



Q-ZINE

Bimonthly Newsletter

National Institution for Quality & Reliability Chennai Branch

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MAR - APR 2017

From Chairman...



The financial year 2016-17 has ended and I hope all of you would have considerable growth in your businesses and I sincerely wish all the very best for the current financial year.

Every financial year ending needs consolidated introspection for any business. Though NIQR is a non-profit organization, I would like to summarize about the business of NIQR Chennai Branch with some major highlights. The Initiative we took on spreading the message on Quality For Industry 4.0 has taken off very well and we are hopeful of reaching our targets. The Monthly lectures on various subjects have been conducted without fail every month. Joint conference with SRM University on Industry 4.0 was a great awakening to the students.

Now, similar to our general business practice of setting goals in every financial year beginning, we would like to set goals for the NIQR Chennai Branch. These goals will be metricised and deployed across the Executive Committee Members. This process we would like to adopt only to accelerate NIQR towards achieving its mission. This will also help everyone who volunteers to contribute to NIQR's mission, to clearly see how they can contribute.

Finally NIQR, being the beacon of TQM thinking, should also weave TQM practices into its own processes!..

Hope all of you would agree with me!..

My best wishes for the Financial Year Ahead!...

K. Manikandan

From Secretary...



It is a great pleasure to bring the Chennai Branch Newsletter in time; it is because of the support all of you are giving in fulfilling the commitment.

We organised two lecture meetings; 'Digital India' by CA Raju in February and 'Emotional Maturity' by Mr. Ravindran. Both were very interesting and the interactions by the audience were excellent; it would have been great if more members decided to attend and make the Hall full.

Industry 4.0: The momentum achieved in the first couple of months has been sustained in the next 2 months; with the support from all members, we are confident of achieving the MISSION20K set by our chairman. We have organised a joint National Conference with SRM University in April; the curtain raiser video and rangoli showcased the involvement of students prompting NIQR to award the artists.

Wishing you all a happy and comfortable summer.

CV Gowri Sankar

Monthly Evening Lecture Programs February 2017

On 23rd February 2017, CA GOPAL KRISHNA RAJU, partner of M/s K. GOPAL RAO & CO., Chartered Accountants, Chennai delivered a lecture on "Digital India" at NIQR Conference Hall. The much awaited lecture on 'Digital India' was organised after a delay of exactly one month much to the satisfaction of members.

CA Raju started giving some insight to the journey of e-Governance initiatives in India which took a broader dimension in mid 90s for wider sectoral applications with emphasis on citizen-centric services. He explained the NeGP, National e Governance Plan and Digital India programme.



In order to transform the entire ecosystem of public services through the use of information technology, the Government of India has launched the Digital India programme with the vision to transform India into a digitally empowered society and knowledge economy. He dwelled on the Nine Pillars of Digital India.

- Broadband Highways
- Universal Access to Mobile Connectivity
- Public Internet Access Programme
- e-Governance
- eKranti
- Information for All
- Electronics manufacturing
- IT for Jobs and
- Early Harvest Programmes



The audience made the Q&A session very lively with interesting queries.

Mr. K Manikandan, Chairman, NIQR Chennai Branch summed up the proceedings and added value to the session with his inputs on digitalisation; he appreciated the speaker for the lively presentation of the subject.

Prof. C. Uthayakumar, ECM, NIQR Chennai Branch gave an account of Digital India HACKATHON 2017 which is a pan India 36 hour nonstop digital programming competition. He also explained about Smart India Hackathon 2017, a 36 hrs non-stop digital product development competition during which teams of thousands of technology students will build innovative digital solutions for the problems posted by 29 different central govt. ministries / departments e.g. Ministry of Railways, External Affairs, Ministry of Defense, ISRO, Ministry of Tourism, Dept. of Atomic Energy, etc.

Mr. C. V. Gowri Sankar proposed the vote of thanks.



CA GOPAL KRISHNA RAJU is a practicing Chartered Accountant from Chennai, partner of M/s K. GOPAL RAO & CO., Chartered Accountants. He hails from a family of Chartered Accountants, his father, mother, younger brother and wife all are Practicing Chartered Accountants. He is having a rare honour of elected for the consecutive third term to the Southern India Regional Council of The Institute of Chartered Accountants of India (SIRC of ICAI) for the triennial term 2016-2019. He is a seasoned speaker on Information Technology, Finance & Taxation; and a visiting/guest Faculty for numerous Institutions, Corporates and B-Schools

Monthly Evening Lecture Programs March 2017

On 30th March 2017, Mr. J. Ravindran, General Manager, Star Health and Allied insurance Company Ltd delivered a lecture on "Emotional Maturity" at NIQR Conference Hall. Mr. K Sridharan Balaji, National Secretary, NIQR presided over the function and spoke about the importance of keeping emotions under control. Prof. C. Uthayakumar, NIQR Chennai Branch ECM welcomed the members and introduced the speaker.

'Machines are predictable but not humans' started off Mr. Ravindran emphasizing the need for taking decisions from the mind and not heart. He explained the five levels of humans namely, body, maya, intellect, emotional and beyond. He beautifully explained how mind becomes cluttered when intellect fails. The best method to become positively emotional (Gratitude, Love & Joy) is to consciously avoid negative emotions like Anger, Sadness & Fear. He gave enough tips to practice this.



