International Journal of Advance Research in Science and Engineering
Volume No.06, Special Issue No.(04), December 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354

REVIEW OF LITERATURE ON SHAININ METHODOLOGY

Priyesh Sanghvi[1], Naitik Devgania[2], Girish Deshpande[3], Nitin M Pathak[4]

[1,2]Student, Mechanical Engineering, SBM Polytechnic (India)

[3,4]Lecturer, Mechanical Engineering, SBM Polytechnic, (India)

ABSTRACT

Today's manufacturing industries are facing a biggest challenges of customer satisfaction in terms of cost reduction, zero customer complaint, and quick service after sales, to achieve this continuous improvement in manufacturing process and quality of the product is required. To overcome such types of problems, different techniques are used such as Taguchi Methodology, Shainin DOE (Design of Experiments) approach, Six Sigma.In manufacturing process, and defects need to be diagnosed correctly for appropriate remedial measures; otherwise new defect may get introduced.

The purpose of this article is to provide an overview of Shainin System (SS), *a critical assessment, and a brief comparison with other industrial problem solving systems. Some SS tools are examined. In our assessment, the Shainin System is valuable for many types of problems. SS tools are very useful to reduce list of suspect variables Shainin tools are powerful tools in early stage of problem solving to identify suspect variables. The Shainin method is gaining popularity now because of the simple tools, which can give substantial good results at low cost and time. However, it is difficult to optimize the process by using SS.*

Keywords: Shainin Methodology, Shainin Tool, GreenY, RedX and Multi-Vari chart

I. INTRODUCTION

Ninety percent of people in industries do not know how to solve chronic quality problems. Simple problems can be solved with the help of seven QC tools, engineering judgment, brain storming, statistical process control etc. But for chronic problems, difficult to solve in defined period they may take days, weeks, months, or even years to solve. Chronic problems cannot be solved with these traditional techniques. Specifically in small scale industries. They utilize workers but not their experience. Most of the times specifications on the drawings are not clear, tolerances are wrong, product and process optimization is unknown. To overcome such type of problems design of Experiments is required.

More and more focus on the quality of the product in the current scenario is leading to the high competition. According to Juran the assurance of quality in any industry is governed by three groups of activities; 1. Quality Planning 2. Quality Control 3. Quality Improvement

The various models and tools used for quality improvement are Deming cycle, FMEA, fault tree analysis, Quality function deployment, Six sigma, Design of experiments etc. The activities of quality improvement always focus on reducing the process variation and thus making the process stable and capable. This reduction

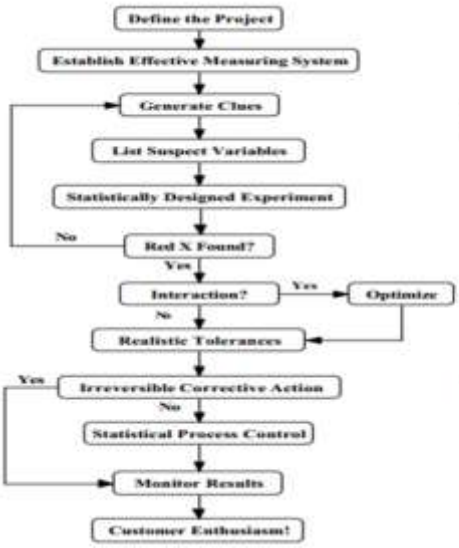
in process variation can be achieved by identifying the root cause with the help of problem solving methodology. Process variation can be reduced in two ways; 1. To identify and control the root cause 2. To decrease the sensitivity of the process to the source of variation.

II. SHAININ DOE APPROACH

Shainin is the world's foremost quality problem solver. Shainin received The Malcolm Baldrige National Quality Award. Shainin DOE basic principle works on concept of target and eliminate suspected sources of variations (SSV) by applying 80/20 rule and logical path.

To achieve the required performance of the part, it is necessary to manufacture parts within specified limits. The tools are required to find out the suspect variable causes for processes variation. Shainin says ''The Parts Are Smarter Than the Engineers!'' Shainin Variables search methodology (VSM) is useful, when an experimenter is interested to study four or more variables in a process or system. Shainin refers to the most important variables as the "Red X" the second most important variables as the "Pink X" and then "Pale Pink X", and so on. Dorian Shainin has developed graphical tools, which require few samples to analyze the root cause of a problem. It is based on principle of Pareto analysis.

