear in separate research report.

The authors with their expertise from this research and also on process and product quality excellence with the leaders of the industry as subject matter expert (SME), can support educational institutions striving for achieving quality excellence, with tailor making solutions to suit individual institutions

**V RESULTS AND CONCLUSSIONS**

The following conclusions can be arrived from this research work.

- Gap in industry-institution interaction towards enhancing applied knowledge is across regions of India and industry segments.
- Out of the eight recommended solutions covering all the five factors [5] of the research study on employability through QFD, including the factor on industry-institution interactions will have a significant impact on applied knowledge.
- Mini-Projects with the industry around the institutions with specific functions like manufacturing, design, quality etc. is found to be impactful on employability than industrial visits as perceived by the employers.
- Student-Faculty sabbaticals in industry shall enhance applied knowledge to the academia, while the benefits of the industry will be through innovations by applying theoretical knowledge to practice.
- For engagement of the faculty in sabbaticals, mini-projects, modern technology tools etc., it is expected that the faculty have to be relieved of administrative duties to earn time or to avoid overloads.
- A detailed research on difficulties of faculty and their current over-load aspects have to be researched through a separate study for effective industry-institution interactions.

**IX REFERENCES**

[1]. India's Macro-Economic Outlook 2020, www. dnb.co.in

[2]. L. Ramanan, K.P.V. Ramanakumar, "Gap in Learning vs Application of by Students and its Impact on Quality Employability of Engineering Students – Case Study in Quality Dimension", Proceedings of the National Conference on Quality Enrichment – A Pinnacle for Higher Educational Institutions. ISBN: 978-93-8570-51-6, pp 1-4, 2015

[3]. L Ramanan, M. Kumar, K.P.V. Ramanakumar, "Knowledge Gap and Its Impact on Product and Process Quality", Journal of Applied Mechanics and Materials, Vols 813-814, pp 1176-1182, 2015

[4]. L. Ramanan, M. Kumar, K.P.V. Ramanakumar, "Six Sigma Methodology for Addressing the Employability of Engineering Graduates", International Journal of Modern Education Forum (IJMEF), Vol 3, Issue 2, pp. 59-64, 2014.

[5]. L. Ramanan, M. Kumar, K.P.V. Ramanakumar, "Significant Factors as Low Hanging Fruits in Addressing Employability Defect of Mechanical Engineering Graduates", International Journal of Science and Research, Vol.4, Issue 10, pp1382-1389, 2015

[6]. L. Ramanan, M. Kumar, K.P.V. Ramanakumar, "Approach Towards Reducing Soft Skill Gap of Engineering Graduates in India from Employers' Perspective of Employability", International Journal of Engineering Research-Online, Vol.6, Issue 3, pp 504-512, 2015

[7]. "Common Employability Skills – A Foundation for Successful Work Place – The Skills all Employees Need, No Matter Where they Work" , Publication from National Network of Business and Industry Associations

[8]. L. Ramanan, M. Kumar, K.P.V. Ramanakumar, "Analytical and Problem Solving Skills for Employability of Engineering Graduates in India – An Employers' Perspective", International Journal of Engineering Research – Online, Vol 4, Issue 1, pp 92-101, 2016

[9]. L. Ramanan, M. Kumar, K.P.V. Ramanakumar, "Quality Skills as an Applied Knowledge Need in Employability of Engineering Graduates in India – Employers' Perspective", International Journal of Engineering Research – Online, Vol 4, Issue 1, pp 237-245, 2016

[10]. "Survey of Industry-Linked Engineering Institutes", AICTE-CII Survey Report, 2012
[11]. "Survey of Industry-Linked Engineering Institutes", AICTE-CII Survey Report, 2013
[12]. "Survey of Industry-Linked Engineering Institutes", AICTE-CII Survey Report, 2014
[13]. Finishing School from Professional Associations like IMTMA
[14]. Notification by AICTE, "Clarifications on certain issues/ anomalies pertaining to qualifications, pay scales, service conditions, career advancement schemes etc. for teachers and other academic staff of technical Institutions" The Gazette of India, Extraordinary, Part-III, Section-IV, No. 7, 6th January 2016,
[15]. www.Minitab.com
[16]. www.Minitab.com/en-us/products/Devize

**Authors Profile**

**Ramanan**, is an entrepreneur of RAISE Consultancy Services, Bengaluru, is an alumnus of IIT Madras, studded with patents, publications in his 35+ years of experience with multi domain, product & cross functional expertise from global poles with Leaders like GE, TVS, Indian Railways etc.,. He earned many prestigious awards & titles like 'Pillars of Pride' from GE India and a six sigma quality champion. He has been a Jury for the National Six Sigma award conducted by CII -Institute of Quality, India and serves many Industries as a Subject matter expert in Quality, Robust Design and Technology domains.

**Dr. Kumar** is an accomplished Technologist with passion for Six Sigma, earned his PhD from University of Sheffield, UK and Masters from IISc, Bengaluru. Kumar is a Prolific Inventor with patents and publications and passionate about experimental mechanics and application of Six Sigma approach. Kumar is a Subject matter expert in FRP Structures, mechanics and nano technology. He is an SME on experimental modeling to many Industries

**Dr. Ramanakumar**, is curren Professor and Dean of Manageme Studies in SCSVMV University Kanchipuram, India and one of the most respected management expert. He is passionate on applied research that benefits the society at large, Industry and academia in particular with impact on human lives, apart from research and teaching interest in International Business Environment, Principles of Management, Indian Ethos for Effective HR, Logistics and Supply Chain Management, Merchant Banking and Marketing Management, with 100+ publications in Journals and Conferences to his credit. He is regular writer on leading national dailies of India on the topics of national importance.