Anger



Sadness



Fear



Gratitude



Love



Joy

He used lot of tiny stories which made the session lively. His use of quotes thrilled the audience; even his use of political satires did not evoke any uneasiness instead enlivened the proceedings.

The audience made the Q&A session very lively with interesting queries. Mr. K Sridharan Balaji summed up the proceedings and appreciated the speaker for the lively presentation of the subject. Dr. S. Karthikeyan, HOD Mech SRM University spoke high about the lecture and honoured the speaker with a shawl and memento. Mr. C. V. Gowri Sankar proposed the vote of thanks.



Mr. J. Ravindran holds a twin master's degree in Law & Business Administration. He is a well known motivational speaker and trainer. He has more than three decades of work experience as a HR Professional. Prompted by his passion for Human development, he got trained in Neuro Linguistic Programming and ventured into corporate training with the motto of making difference to the lives of people and empowering them to lead a happy personal and exciting professional life. Currently he is General Manager, Star Health and Allied insurance Company Ltd.





NIQR welcomes the new members who joined during Mar April 2017

Individual Life Members

Mrs. Satya Suganya – Proprietor BPM Industries
 Mr. R. K. Jain – AVP Maruti Suzuki India Ltd
 Mr. Pritiman Dey – AVP Maruti Suzuki India Ltd
 Mr. Sushant Bose – DGM Maruti Suzuki India Ltd
 Mr. Vivek Saraf – AGM Maruti Suzuki India Ltd



Company Members

M/S Eskay Home Collections (P) Ltd. Chennai
 M/s Valasumani Farm Machines (P) Ltd. ERODE

Student Members

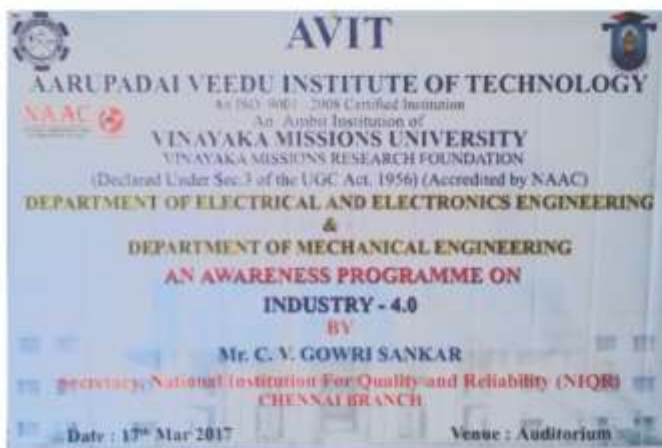
213 from Global Institute of Management, Amritsar

INDUSTRY - 4.0 Awareness Program: No. 9

The 9th Program in the series was conducted in Arupadai Veedu Institute of Technology, Chennai on 17th March 2017. There were 300+ students from 3rd year and 4th year of Mech. Engineering.

Dr. V. Lakshminarayana, Principal of the college spoke about the expectations from the Industry and urged the students to make full use of this program which will add value to their class room learnings and wanted more such programs from NIQR.

Mr. C. V. Gowri Sankar, Secretary, NIQR Chennai Branch, conducted the program from 10.00 AM to 12.30 PM covering the industrial and economical Scenario of India and explained the 4th Industrial revolution. Some of the students and staff members appreciated the contents of the awareness program. They expressed their happiness in learning an important topic which is very vital for India.



INDUSTRY - 4.0 Awareness Program: No. 10

The 10th Program in the series was conducted in Jayalaxshmi Institute of Technology, Thoppur on 5th April 2017. There were 100+ students and staff of MBA.

Mrs. B. Umamaheswari, HOD In-charge / Management Studies, in her welcome address spoke about various initiatives of NIQR and urged the students to make full use of this program which is a new topic to all of them. She requested NIQR to arrange more such programs.

Mr. C. V. Gowri Sankar, Secretary, NIQR Chennai Branch, conducted the program from 10.00 AM to 12.30 PM covering the industrial and economical Scenario of India and explained the 4th Industrial revolution. Some of the students and staff members expressed their happiness in learning a new subject which will add value to their career.

At the end of the session, Dr. S. Mohana Murugan, Principal of the College discussed with each and everyone of the participants to spell out the gains of the program. The students were very happy to learn about AI, IOT and cloud computing and the challenges and opportunities facing India today and how the student community can help in bridging the growing skill gap.



INDUSTRY - 4.0 Awareness Program: No. 11

The 11th Program in the series was conducted in Vellore Institute of Technology, Kelabakkam on 13th April 2017. There were 400+ students and staff of all engineering disciplines.

Dr. G. Vinitha AP (senior), School of Advanced welcomed the 400+ students and staff of all engineering disciplines and introduced the speaker, Mr. C. V. Gowri Sankar, Secretary, NIQR Chennai Branch.

The faculty started the session explaining about NIQR and its activities and its mission of sensitising 20000 minds this year about Industry 4.0. The program was from 10.00 AM to 12.15 PM. Starting with the industrial and economical Scenario of India, he showcased the challenges and opportunities facing India. Elaborating on the need of the day to embrace Industry 4.0, he advised the students to be in the forefront to take up the challenges in embracing Industry 4.0 instead of being mere followers of technological changes as in the past.

