

APEGM Progress Report for: #31989 - Raviinder Mattu EIT

Period beginning: Mar 10, 2004 and ending: May 25, 2005. (14.5 months)

Submission Date: Oct 10, 2012

Supervisor: [REDACTED], Submitted on Oct 14, 2012

Period Employer: Goetze India Ltd. , Bhadurgarh, Patiala , India

Job Title: Thesis Work

This report contains Post-Grad Time.

1. Give a description of the Engineering work experience you have obtained during this reporting period. Include information supporting the rest of your answers.

The thesis work was a part of my masters of engineering degree and started on after completion of course work at Punjab Engineering College Chandigarh. It was a full time industrial project and carried out at Goetze India Ltd. which is a leading manufacturing company in north India. The main products of the plant were pistons, piston rings and engine blocks. The company was facing problems with their maintenance system and, as a result, there was a high number of breakdowns causing low plant efficiency. The project was offered by our department to the post graduate students who have CNC machines as their major along with sound understanding of various maintenance techniques. I found this project a perfect match for my skills and showed interest in it.

It was a full time project and involved time studies, production scheduling, preventive maintenance techniques, planned maintenance methodologies and analysis. This opportunity provided me a great understanding of Total Productive Maintenance system and helped me to sharpen both technical and soft skills. The project was a great success and completed in almost fifteen months.

Application of Theory

Analysis: The project was started with a detailed time study. I designed a time study sheet that included all the major factors related to the production cycle like machining time, setup time and breakdown, etc. After getting the approval from my supervisor, I started data collection with the help of under graduate students. All the information was then fed into an Excel worksheet and I reviewed it to study the pattern of product flow by using pivot tables. I also reviewed the history of production planning to determine the plant efficiency trends. After gathering an adequate amount of information about the production system, I started reviewing the maintenance strategies adopted by the company and the breakdown rate for each approach.

By the end of the study, I found that, even having CNC manufacturing cells, the Goetze's plant efficiency was lower than a conventional plant. The main reason behind that was the absence of an intelligent maintenance system. Goetze had adopted different maintenance strategies from time to time, but they never succeed to diminish the breakdown frequency. Our study and available past data confirmed that breakdown frequency was always high regardless of the maintenance system.

In the study we also included the human factor responsible for the breakdown or low efficiency. This part of the study also gave me a better understanding of why certain methodologies failed to show expected results. I examined that part from different aspects of human behavior and came to conclusion that there was not enough employee involvement in all those decisions and also there was a lack of training.

After examining all the affecting parameters, I discussed various maintenance methodologies with supervisors and managers. Considering all the factors and by reviewing literature, the Total Productive Maintenance system came up as the best option. I visited some industries in the north region of India

that were practicing TPM at that time and discussed the pros and cons of the system with the TPM coordinators. I prepared a detail report of my findings about TPM and submitted that to the office for review. After reviewing all the aspects, management gave green light to the project. The next step for me was to plan a detailed methodology for introducing and implementing TPM in the plant.

Design and Synthesis

A wide range of options were available to me for how to implement a total productive maintenance system in a manufacturing plant, but all those were designed for a certain environment which may or may not be suitable for Goetze. This finding triggered the need for a methodology to implement TPM at Goetze that will suit the existing atmosphere of the plant and utilize the existing resources.

I had already reviewed the different approaches adopted by various industries, which provided me a better understanding of the factors to be considered while designing the methodology. The major driving factors I had identified were machine availability, process design, tools available, operator and maintenance personnel skill level, preventive maintenance plan, machine reliability and cost. I had the input data for most of the factors from the time study, but some needed to be calculated. Most of the calculation part was done in Excel and MS Access. I designed different Excel sheets for individual parameters which provided me a great deal of flexibility for a change, i.e. if I wanted to input any information in at a later stage. After running all the calculations my next step was to design a flow chart for the whole process.