The figure 2.2 shows the terms used for causes in Shainin System. The figure 2.1 shows the Shainin system for Quality Improvement. In Shainin first define the project (problem Green Y), generate clues to get suspect variables list using brainstorming, fishbone diagram, past experience etc. Multi-Vari chart, Product search, these Shainin tools can be used to find Red X. Find out in which category Red X belongs such as process, product, handling stage, during transport, design etc. Depending on the clues select the proper tool to find out the solution. Shainin Methodology is divided in two parts first is Diagnostic journey and second Remedial journey. Under diagnostic journey four clue generation tools which are called as primary clue-generation tools, the Multi-Vari Chart, Components Search, Paired Comparisons, and Product / Process Search. They provide clues by talking to the parts that are far more effective than engineering guesses, theories, opinions, and biases, all the basis of the classical and Taguchi methods without interrupting production. Require few samples from the ongoing production. They reduce list of suspected variables from large numbers to smaller number families.The diagnostic journey ends as the target Red X is identified. The second part remedial action to reduce effects of variables and to optimize the problem, continuously monitors theresult for minimum product/process variation to improve quality output. [1] [19]



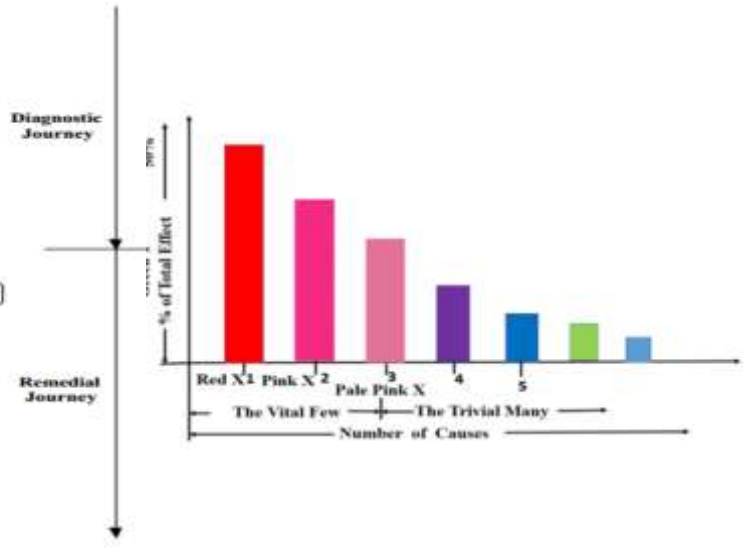


Fig.2.1: The Shainin System for Quality Improvement [14]Fig.2.2: Terms Used for Causes in Shainin system [14]

III. LITERATURE REVIEW

Stefan H. Steiner [1] (2008) Over viewed the shainin system. Shainin tools such as Multi-Vari Chart, Isoplot, Group comparison, Component search, Precontrol, B vs C (Better vs Current) with other industrial problem solving systems. The guiding principles of the Shainin System are powerful. They include the application of Pareto principle to find out the contribution of the causes. They are using observational investigations in the diagnostic journey. To identify dominant cause they use process of elimination. Shainin tools, by conducting a small verification experiment possible suspect causes can be identified. The principles and tools to the diagnostic journey are generally very strong. Those related to the remedial journey are much weaker. The Shainin System, is best suited for medium to high volume production.

Andrew Thomas [2] (2008) Illustrates how Shainin Variable Search Method has been used in identifying the influencing variables that control the joint strength of honeycomb composite tongue and slot joints within an aerospace company. Aerospace structure are of composite panels. To assemble these panels, slot joints are used. Shainin's variables search tool is used to solve the problem. The Shainin DOE technique permits the luxury of considering as many variables as can be identified. The subsequent grouping of these variables into "families" and identifying the most influential variables based on statistical significance as opposed to assumptions. Shainin tools are useful for implementation of Six Sigma in manufacturing industry**.**

Martín Tanco [3] (2008) compared three different approaches to DoE (Taguchi approach, Classical approach OFAT (one factor at a time) and Shainin technique) have been presented. There are few articles are available on Shainin tools which gives useful information. OFAT (one factor at a time) strategies, are successful. However, this does not prove that they are the only techniques useful in improving quality. Shainin technique can be used during in process production. Shainin technique is having certain limitations compared to other two methods. Classical and Taguchi approaches are powerful methods, more statistically valid and more robust. Shainin methods are more suitable for medium to high volume processes. Taguchi Methods is not recommended when numbers of variables are more than four. In those cases, Shainin can be used to carrying out several on-line

experiments in a diagnostic stage to analyze and characterize the problem before actual experimentation must be considered. Once the filtration is done then apply Taguchi Quality Loss function and Crossed arrays methodology.