Dr. Atanu Datta, Dean, Division of Physics appreciated the efforts of NIQR in taking up a big task and wished all success for achieving the MISSION-20K.



SRM – NIQR National Conference

NIQR Chennai Branch and SRM University, Vadapalani organised a one day National Conference on Industry 4.0 on 7th April 2017 at SRM University's Vadapalani Campus. The theme of the Conference was "Industry 4.0... way forward towards Next Orbit" and 50 papers were received from 7 Institutions and they were scrutinised by Mr. C. V. Gowri Sankar, Secretary - NIQR Chennai Branch and 21 papers were selected for final presentation on the conference day.

The delegates, participants and Guests were welcomed to the conference by a thematic Rangoli drawn by 3 of the students; it was well appreciated by one and all.

The conference started auspiciously with the lighting of Kuthuvilakku by the distinguished Guests. Dr. S Karthikeyan, Professor & HOD of Mechanical Engineering welcomed the guests, delegates and participants. While welcoming debates and presentations on the technological advancements due to Industry 4.0, he also wanted the participants to discuss the flip side of the same, namely unemployment due to more and more automation.

Dr. K. Duraivelu, Dean (E&T), Vadapalani Campus presided over the Inaugural Function. The curtain raiser video by 2 of the students was breathtaking and was well appreciated by the audience.

Mr. P. K. Aggarwal, National President NIQR was the Chief Guest. In his address to the participants, the Chief Guest explained about migration to Industry 4.0 and the benefits of the same.

Mr. K. Manikandan, Chairman NIQR Chennai Branch made a fitting presentation on the theme outlining current Indian Economic Scenario compared to the developed countries and showcased the challenges and opportunities of the Industry and concluded that the way forward is to embrace Industry 4.0.

A souvenir of the conference containing the shortlisted papers, messages from dignitaries from NIQR and SRM and expression of thanks for the sponsors was released by the Chief Guest on the occasion.

The main proceedings started with paper presentations in two halls. Mr. K. Sridharan Balaji, National Secretary, NIQR and Mr. G. Pandurengan, ECM - NIQR Chennai Branch were the Juries in Hall 1.

Dr. V. M. Gunasekaran, ECM - NIQR Chennai Branch and Mr. R. Nandakumar, Life Member, NIQR Chennai Branch were the juries in Hall 2.

Top two teams from the 2 streams were selected for final presentations in the auditorium in front of a full house. The details about winning teams are given in a separate box.

Mr. S. Rajasekaran, National Vice President NIQR was the Chief Guest for the Valedictory Function. In his address to the audience, he praised the quality of the presentations and asked the students to focus on studies and enrich their knowledge through various activities like this conference. Dr. V. Swaminathan, National Vice President NIQR was the Guest of Honour.

Mr. N. Dinakar, Associate Professor summed up the proceedings of the day and Dr. V. M. Gunasekaran gave the views of the juries. The Chief Guest distributed the awards to the winning teams and also mementos to the students who have donned the curtain raiser and rangoli.

Dr. S Karthikeyan proposed the vote of thanks.





1st Prize	Ms. V. Saikumari Ms. S. Jayanthaa	SRM University, Vadapalani Campus
2nd Prize	Mr. G. Vignesh Mr. R. Adarsh	SRM University, Vadapalani Campus
Joint 3rd Prize	Ms. S. Sree Vidhya Ms. K. Deepika Ms. A. Gayathri Ms. D. Rukkumani	Meenakshi Sundararajan Engineering College
	Mr. Shaurya Chhabra Mr. Akshit Sharma Mr. Jasim Sinnan Basha	SRM University, Vadapalani Campus
Rangoli Team	Mr. Saagar Jose Mr. Manoj Kumar Mr. Anish Karthik	SRM University, Vadapalani Campus
Curtain Raiser Team	Mr. Sayan Dasgupta Mr. Sunil Kumar	SRM University, Vadapalani Campus



NIQR Student Chapter - Dr MGR Educational and Research Institute University

Lecture on Solar PV Power and its Prospects

NIQR Student Chapter of Dr MGR Educational and Research Institute University, organised a guest lecture on 24th February 2017 on "Solar PV Power and its Prospects" for the 2nd year & 3rd year students of mechanical engineering department.

Dr. M Ganesan, Prof and HOD of Mech Engg Dept introduced the guest speaker Mr. Saswat Das, Director of Sunmeister Energy Pvt Ltd. to the Forum.

In the beginning itself, Mr. Das enthused the students to be interactive to gain full knowledge of the topic. He explained the pattern of energy requirements and how the world is moving in the right direction and by how much India is lagging behind. He then explained the technical and economical considerations of photovoltaic devices such as solar bulbs and rooftop installation of solar panels.

He explained to the students about the different types of panels such as Polycrystalline, Mono crystalline and thin film panels. The details about the materials used such as c-Si, GaAs and CIS and their spectral response characteristics of solar modules were shared to the students. The students gave an excellent feedback about the lecture and wanted NIQR to arrange lectures every quarter.