Goetze had a giant set up and the whole plant was sub-divided into shops based on the process like foundry shop, machine shop and grinding shop etc. We sketched a master plan under the supervision of our TPM coordinator. This plan was prepared in MS Project and illustrates the TPM implantation phase for the overall plant. It also includes the tentative completion dates for different phases and name of the persons involved in the project along with their responsibilities. On approval of the master plan I prepared individual plans for each shop.

On completion of plans I presented these to related managers for review. Once I received approval from the manager of a particular shop then I started preparing the budget and forecasting sheet. In the TPM master plan, the whole plant was divided into different zones. The Goetze tool room was designated as zone A because this was the facility where they make all the tools and dies for the whole plant.

The other reason why the tool room was assigned as zone A was because I wanted to test the methodology before introducing it to the production shops. Being a service provider to internal production shops the Goetze's tool room did not have to meet any tight deadlines, so there was less pressure for on time delivery, which enhanced the machine availability for my experiment. The tool room had a dozen CNC machines and about fifty workers, five supervisors and a shop manager. As a first step I started providing TPM training to supervisors and the shop manager. It was a one day training session and it helped them to understand the concept and benefits of TPM. On completion of the training they arranged the training sessions for the shop floor workers. We took the tool room as a model set up for TPM implementation and our plan was to use this set up as a TPM prototype to validate and demonstrate the TPM effects.

After identifying the starting zone and the initial training process, the next step for me was to write tentative standards for the machines. These standards covered all the machine related activities such as cleaning, inspection and lubrication. I used machine manuals as references and designed the standards as per the requirements. These standards also included the time interval or frequency for each activity. I estimated the total time required to perform daily TPM activities and sent a request to the capacity and production planning department to allocate time for TPM. The last step in the standardization phase was to provide the training to the operators so that they could efficiently perform all the TPM activities.

The next tread was to design an automated data collection tool for OEE (overall equipment effectiveness) calculation. I used visual basic for that and designed a database in which the operator had to input the time spent on all the productive and nonproductive activities. And as an output, the database generate a report which described the efficiency, utilization, downtime and machine availability for the given time period. This report was then used as a tool to identify the reason for any downfall in

efficiency or drastic raise in downtime. The database also provided the information about repetitive failures with their recurring frequency. Efforts were made to diminish those recurring failures by performing root-cause analysis and treating each failure individually until it was diminished to zero level.

To maintain the high product quality, an online inspection system was introduced which used several inspection tools and fed the measurements to a dedicated computer system. Because it was online inspection, it could be done while the machine was running, which in turn reduced minor stoppages and inspection times. The new inspection system gave flexibility to the operator to adjust the machine to reduce the error, which could have been caused by machine or program error. The online inspection reduced the rejection rate by 30%.

I also designed some fixtures to reduce the setup time. The need of the fixture came up from the data collection, which showed higher setup time for some specific machines. The corrective action to reduce the setup time was to design a fixture for easy and quick set up. I designed the prototype of the fixture in Solid Edge, and once the model was approved, we fabricated the fixtures in-house by using the available resources. The use of the fixture reduced the setup time by 40% for that particular machine. I made a recommendation to the shop manager to adopt the same approach for the other machines with higher setup times.

Practical Experience:

Visits to existing Engineering Works

Most of the planning work of the project was done in the office environment, but I did make frequent visits to the plant to analyze the plant layout and to understand the existing facility. Once I was done with the planning part, I spent most of my time in the production areas of the plant. I participated in the TPM implementation as a team member to boost the moral of my team. I faced several social and technical issues during implementation. Most of the social issues were because of the unionized environment. Because at the existing stage each worker had been performing a set of duties and it was very difficult for me and my supervisor to add more responsibilities without providing any monetary benefits. There were some technical issues as well which acted as hurdles in the TPM implementation process. For instance, while performing a kaizen, we needed to make some modifications to the unloading station of a machine but there was no drawing for the existing setup, so I had to start from scratch and create a drawing for the existing station and then modified it to meet the requirements. There were other numbers of issues as well but we as a team resolved those through brainstorming sessions. I visited other facilities in town to get ideas for any problem which I couldn't solve internally. I also experienced some human resistance to change, but those resistances were overcome with the passage of time. I found greater employee involvement after we completed our model machine TPM implementation and posted the results on the company's bulletin board.