Nagaraja Reddy [4] (2014) successfully implemented 'Shainin tools' for the root cause identification and Design of Experiments (DOE) techniques for analysis of the quality related issues in Bosch Production System (BPS) - one of the leading manufacturers in Diesel system equipment's. Cam shaft key way tight problem was resolved by using Shainin component search tool. By changing milling cutter size for key way milling operation size 3mm and 4 mm keyway has resulted in 0% rejection of camshafts due to keyway tight.

R. B. Heddure [5] (2014) used Shainin tools for elimination process. To find out root cause of slag and porosity rejection in CI foundry, Shainin BOB (Best-of-the-Best) and WOW (Worst-of-the-Worst) tool was used. Carbon Equivalent Percentage (CE) & Carbon value was the reason for the slag and porosity problem. By keeping Carbon Equivalent 3.98 to 4.10 & % Carbon value 3.38 to 3.52 rejection of casting due to slag and porosity was reduced and achieved 95% confidence level.

J.P. Calderón Urbina [6](2013) applied Shainin Variable search tool was used for identification of the most significant variables based on parameter comparison and the Pareto principle. Ultra-short pulse laser processing of hard materials, such as cemented tungsten carbide, requires adequate information and setting parameters to maximize ablation rate. This method helped to find laser power as well as pulse and track overlap as the most influential variables on the process.

Nagarjun.S [7] (2014) Used Shainin tools to identify root cause of quality problem of pumping element. Pumping element is an important component of a diesel fuel injection system. Experiment was carried out in Bosch Ltd Adugodi, Bangalore. Pareto analysis was used to identify defects with highest percentage rejections. The important defects that occur during the production of pumping elements are barrel bore taper more, honing line in barrel, element sticky, barrel with wrong taper, ungrounded shoulder of bar. Root cause analysis is done using Shainin Technique Isoplot Multi-Vari Chart. The overall defects in the production of pumping element were brought down by 36%.

Raveen John [8] (2015)conducted experiments to find out the root cause of quality problem of spur gear, while gear manufacturing many defects takes place in the areas of hobbing, Shaving, Heat Treatment processes, etc. Trials where conducted to get the solution for the said problems. During manufacturing of spur gear manufacturing unit was facing a problem of Sine pattern occurrences on gear involutes during shaving operation and required to be controlled as per K sheet specification. By using Shainin Root Cause Analysis techniques, sine pattern problem occurring on work gear during shaving process was corrected. Shainin Tree Diagram helped in finding the root cause for the occurrence of sine pattern problem. The need for shaving cutter modifications was focused. Sine pattern was not observed on gear involutes after changing shaving cutter.

Johan Goodman [9] (2001) integratedShainin Methodology and ANOVA to optimize the honing operation. Shainin Multi-Vari Charttool was used to reduce number of suspected variables for the honing operation. Root cause was hone head, hone stones, stone pressure or cylinder fixture. For further analysis full factorial ANOVA is used. Some Shainin technique advantages are concluded from his experience such as Shanin method is easy

for implementation and easy to set up. Very little calculations/math required. Targets can be achieved within a short period of time.

Sahib Datar Singh [10] (2014) conducted experiments to solve the problem of Face Run out oversize after heat treatment. The average Rejection in last Six month is between 6-9%. Identification of sources of variation and control of that variation is an important factor for the improvement of quality.To identify the sources of variation DMAIC (Define, Measure, Analyse, and Improve & Control) method was used. In define phase, Pareto chart and Process flow charts were used to identify the problem. In measure and analyse phase, Shainin tools Component search and Multi-Vari chart and B vs C were used and in control phase control charts were used. The worn out pins in the lower Broach holder was the main root cause. Confidence level of 95% after replacement of broach holder was achieved. Shainin technique was very helpful for defining a problem.