NIQR Student Chapter - JIT, Thoppur

Lecture on Poka Yoke

The NIQR Student Chapter of Jayalakshmi Institute of Technology, Thoppur organised a guest lecture on Poka Yoke on 4th April 2017 from 10.00AM to 12.30PM. Mrs. B. Umamaheswari, HOD Management Studies welcomed the gathering and Mr. C. Manivannan, Coordinator of the Chapter introduced the speaker Mr. C. V. Gowri Sankar, Secretary - NIQR Chennai Branch. The faculty explained the necessity of Poka Yoke in every walk of life and the benefits of in manufacturing industry. Through some simple exercises, he made the management students and staff understand why mistakes happen and how to implement mistake proofing in the design stage itself. He briefed the audience about the Ten Types of Human Mistakes and various errors possible during mass production. He then explained the 3 methods of Poka Yoke, namely the contact method, the fixed-value (or constant number) method & the motion - step (or sequence) method.

The lecture was attended by 60 NIQR student members and the Faculty members of management studies.

Dr. P. Mathialagan, proposed the vote of thanks and wanted NIQR to arrange such Guest Lectures to make the Students Industry-ready.



“Abundance and Greediness”

Waste is always associated with Cost and Time. We get many opportunities to witness the “WASTE” in our day to day life. It's something which is addressable but most of them are not really actionable by oneself. We decide to ignore or postpone at times.

For instance, IPL – Cricket match is happening during night time by burning so much of electricity. Entire mall is operated with air conditioning without people around. Unsold food is dumped into the soil without serving needy people. Millions of people are waiting in railway stations, bus stands and airports to receive late arrival of people. Day time running office with night shift closed. Spending thousands of hours for IIT exam and other competitive exams without successful result etc.

We are not sure that how known waste is captured rather than unknown hidden waste through lean tools and techniques. The reason for not addressing known waste is “Abundance and Greediness”. Mother Nature teaches us through various signals such as storm, heat waves, poverty, earth quake etc., to spend it wisely. As you know, time and cost have flexible bandwidth. “War on Waste” is not an option when abundance and greediness is challenged. If all of us are given a chance to reduce our time by 12 hrs instead of 24/day and half of income, Imagine a situation where all known waste will turn to useful things and the power of applying creativity would be multiplied.

This means that always make a stringent target for every goal you work with. It is the possible way to crack addressable waste. Please be mindful on consequential impact that is something very important to evaluate, but not as a constraint element.

Encounter Abundance not waste!

...by **Mr. Ganesan Nagaraj**,
Director, Global QSE, VESTAS Wind Systems

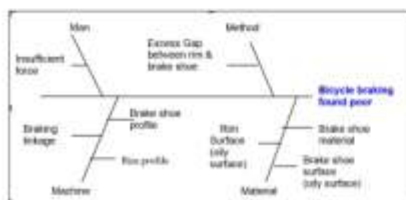


P-M Analysis and its similarity with PFMEA

The word phenomenon means the outward manifestation of an abnormal event. An abnormal event could be a defect, breakdown, or malfunctioning of a machine.

When a phenomenon occurs due to some chronic causes the conventional problem solving approach may be the cause and effect (CE) diagram. This method, however, has some shortcomings because it ignores causes that are individually insignificant but significant in combination.

A suitable method in this situation is called phenomenon mechanism (P-M) analysis, developed by Kunio Shirose. It works similar to Process Failure Mode and Effects Analysis (PFMEA) and allows users to solve the problem in totality.



There are two main downfalls of the CE diagram approach:

1. Only reasons that are presumed to be relevant and predominant to the problem will be listed. The casual factors that can contribute to the problem silently on a secondary level may be ignored.
2. There could be two reasons that, individually, don't have an effect, but together, may cause the problem. For example, brake shoe material or insufficient force may not be a problem independently, but together, they cause poor braking. This type of combination might not be considered in a traditional CE diagram.

Now, let's look at how P-M analysis tackles this problem.

Problem Solving with P-M Analysis

The first step in a P-M analysis is defining the phenomenon. In this case, it is "poor braking." Through a physical analysis, you determine the mechanism that causes the phenomenon. In this case, it is "the frictional resistance between the rim and the brake shoe is inadequate." Conditions that cause the mechanism are called constituent conditions.

The constituent conditions are further expressed in terms of the primary and secondary 4Ms—machine, method, man, and material. The standard value and respective measured value for each constituent condition and 4M is compared and corrected in case of abnormality. For example, the rim surface finish is to be 0.5 - 0.6 micrometer (μm) roughness average (Ra). If it's found to be 0.4 μm Ra, it's an abnormality.

Each of the 4M will have quantitative or qualitative standard value. Constituent conditions may or may not have standard values. If the standard value is available for the constituent condition itself, it may reduce the work of enumerating its 4M condition.

Thus, using this method, the phenomenon is physically analyzed through the mechanism of the equipment in terms of 4M, and the problem is resolved.

How a P-M analysis compares to the conventional CE problem solving method can be seen below. The main difference is that in the CE method, you proceed to the causes directly from the phenomenon. In the P-M analysis, you first understand the mechanism of the phenomenon, followed by the constituent conditions, and then the causes.