I provided onsite maintenance training by demonstrating the various maintenance activities on the actual equipment. The Goetze maintenance department helped and guided me throughout the whole training process. Once the training was complete, we started auditing the activities on a weekly basis. The audit was done by me or the supervisors. After completing the audit, the auditor submitted the report to the shop manager. This part of the work provided me a better understanding of CNC operation and machine maintenance.

Opportunities to observe the limitations of practical engineering and related human systems:

I was working with different departments and shop floor employees and my role was not limited to certain areas. So, this project provided me a great opportunity to understand the role of the human factor in manufacturing and design. In several situations, I found some misassumptions made by the design department regarding machine capability and the manufacturing process; for instance, the required high surface finish could not be achieved with existing set up, and tight tolerances for cutting and machining were hard to achieve with the specified machine tool under existing conditions. All this could have been avoided by having proper coordination between the design and manufacturing department. I also found that scheduling could be improved by a great extent, if the scheduling department would conduct

frequent meetings with the supervisors because they are the one who are in direct contact with the operators. Most of the machine efficiency improvement ideas come from the shop floor, and these ideas were first discussed with the supervisors. So by involving supervisors in scheduling meetings these ideas could be discussed and implemented for efficient scheduling. For example, cutting the same materials in one batch to reduce setup time, or creating more detailed drawings to make the inspection process easy and fast.

Engineering Management

As mentioned in the previous section this project provided me an opportunity to work with various levels of management. By the completion of the project I had a better understanding of management strategies and conflicts. Some of the areas I dealt with during this project were:

Planning: I was involved in project planning from the conceptual stage and played the role of an active planner throughout the project. Initially, I prepared a master plan for the TPM implementation for the whole plant and submitted that for management review. This plan was prepared by using a project charter and covered all the steps required for implementation with tentative dates. I also completed the project planning for the individual departments of Goetze. The individual plans were more elaborated, because they included the material and resources required for the project completion. I had an understanding of how to use the planning tools, but had never used those for a real project. So, it was a good opportunity for me to sharpen my planning skills and I learnt a lot throughout the project, for example, deadline estimation and assignment, forecasting, resource management and financial aspects related to project planning.

Supervision: As I was dedicated to the project on a full time basis, the whole implementation process was carried out under my supervision. I had direct communication with shop floor employees and I supervised and guided them throughout the project. Initially, I found it hard because of the employee's resistance to change, but eventually I started understanding their behavior and planned my own strategies to deal with both social and technical conflicts. I learnt a lot about human behavior and interest-conflicts throughout the project. I will always be thankful to my supervisor for guiding and training me on how to deal with different conflicts in a work environment. I supervised a number of teams working in different areas and environments, which gave me an idea about how behavior changes with a change in environment. I found that a person working on a CNC machine is more adaptive to change as compared to a person working in a foundry or other conventional machining environment. To find out the cause, I interviewed a number of individuals from both the environments and the result was as expected; a neat and clean environment makes an employee more efficient and flexible for change in a system. On the basis of this analysis, an attempt was made to provide the same work environment to every employee regardless of the shop or department he works in.

Project control: This is the other aspect where I found myself more strengthened on successful completion of my thesis. Because this was my first live project, I had no past experience in forecasting and working under pressure to achieve the target before deadline. But, throughout this project, I completed the forecasting and planned strategies to complete the project in the specified time, which in turn sharpened my project managing skills. In some situations, if I found one team was lagging behind another, I moved some of the personnel from the leading team to the team that was behind on their tasks. Sometimes, I also provided more recourses and training, if project was delaying or losing its pace. All these activities really helped me to learn resource management and project control.