Anand K. Bewoor [11](2010) used Shainin tools to solve quality problem of welding defect in Welding unit at Pune. Welding unit was facing a problem of parts named Assy-sub structure with floor (613 LP RUSSIA) (XXX 6100 0182), which fits into assembly frame of light commercial vehicle after welding on (M/C ST-CO2-17) welding machine, was under rejection because of defective welding (un uniform welding, weld penetration, dry welding, weld under cut and spatter etc.), which resulted in to annual Cost of Poor Quality (COPQ) about Rs 2Lakh/-.in Process stages. Shainin BOB and WOW tool was used to resolve the problem. Shainin tools, small samples of BOB and WOW pieces are sufficient to analyze the data. They are easy to understand, requires simple mathematical calculations, shop floor people can also understand it very easily and time required for training is also less, software's are not require to analyses the results.

Marcus Heincke [12] (2006)optimized the rear axle manufacturing process by using integration of Shainin tools, Taguchi Method and ANOVA. General Motors two vehicle models (GMT 800 and GMT 900) rear axles are found leak during manufacturing, assembly and at customer end. The company is having a four sigma still they were facing a problem to overcome this they formulated this problem as Six Sigma Vs Design for Six Sigma. To resolve these problem different tools were used. To identify the root cause Shainin BOB and WOW, Component search tools were used and further analysis ANOV, Taguchi method were used to optimize the problem. The root cause of problem was vent cap. The vent cap fails to sustain the amount of pressure that is built in differential during the manufacturing processes. Final conclusion was to remove the cap for 5 seconds has added in process. After corrective action almost 50% cost saved i.e. $ 29000.

David M Plum [13] (2015) concluded the importance of Multi-Vary –Chart for identification influencing variable. Multi-Vari charts are different than multivariate control charts. Multi-Vari Chart is a graphical tool, which is more useful in early phase of identification of influencing variables. It reduces the number of suspected variables. The result of Multi- Vari Chart provides information such as Piece-to-piece variability, Time-to-time variability**.**

Bhote [14](2000) overviewed Shainin Methodology, Shainin methodologies are trade secrets or proprietary rights, there has been little peer review work of Dorian Shainin methods nor been exposed at large to professionals. Shainin Methdology is implemented in Motorola Quality Improvement. After implementing Shainin DOE defect reduction achieved up to 90% within a short period of time (in weeks).

Basic Principles followed in Motorola case study from Shainin approach:

Pareto's Law (80/20 Rule), operation wise study such as operation generating defects occasionally, operation fundamentally sound, Identify changing effects and its causes, identify what has changed and control it, compare performance of process to get consistency in process. Identify why things go right is to observe and what is different when things go wrong. Identify all critical parameters, find out their Realistic Target Values and Tolerances to get Zero Defect output

Maruti Talawar [15] (2016) conducted experiments to optimize the of fuel delivery in automobile engine at different speeds.It was observed that the required fuel delivery in automobile engine is not optimized at the different speeds and the fuel delivery variation was more at the constant speed. After experimentation it was observed that major fuel delivery variation at 1800 RPM. It was observed as major variation is at higher speed. The root cause is analysed by using Shainin Technique (BOB and WOW) and Design of Experiments (DOE) and optimized at 800 rpm.

Abhaysinh K. Desai [16] (2014) conduced the experiments to optimize the tappet setting process. Optimization is one of the critical tasks at assembly line of engine manufacturing industry, Six Sigma with coordination of Shainin methodology is highly adopted because of lesser data collection to achieve the target. To solve the problem DMAIC (Define, Measure, Analyze, Improve and Control) has been used to reduce the number of water cooled engine rejection at hot testing. To reduce rejection optimization of tappet setting is required. This is achieved by using Shainin Methodology, Product Process Search. New limits for tappet setting were derived.

Steven Cox [17] (2015) introduced a new method, known as the Process Variation Diagnosis Tool (PROVADT), is introduced to demonstrate how tools from other quality disciplines can be used within the Six Sigma framework to strengthen the overall approach by means of improved objectivity and efficient selection of samples compare to current Six Sigma practices DMAIC process improvement cycle.

Using PROVADT and sample sizes of 20 units it was possible in all cases to validate the measurement system and gain an early objective insight into potential root causes of variation, leading to significant cost savings for both companies.Problem of Edge bending process was solved by using Shainin Multi Vari and Isoplot tools. The Shainin Multi-Vari (SMV) study demonstrates that the with-in piece variation is the Red X. This is consistent with the Isoplot which demonstrates that there is a large amount of measurement variation.