P-M Analysis vs. PFMEA

P-M analysis is a technique for problem solving and PFMEA is a technique for identifying problems that have not occurred yet. The phenomenon and physical analysis in P-M analysis are similar to the effect and failure mode, respectively in a PFMEA. Thus the physical mechanisms of defects can be inferred through failure modes in a well-made PFMEA.

Hence it may be even a good idea to introduce a column for constituent conditions in PFMEA as shown below to facilitate P-M analysis

When to Use P-M Analysis

P-M analysis is applicable for quality problems or breakdowns in a particular machine only. A full understanding of the machine and mechanisms is required to carry out P- M analysis. Conventional approaches of problem solving may be used to the extent possible and then, P-M analysis may be used.

References

1. Kunio Shirose, Yoshifumi Kimura and Mitsugu Kaneda, P-M Analysis, CRC Press, 2004.
2. Kenneth S. Stephens, ed., Juran, Quality and a Century of Improvement, ASQ Quality Press, 2004.

...by **R. GANESAN**, NIQR Life Member
 He was Head of Engineering and Quality at Axles Limited India in Sriperumbudur.
 Mr. Ganesan is a member of ASQ.

P-M analysis

Phenomenon	Physical analysis	Constituent condition	Primary 4M conditions	Secondary 4M conditions
Poor braking	Inadequate frictional resistance between rim & brake shoe	1)Jolly surfaces 2)Smooth surfaces 3)Linkage movements	1a)jolly surface of rim 1b)jolly surface of brake shoe 2a)smooth surface of rim	1a)joli present in rim 1ab)joli drop falling from handle bar

PFMEA

Effect	Failure mode	Causes
Poor braking	Inadequate frictional resistance between rim & brake shoe	1)jolly surface of rim 2)jolly surface of brake shoe 3)smooth surface of rim

Effect	Severity ranking	Failure mode	Constituent conditions	Causes	Occurrence ranking	Detection ranking
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Head Quarters Activities

NIQR –NABET

Lean Manufacturing Cluster Program at Hosur and Bangalore is progressing well. As an important milestone a DSR (Diagnostic Report) audit was conducted on 23rd and 24th February 2017 at Hosur based industries. Mr. Devarajan nominated by QCI and Mr. Simiyoon nominated by directorate of MSME (Tamil Nadu) were the auditors. On 28th March '17 Bangalore based industries were audited by Mr. Surya Prakash from QCI and Mr. Sivakumar from Directorate of MSME (Karnataka)

The auditors were appreciative of the progress made and improvement initiatives implemented. They went to the extent of suggesting to their senior officials that these industries can be show cased for other clusters to follow. The credit goes to the industries and counselors Mr. M. V. Prakash and Mr. R. Ravi who were guided by the NIQR team – Dr. V. Swaminathan, Dr. A. Sanjeeva Rao, Mr. K. N. Krishnamurthy and Mr. G. Rangarajan



ZED Awareness Programs

Quality Council of India (QCI) has been nominated by The Ministry of Micro, Small & Medium Enterprises as the National Monitoring and Implementation Unit (NMIU) for the Zero Defect Zero Effect (ZED). QCI had conducted Faculty Training Program for 23 members of NIQR during January 2017 and had provided a prestigious slot to NIQR in organising ZED Awareness Programs for MSMEs. NIQR Head Quarters have organised 4 such Awareness programs in March 2017.

Mr. K. Sridharan Balaji, NIQR National Secretary coordinated the programs for the suppliers of major industries in Chennai. Mr. R. Gopinath, NIQR Office Staff coordinated the on-line registration of participants and other requirements of the program as directed by QCI.



First ZED Awareness Program; Mr. P.K. Aggarwal inaugurated the first program on 15th March 2017 at TAFE; Mr. A. Pradeep, ECM, NIQR Chennai Branch was the faculty and there were 49 participants from vendors of TAFE.

Second ZED Awareness Program; Mr. P. Kothandaraman, ECM, NIQR Chennai Branch was the faculty in the program conducted on 17th March 2017 at Super Auto Forge for 42 participants from their suppliers.

Third ZED Awareness Program; this was organised on 18th March 2017 for members of SIMA. Mr. Sundaravadivelu, ECM, NIQR Chennai Branch was the faculty and there were 28 participants from suppliers of M/S Severn Glocon India Private Limited, Irungattukottai.

Fourth ZED Awareness Program; Dr. V. M. Gunasekaran, ECM, NIQR Chennai Branch was the faculty at Irungattukottai for supplies of M/S Sharada Motors and Wipro. There were 45 participants in the program conducted on 22nd March 2017..

The feedback from all the participants was excellent.



Delhi NCR Branch Activities

Message from Chairman

Dear Colleagues,

The end of Financial Year 2016-17 marks the completion of 1st year of working of NIQR – Delhi NCR Branch. Our branch, being in early stage after its inception has started working in spreading Quality Culture throughout the Industries and Academic Institutions in order to assist them for being globally competitive.

The activities carried out by our branch in 1st year include engagement with Various Academic Institutions and Supplier Associations. Initial meetings were carried out followed by sharing latest Quality concepts and Industrial practices so that the members are updated with the ongoing Trends. In this process, various tie-ups were done with Academic Institutions to open Student Chapters in their campus in order to have regular sessions with NIQR for knowledge sharing. Few sessions were also conducted with Suppliers in JCB and through Faridabad Suppliers Association enhancing their know-how about the latest automobile practices and new technologies.