Supervisor Agrees: Ravi's work assigned to him in Goetze was quite exhaustive and accomplishing. Ravi's work in understanding, first, the scale and the complexity of the problem through detailed analysis of the data collected of the plant losses and study of human behavior, linking it with the plant problems of huge losses in terms of breakdown and quality problem is worth to the company. Thus it

helped the company in bringing the losses down and implementing the TPM through 'Total Employee Involvement'

2. Please check the following options that apply:**2.1: During this reporting period, I have applied theory in:**

- Analysis/Interpretation
- ✓ Project Design/Synthesis
- ✓ Testing/Verification
- ✓ Implementation

Supervisor Agrees: Ravi's work of creating the different analysis tools in MS Excel sheet using pivot table for analyzing the data trend, plan for preparing methodology for introducing and implementing TPM. His initiative in providing the training on TPM to the employees is quite accomplishing.

2.2: I have obtained experience by:

- ✓ Studying or being exposed to existing Engineering works
- Applying Designs as part of larger systems
- ✓ Experiencing the limitations of Engineering designs
- ✓ Experiencing time as a factor in the Engineering process

Supervisor Agrees: In the process, Ravi has been exposed to various complex issues of like co-ordination between Engineering Design and actual shop floor practices. Various conceptual issues of plant maint., who were all the time focusing on the breakdown maint rather than preventive approach and involving people. Thus he understand and co-ordinate the TPM activity well.

2.3: I was exposed to the following areas of Engineering management:

- ✓ Planning
- ✓ Scheduling
- Budgeting
- ✓ Supervision
- ✓ Project Management
- Risk Assessment

Supervisor Agrees: Ravi successfully designed the fixtures to bring the down the setup time on the machines. Making the tentative standards for machine upkeep, it also helped the operator' s understanding of the machine and in implementing the TPM.

2.4: I was required to make decisions based on professional and ethical responsibilities to:

- The Public
- ✓ The Profession
- ✓ The Client and/or Employer
- ✓ Co-Workers
- The Environment

Supervisor Agrees: Ravi directly deals with the employees thru out the project and have been ethical

with all and all the time.

3. Describe any activities that have improved your Communication, Teamwork, or Interpersonal Skills in the following areas:

Oral Presentations:

Because this was an industrial project, I spent most of the time in the plant monitoring and supervising various project related activities, which required good communication skills. I found a significant improvement in my soft skills on project completion. I gave presentations at various stages of the project, including presentation of the TPM introduction to management and initial training to the employees. In addition to that, I presented the project progress to management and employees on a regular basis. I also presented a paper at the Uttaranchal State Science Congress conference. At the final stage of the project, I presented the journey of TPM at Goetze, which highlighted all the phases of the project, resources utilized and the benefits received from the project. After completion and result compilation I presented my work and findings in front of the production department of Punjab Engineering College.

Written Documents:

There was a lot of technical as well as formal writing involved in the project, which provided an opportunity to sharpen my writing skills. I wrote a number of instruction manuals for preventive maintenance and daily checks for different machines. Throughout the project I wrote a number of office memos and circulars to conduct project meetings and discuss progress of the project. I also preferred written communication with my supervisor and always wrote him email for any doubt and question. In addition to that, I also wrote the project progress reports on a monthly basis. On the completion of the project, I wrote the final thesis report, which was the university requirement for the fulfillment of my post graduate degree. Moreover, I wrote a technical paper under the title of "TPM, An Effective Tool for OEE Improvement", which was published in the journal of Uttaranchal State Science Congress Conference, India

Interaction with Others:

Other:

Supervisor Agrees: Ravi has always presented his study work timely. Ravi participated in all meeting with various deptt. manager. Ravi shows his engineering skills and other soft skills while implementing the improvements.

4. During this period, I had to consider the social implications of my work in the following areas:

During this project I worked closely with shop floor employees and realized that they have their own work comfort zone. Any alteration in that comfort without their consent could affect their productivity and product quality.