Bhaskara [18] (2014) using Shainin Methodology in Diesel systems plant, Bosch Ltd., Bengaluru, the governor cover main spring length variation has been found as the RedX causing control rod friction problem. Design optimization in spring length is needed to set right the GreenY and reduce the rejection rate of FIP at idling condition check point during calibration. To identify root cause Shainin BOB and WOW technique is used. It is suggested in the new design that, either GC spring length tolerance has to be reduced to 0.5mm that is 51.5±0.5mm to 51±0.5mm, which can possibly reduce the problem occurrence and rejection rate. Shainin has found to be simple and efficient statistical tool which can give clue about the most unsuspected design variation also.

Jan Kosina [19](2015) briefly overviewed Six Sigma, Shainin RedX methodology to propose the modification of Six Sigma methodology in order to achieve the improved efficiency of DMAIC in the diagnostic journey using some of the approaches of Shainin RedX methodology.

The analysis of the Six Sigma diagnostic journey leads to the conclusion that Six Sigma lost its task domain character and the diagnostic process does not provide efficient support to a problem solver in terms of

eliminating the root-cause candidates. The proposal to use alternative methodology – Shainin RedX methodology. Comparing both methods the Shainin System is a task domain method based on a convergent approach to investigation (from output to input). The lack of task domain character as well as weakness in the diagnostic processes can be covered by the implementation of the Shainin key elements within a Six Sigma DMAIC framework.

A.K.Verma [20] (2004)overviewed **t**hree case studies to show that how screening test of Shainin method can be applied on the Taguchi's orthogonal array to assess the adequacy of the experiment. It is observed that case 1 and case 2 show D/d ratio less than 1.25 and therefore it can be concluded that the experimentation result be successful in identifying the influence of variations in parameters. In fact, it goes to assert adequacy of tolerance levels (i.e. the tolerance variations are not influencing the quality). However analysis of these two case studies do emphasis that the additional experiments conducted were not really required and could have been eliminated using Shainin variable search method at screening stage only. While case 3 shows higher ratio of D/d and hence it can be concluded that the experimentation might give significant result. Thus the Shainin variable search method can be effectively used to find and fix the few important factor as well as its levels by conducting minimum number of experiments in the screening test.

IV. CONCLUSION

Shanin tools can be used to any type of industry. It is a part of implementation of Six Sigma. It is very useful tool for small scale manufacturing units to improve quality of product.

Shainin tools are powerful tools in early stage of problem solving to identify suspect variables. It allows conducting experiments without any specific arrangement, which saves cost and time. No need of special software's. Multi-Vari Chart is powerful tool to reduce number of suspect variables. It is very useful tool for small scale manufacturing units to reduce in House rejection. Training period is very short in days or weeks. Shop floor persons can also understand these tools. Cost of experiments is less.Optimization of process is very difficult to understand.

REFERENCES

[1] Stefan H. Steiner, R. Jock MacKay and John S. Ramberg "An Overview of the Shainin System For Quality Improvement" Quality Engineering, 20:6–19, 2008 Taylor & Francis Group, LLC. ISSN: 0898-112, DOI: 10.1080/08982110701648125.

[2] Andrew Thomas and Jiju Antony "Applying Shainin's variables search methodology in aerospace applications" Assembly Automation Volume 24. Number 2/2004 pp 184 –191*q* Emerald Group Publishing LimitedISSN 0144-5154 DOI 10.1108/ 01445150410529973.

[3] Martín Tanco, Elisabeth Viles, Lourdes Pozueta "Are All Designs of Experiments Approaches Suitable for Your Company?" Proceedings of the World Congress on Engineering 2008 Vol II WCE 2008, July 2 - 4, 2008, London, U.K. ISBN:978-988 17012- 3-7 WCE 2008.

[4] Nagaraja Reddy K M, Dr. Y S Varadarajan, Raghuveer Prasad "Quality Improvement during Camshaft Keyway Tightening Using Shainin Approach" International Journal of Scientific and Research Publications, Volume 4, Issue 7, July 2014 1 ISSN 2250-3153.

[5] R. B. Heddure, M. T. Telesang "Casting defect reduction using Shainin Tool in CI foundry – Case study" Proceedings of 8th IRF International Conference, 04th May-2014, Pune, India, ISBN: 978-93-84209-12-4.