I am delighted to share that we have successfully enrolled 240 students through Student Chapters and included 10 Life Time NIQR Members this year. This was possible only with the contribution of whole NIQR Delhi-NCR Branch and continuous guidance from NIQR Head-office. In line with the Mission – Quality for Industry 4.0, I am also sure that with such commitment, we will be scaling Greater Heights in upcoming new financial year.

With Best Regards,

A K Tomer

Chairman (NIQR Delhi-NCR Branch) & ED Quality, Maruti Suzuki India Limited



Review to Lean Six Sigma (Problem Solving Approach)

Introduction

Motorola design team developed the original six-step process in 1988 for use in training manufacturing teams (Schroeder & Linderman, 2008). The six-step process continually advanced into Six Sigma, an approach that has been integrated into Total Quality Management (TQM). Processes operating at Six Sigma would produce a yield of more than 99.8% yield although the yield would continually decrease with time. However, most of the manufacturing processes in many companies do not operate at Six Sigma rather between 1 and 2 Sigma thus producing a yield of not more than 70%.



Besides its initial applications as a defects reduction tool in manufacturing, the project-driven management approach is widely being integrated into other areas. Currently, the approach is used as a business strategy that primarily deals with customer satisfaction, maximization of productivity as well as improved performance (Kwak & Anbari, 2006). With its continued wide adoption and usage, the approach no longer deals with defects per million opportunities. The focus is now shifting to various measures of quality such as variability reduction through data assimilation and organization to increase savings. The primary focus is the process that results in a defect than the defect itself. This is attributed to the fact that the model has been adopted in other non-manufacturing sectors such as businesses that deliver services.

The Six Sigma approach, which is also commonly referred to as the Lean Six Sigma program, is now widely adopted in non-electrical, non-manufacturing settings such as Motorola and Texas Instruments it initially originated. The past couple of decades has seen the evolution of the program into service industries which mainly use it in the supply chains (Arnheiter & Maleyeff, 2005; Wei et al., 2010). Besides, in the supply chain, hospitals, local governments, and the public sectors have equally embraced the Six Sigma program. In the health sector, for instance, Van den Heuvel et al. (2005) report that the implementation of the Six Sigma program at the Red Cross Hospital in Beverwijk resulted to tremendous annual savings of up to €1.2 million. This is one of the many areas where great savings and huge profits have been accrued due to the adoption of the program.

Through a systematic review, this paper aims at investigating state of the art within the Six Sigma philosophy while documenting the key development of practices. This will be done by critically reviewing and assessing the existing Six Sigma healthcare literature. The key areas of focus include application, process changes and outcomes, including process-metrics; cost, and revenue improvements. The areas of successful application of the strategy as well as suggestions for other applications and Six Sigma's improved usage are discussed.

Application and Overview of Six Sigma Approach

In business settings, Six Sigma is used as a business strategy that is necessary for the effective running of the processes as well as attaining business goals. The significance of the tool can be seen by its wide adoption by such multinationals as Motorola, General Electric, Bombardier, Sony, and ABB (Antony, 2006). Nonetheless, the project-driven approach is equally adopted by numerous companies that offer services. These include Zurich Financial, American Express, J P Morgan, City Bank and BT (Antony, 2006).

Six Sigma is no longer merely a quality measurement tool rather a business improvement tool. Van den Heuvel et al. (2005) define it as 'quality improvement approach aimed at optimizing processes while reducing defects and costs' (p.380). The initial idea of the approach was discovered in 1986 by Bill Smith, a senior engineer, and scientist at Motorola – the flagship company that first used the approach. Surprisingly, the approach was the long-sought solution for the company's warranty claims that cost the company tremendous amounts of dollars. Besides solving the company's problem and achieving product quality, the Six Sigma approach significantly lowered defects in the processes. This was achieved by the use of powerful statistical tools and techniques. Consequently, Motorola recorded tremendous improvements regarding productivity, customer satisfaction,

costs reduction, quality improvements and such benefits. The company received the Malcolm Baldrige honorary award for its exemplary performance in 1988 and had invested approximately \$170M over a period of three years training its workers on Six Sigma. The \$170M investment by Motorola saved the company approximately \$2.2B that would have resulted from the cost of poor quality products (Antony & Banuelas, 2002). Besides Motorola, General Electric (GE) has equally implemented the approach.

The success of GE's move to implement the Six Sigma model in its processes is irrefutable. GE's Chair of Board and CEO have in various instances attested the success of adopting the approach. Over the past nine years, Six Sigma has become a part of GE's lifestyle, its way of working. The company successfully implemented over 50000 projects in its past year (Antony, 2006). The three major areas of focus were addressing customer concerns to ensure satisfaction: improvement of internal processes to maximize cash generation and finally streamlining the flow of the company's high technology services as well as products to meet market demands as well as maintaining her market share. In 2002, GE confessed that Six Sigma has continually resulted in consistently strong processes that have in return lowered the amount of the company's cash that has for long been held in inventory and receivables (Antony, 2006). Other leading brands such as Sony, Ford Motors, Kodak and Honeywell (formerly Allied Signal) have had their success stories on the adoption of the approach. For example, Ford Motors adopted the model in 1999 after the company's director of quality did intensive research on the approach (Arnheiter & Maleyeff, 2005). The director booked a visit by Mikel Harry, a former Motorola employee who is currently recognized for the development of the approach. After holding talks and benchmarking with such companies as GE that had previously adopted the model, Ford decided to initiate the program in an attempt to hasten the quality delivery process. After a year and a half, the company had successfully trained close to 10,000 employees throughout its global operations (Arnheiter & Maleyeff, 2005).