At Goetze we were manufacturing critical components for automobiles. So there were a number of guidelines that I had to follow while redesigning any process or equipment. For instance a piston is like the heart of an engine and any flaw in casting or inaccuracy in machining can cause a complete engine failure. Our clients had a number of obligations towards the product user under the warranty agreement and we had to understand those obligations to provide better service to clients. This provided me an opportunity to learn an engineer's obligations towards the society and end user. During this tenure, I also learnt safety regulations for the auto industry. I also learnt some labor laws to provide a safe work environment to the employees.

Supervisor Agrees: During the project Ravi constantly shown the responsibility in maintaining the good relation ship with all the employees.

5. Examples of my ability to work effectively as part of a team, during this period, include:

The whole project was based on team work. I planned and practiced in all routine activities which are carried out in a team environment. We discussed the issues in weekly meetings and I actively participated in those discussions .During this project I also learnt how to set up teams in a manufacturing environment and how to resolve any conflict or issues within the team. For instance while building a team for a specific kaizen I had to look at all the aspects for the given situation and then find the right people with the desired skill level within the organization. In initial stage of a project, sometimes I found there as a conflict between team mates regarding ideas and methodologies. So in those situations I jumped in to found a way to settle down those conflicts without disturbing the team environment. During this project I worked with various teams with different skill levels.

Supervisor Agrees: Ravi showed good managerial skills, Ravi is a good team member.

6. Examples of my ability to assume responsibility include:

The whole project was well structured and had a time frame assigned to each activity. My main responsibility was to assist the TPM coordinator for successful completion of each module of TPM implementation. In order to complete project activities within a given deadline, I arranged project meetings and provided additional resources if the project was falling behind. I also wrote monthly reports to indicate the project growth for the given time period. I assisted colleagues and other departments in several situations to accomplish TPM goals. I arranged TPM training sessions and gave training to employees for the successful completion of the project.

Supervisor Agrees: Ravi is a dutiful and duty bound. He full understand his responsibility well and work for it.

7. I have shown progress since the last report (where applicable) as follows:

Supervisor Agrees.

8. I feel myself to be lacking in exposure to, or requiring improvement in, the following areas:

I did forecasting at various points during this project but still I feel I need to sharpen my project time estimation skills. I also found myself less confident in dealing with social conflicts in certain situations. I would like to have more exposure to engineering management techniques like project planning and budgeting. I would also like learn more about project control specifically monitoring of expenditures and resource management.

Supervisor Agrees: I don't see it a problem , it is there in the industry all the time with everybody.

9. I would like to provide the following additional, relevant information:

APEGM will recognize a certain percentage of work done within a post-graduate program.

Eligible Experience				Ineligible Experience			Report Total
Thesis	Teaching	Other Projects	Total	Courses	Other	Total	Months
14.5	0	0	14.5	0	0	0	14.5

Supervisor: "I am qualified to comment on the quality of this MIT's work because:

I am certified TPM counselor and Sr. Manager - Manufacturing Excellence.

I am certified TPM counselor and Sr. Manager - Manufacturing Excellence.

I make the following evaluation and recommendation regarding the progress report for this MIT:

During his project work Ravi showed the great dedication towards the project assigned. His systematic approach to the problem solving was quite good. He helped the team member in learning various tools and techniques of problem solving and analysis. His approach towards continual improvement is quite good. He played the role good trainer to his team members. Ravi work of TPM was quite rewarding in terms of reducing the losses of setup time by 40% and inspection time by 30% by introduction of OEE and on-line inspection system. Recording of the loss data, calculating the OEE in regular and systematic way helped further in reduction of losses.

In my opinion, during this reporting period, (Mar 10, 2004 - May 25, 2005) (14.5 months), Raviinder has completed an equivalent of 14.5 months full time engineering work experience.

Please show my comments to the MIT.