[6] J.P. Calderón Urbina, C. Daniel, C. Emmelmann "Experimental and analytical investigation of cemented tungsten carbide" Sciverse Science Direct Physics Procedia 41 (2013) 752 – 758Lasers in Manufacturing Conference 2013ultra-short pulse laser Ablation.

[7] Nagarjun.S, Dr.H.N.Divakar, Raghuveer Prasad "Quality Improvement of Pumping Element used in Diesel Fuel Injection Pump" International Journal of Scientific and Research Publications, Volume 4, Issue 7, July 2014 1 ISSN 2250-3153.

[8] Raveen John, Dr. Y. S. Varadarajan, Paul Pereira To Arrive At Solution for Sine Pattern Problem Occurring on Gear Involute during Shaving Operation of Gear Manufacturing Process Using Root Cause Analysis International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 9, September 2015 ISSN(Online) :2319-8753 ISSN (Print) : 2347-6710.

[9] John Goodman and David C Wyld "The Hunt for the Red X: A case study in the use of Shainin Design of Experiments (DoE) in an industrial Honing operation" Management Research News; 2001; 24, 8/9; ProQuest Central volume 24 Number 8/92001.

[10] Sahib Datar Singh, Dr. Rajendra M. Belokar, Mr. Achitanand Dubey "Identification of Sources of Variation in an Automobile Parts Manufacturing Unit by Applying DMAIC Methodology" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Vol. 3 Issue 7, July – 2014.

[11] Anand K. Bewoor, Maruti S. Pawar "Use of Shainin Tools for simplifying Six Sigma implementation in QMS/ISO Certified environment– An Indian SME Case Study. Journal of Engineering Research and Studies E-ISSN 0976-7916 JERS/Vol.I/ Issue II/Oct.- Dec.,2010/ 177-194.

[12] Marcus Heincke "Leaking Rear Axles a Design for Six Sigma Project at General Motors" Lulela University of Technology 2006.239 CIV.ISSN1402- 1617. ISRN. LTU- Ex---06/239--- SE.

[13] David M Plum, Heather Foyt, Joel Jacobson Discovering the "Real' Data in Multi-Vari Analysis Charting" International Journal of Applied Science and Technology Vol. 5, No. 1; February 2015 ISSN 2221-0997 (Print), 2221-1004 (Online) © Center for Promoting Ideas, USA.

[14] Keki R.Bhote and Adi K. Bhote "World Class Quality Using Design of Experiments to Make It Happen."Second edition American Management Association 1925.

[15] Maruti Talawar, Subbaiah.K.M and Prasad Raghuveer "Optimization of Fuel Delivery Variation in PF Conventional Pump" Research and Reviews International Journals ISSN ONLINE (2319-8753) PRINT(2347-6710)2/7/2016.

[16] Abhaysinh K. Desai, L. M. Jugulkar "Process Optimization by using Shainin Six Sigma tools and techniques – A case study in manufacturing industry" International Journal of Mechanical and Production Engineering, ISSN: 2320-2092, Volume- 2, Issue- 4, April-2014.

[17] Mr. Steven Cox, Mr. John A. Garside, and Dr. Apostolos Kotsialos "Concise Process Improvement - a Process Variation Diagnosis Tool" Paper No:– 37th MATADOR Conference Available from: Apostolos Kotsialos Retrieved on: 13 November 2015.

[18] Bhaskara , Raghuveer Prasad, K M Subbaiah and G L Shekar "Root cause analysis of control rod friction problem in DFIP using Shainin approach"International journal of Mechanical engineering and Technology (IJMET)ISSN 0976 – 6340 (Print) ISSN 0976 – 6359 (Online) Volume 5, Issue 9, September (2014), pp. 200-205.

[19] Jan Kosina "Shainin Methodology: An Alternative or an Effective Complement to Six Sigma?" Quality innovation prosperity/ Kvalita inovacia prosperita 19/2 – 2015 DOI: 10.12776/QIP.V19I2.580Received 6 June 2015, Accepted 17 October 2015, Published 31 December 2015.

[20] A.K. Verma,A. Srividya A.V. Mannika, V.A. Pankhawala and K.J. Rathanraj "Shainin edge over other DOE techniques" International Engineering Management Conference 2004 0-7803-8519-5/04/$20.00 2004 IEEE.