In the health care sector, quality concerns have been on the rise due to escalating expenditures. The need to boost quality in the health care sector arose in the late 90's when the Institute of Medicine published a report that indicates that close to 98000 deaths result from poor quality of healthcare which is primarily because of medical errors (IoM, 2002). There have been efforts to improve the quality of care although the lack of well-laid out procedures on performance results in the delivery of substandard care.

Six Sigma approach, which deals with these inconsistencies, would then be an ideal solution for the health care sector. As such, several concerned stakeholders in the health care sector, as well as such authors as Woodard (2005), proposed the implementation of the approach in the US and abroad. The implementation would produce and yield significant benefits for the health sector. According to Carrigan and Kujawa (2006), a hospital that adopts the strategy can develop and maintain a competitive advantage as well as achieve its long-term goals. More importantly, the strategy enables organizations to enhance their revenues, save on time and costs, as well as provide measures to analyze a company's progress regarding the on-going process, expected outcomes and product quality (Black & Revere, 2006). In hospital settings, the physicians should participate so as to provide insights on their engagement in the entire process.

Despite the apparent benefits of integrating Six Sigma strategies in health care, its value in improving the sector is poorly defined. Landek (2006) argues that despite the usefulness of the Six Sigma approach, the strategy may be ineffective in a hospital setting due to the required cash and resources. Bandyopadhyay and Coppens (2005) argue that such challenges as lack of definitive measures of performance hinder implementation in service industries (it is better to indicate what kind of literature supports it). For example, the strategy may be overwhelming, thus requires to be broken into manageable units that are time-consuming. As such, it would not be ideal for a hospital setting bearing in mind the work intensities in most hospital setups.

The effectiveness of the statistical tools and techniques in Six Sigma strategy are irrefutable. Implementation of the strategy's methodologies involves employing such steps as:

1. Formation of a Six Sigma implementation team.
2. Studying and understanding the company's products, processes, systems, methods and product functions.
3. Establishing values based on the incurred costs and so on.

To effectively implement and establish these steps, various tools and techniques are used. In the initial stages of the implementation, product oriented figures have to be determined. Consequently, such tools and techniques as Project Charter, SIPOC, Fishbone Diagram, FMEA, RTY and Gauge R&R are employed. Next, tools for improving the functions are employed. These include decision-making methods as well as brainstorming methods.

Six Sigma job Plan necessitates implementation of the methods. Change is an invaluable asset required for the implementation of the Six Sigma strategy. All employees regardless of the seniority must adapt to forthcoming changes. Employees must be willing to work harder and longer if need be. Managers need to be more creative and develop the necessary strategies to ensure full utilization of Six Sigma. In light with adapting to change, the Six Sigma coordinator needs to ensure that each stakeholder plays their part.

Lean Six Sigma

Lean Six Sigma is an extension of the first Six Sigma applicability of which was limited to quality in manufacturing. It is a collection of tools and techniques, main goals of which are the variation reduction, waste elimination, and quality improvement. Unlike the original definition of quality, which specifically dealt with conformance to pre-determined standards of manufacturing goods, the definition of quality is advanced in Lean Six Sigma. The new definition of quality now covers both the economic and practical aspects of the product to meet consumer needs as well as fulfill the goals of the company. As such, quality now covers value entitlement, which is a company's need to produce goods or offer services that attain highest profits. Value entitlement is a philosophy based on the idea that organizations can develop and maintain the competitive advantage by defects reduction in all of their manufacturing and commercial processes. However, the definitions of Lean Six Sigma denoted as LSS, vary from one author to another. Some of the standard definitions of the term will be documented later on.

Phases of Six Sigma (DMAIC)

Phases of Six Sigma	Key Deliverables
Define	Project selection, Objectives, Team formation, Project charter, Project registration
Measure	MSA, process characterization, COPQ, Process capability, Basic Statistics
Analyze	Hypothesis testing, Regression Analysis, Measuring and Modeling relationship between variables
Improve	Design of Experiments, Kaizen, Risk analysis, and mitigation
Control	Statistical process control, maintain control, sustain improvements

...by Mr. Parveen Yadav,
Sr. Manager - Quality, JCB India Ltd &
EC Member, NIQR Delhi NCR Branch

Pune Branch Activities

The baby steps taken by Our Pune Branch show the Branch's desire to grow steadily. After the informal meeting of all committee members on the opening day of the branch, the members have shown their interest by attending in large numbers.

The first committee meeting conducted on 11th March 2017 at Kirloskar Office was attended by 11 committee members discussed various points to establish NIQR's presence in Western India & way forward for Pune Branch's roles in NIQR's Vision to be a World Class Professional Institution dedicated for promotion of Excellence in Quality.

A new mail ID was created & it was decided to have the following as its temporary communication address.

National Institution for Quality & Reliability

Accurate Sales & Services Pvt Ltd,
67, Hadapsar Industrial Estate
Pune- 411013
Email: niqrpune@gmail.com

During the second committee meeting conducted on 8th April 2017 at Kirloskar Office, registration of Life time membership completed for 9 executive committee members. Trainings & activities were planned for upcoming months for selected auto segment industries (Sheet metal & Non-Metallic) vendors.

- Problem solving techniques
- Cost of poor Quality
- Focus on starting a Student chapter (COEP & other leading Institutions)

It was decided to communicate to all Key Industry CEOs regarding training & activities. Next EC Meeting is scheduled on 6th may 2017 @ Ashok Leyland Pune Office.





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Members in News

Dr. R. Mahadevan, former National President NIQR & Director of India Pistons was the Chief Guest at the 11th anniversary celebrations of the IIT-M Heritage Centre on 6th March 2017. He unveiled the IIT-Madras Heritage Trails App and a model of Gajendra Circle (a popular landmark on the IIT Campus) in its original form, as built in the 1950s. He is a 1964 batch alumnus of IIT Madras



Department of Chemical Engineering, CIT, Coimbatore organized a AICTE sponsored Quality Improvement Programme, short term course on "Current Scenario in Nano and Functional Materials" (Nano-Fm 2017) between March 1st and 7th 2017. **Dr P. Ramesh, Vice Chairman, NIQR Chennai Branch** was one of the speakers and gave a lecture on Lightweighting and Green Materials.

Topic covered included 1 Overview on Lightweighting and Green Materials 2 Industry demands 3 Lightweighting options 4 Lightweighting materials used in Automotive application 5 Renewably sourced materials and 6 Hazardous Materials -Environmental regulations/directives.



Dr. MGR Educational and Research Institute University, Chennai organised a "Quality Conclave" on 3rd and 4th March 2017. **Mr. V. K. Venkataramani, ECM, NIQR Chennai Branch** was a panelist in the session on 'Student perspective on curriculum enrichment in Higher Educational Institutions in India' on 3rd March 2017.



Dr. G. Saravanan, Life Member of NIQR inaugurated the "Management Day" function of the Department of Management Science at S. A. Engineering College, Chennai on 20th Feb 2017. He gave a lecture sharing the expectations of Industry from Engineering and Management students when they graduate out from college.



Mr. N. Anbuchezhian, NIQR HQ EC Member has been selected as Convener for CII Chennai Zone Manufacturing Panel for the year 2017-18. He will be chair person for this panel whose objective is to drive and promote manufacturing excellence in member organisations.



Mr. P. K. Aggarwal, National President NIQR was Panelist & Guest Speaker in the seminar titled "ZED Certification Scheme – Roadmap to Global Competitiveness". The seminar was organized at Chennai Trade Centre on 17th March 2017, by EEPIC India in association with various other organizations viz. Quality Council of India, Ministry of MSME and Russia as partner country. The seminar, attended by the representatives from various sectors of industry, was chaired by Mr. S. N. Tripathi, Addl Secretary & Development Commissioner in the Ministry of Micro, Small & Medium enterprises (MSME).

During his session, Mr. Aggarwal emphasized upon how participation in ZED scheme will help the MSMEs in revisiting their current capabilities w.r.t. the requirements to achieve global competitiveness, identify gaps, plan & implement actions for improvements to move to next level.



Meenakshi Sundararajan Engineering College, Kodambakkam organised a National Conference on Technological Innovations in Electrical Engineering (NCTIEE'17) on 18th March 2017, where students of EEE department showcased their projects. **Mr. C. V. Gowri Sankar, Secretary NIQR - Chennai Branch** delivered the Keynote Address during the Inaugural Function highlighting the changing requirements of Industry.



ASSOCHAM India organised the second DIPLOMAT'S NITE to launch the MAKE IN INDIA – MAKE IN TAMIL NADU Campaign on 24th March 2017 at Hotel Leela Palace, Chennai. The Chief Guest, Mr. Atulya Misra, IAS, Principal Secretary, Industries Department, Government of Tamil Nadu gave an account of the current industrial scenario and explained the future prospects for industrial growth in Tamilnadu. It was well attended by foreign Diplomats, Investors and Indian Industrialists.

NIQR was well represented by a seven member team led by **Mr. P. K. Aggarwal, National President.**



Dr. V M Gunasekaran & Mr. P. Kothandaraman NIQR Chennai Branch ECMs have undergone a 5 day intensive 'ZED - Master Trainer Training Program' organised by QCI and held at NPC, Chennai between 28th March 2017 & 1st April 2017 covering the following topics:

1. ZED Maturity Assessment Model
2. ZED Five Maturity Levels
3. ZED Enablers
4. ZED Outcome
5. ZED Parameters
6. ZED Rating System for Bronze, Silver, Gold, Diamond & Platinum
7. ZED Training, Assessing & Consulting Skills





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Forthcoming Events

National Institution for Quality & Reliability Head Quarters

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Chennai Branch Newsletter March - April 2017

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