CHAPTER IV

CONCLUSION, EVALUATION AND RECOMMENDATIONS

This chapter concludes the project-based production planning and control system, which has been developed for the distribution transformers division of PEM. Then the system is evaluated basing on the expected benefits, which should be gained from all applications which have been applied in comparison to the traditional system. The recommendations for further improvements of the system are also proposed.

4.1 Conclusion

The developed system can be concluded as follows:

4.1.1 Project Planning and Control Process

Project for manufacturing an order of distribution transformers can be broken down into nine main processes namely Insulation production, Low voltage coil winding, High voltage coil winding, Core cutting, Core stacking, Core and coil assembly, Vacuum and dry, Tanking and oil Filling, Final assembly. These repetitive tasks are viewed as the integration of many small batches in order to allow overlapping work. The maximum number of distribution transformers which can be contained at a time in the oven for the drying process is employed as a criterion for the determination of batch size.

The activity duration estimate is broken down for each batch as smaller time consuming elements in order to reduce hidden task. It is made under normal working conditions, normal level of resources and normal efficiency to get the most

realistic estimate. Besides, the estimate of an activity duration is independently considered for preceding processes and succeeding processes; also. It neglects events with contingencies. The estimate for each process is made by the most knowledgeable production leaders, who have close experiences with these processes and hold responsibilities for their achievements. In addition, these estimates are approved by section manager, again, so as to reduce bias.

The ladder technique is applied to represent network plan of repetitive and overlapping process, which are dependent upon a continual flow of processes from other batches. The materials requirement for each process is included in the network plan as the milestone, batch by batch. Furthermore, the dependency relationships of each activity in the network are linked together with many types of precedence diagraming constraints.

The quantity of each material which is needed is planned and ordered batch by batch. The resource constraint is resolved with heuristic approaches. Next, the project planning network is precisely converted on the rolling-wave basis to set as daily production target schedule.

The performance measurement of each process is done at the appropriate level of measurement in terms of Equivalent Unit (EU). The data collection system is developed in an attempt to maintain the current data collection system as much as possible. First, with the traditional operator's work record, the production leaders are assigned the responsibility to verify daily production reports of his/her workers. Then these results are summarized in the form of daily production reports and are sent to the office on a daily basis.

The concept of Line of Balance (LOB) is modified to establish the monitoring system to monitor, control and present progress against target in relation to time and accomplishment at each process as the control point, except the Vacuum and dry process - since generally, there is no deviation between actual and target performance for this process.

Four project monitoring indicators, namely Percentage completion, Project performance ratio, Forecasted project duration and Cumulative actual final assembly to delivery contract comparison, are developed to measure the performance of the entire project.

Each production leader has the responsibility to send daily production reports to the office and to record the results on his/her Production Centre Monitoring Board. While the officer has the responsibility to key in daily production results onto Production Monitoring and Control (PMC) program and to update Project Monitoring Boards.

4.1.2 Project Management Tools

Network planning model is set as the template on Microsoft Project software package, which provides many sophisticated project management applications. Then this plan can be converted to daily production target schedule by Production Schedule (PS) program. While the developed Material Requirement Schedule (MRS) program is capable of planning materials requirement and generating the purchase requisition.

The production results of each process are represented not only in numeric but also in graphic forms on Production Monitoring and Control (PMC) program and on the Production Centre Monitoring Boards installed at each production centre.

Similarly, project monitoring indicators are graphically depicted on the Project Monitoring Boards in the office and on PMC program, also.

4.2 Evaluation

The developed project-based production planning and control system is evaluated by basing on the expected benefits, which should be gained from each application of the system.

With the overlapping approach, which breaks down the whole project to many smaller batches, building up a plan from smaller parts is more convenient. The second batch does not have to wait until the first batch is completed to start. This leads to shorter project duration. Besides the time estimate of each process, which is broken down for each batch as smaller time consuming elements, can reduce the number of hidden activity duration estimates.

Ladder technique, which links activity in project and materials requirement milestone batch by batch in the network, allows project managers to know when each process of each batch starts and finishes - which benefits not only in project monitoring and control but also in materials planning. Network planning with ladder technique also provides the identification of floats and critical paths which are very crucial in project planning.

Moreover, materials requirement can be planned and ordered in batches with Just-In-Time (JIT) delivery. This not only reduces the delay due to materials shortage but also reduces the problem of huge inventory from materials arriving too early before needed. The possibility of damages and losses due to re-handling, deterioration and pilferage of the materials on the site will be less. Besides, the cost due to interest on their payments will be lower, also.

MRS program, which has been developed, is capable of facilitating the computational procedure of materials planning, items by items and batch by batch. It can generate purchase requisition of every production centre with little processing time and high accuracy.

The application dependency relationships of precedence diagram with lead and lag times allows more overlapping by concurrent working of the activities and leads to shorter project duration with better duplication of more realistic manufacturing situation. This network planning model, which is developed as the template on Microsoft Project software, provides many resources management methods and other sophisticated applications. The project manager is able to explore more to get the best solution using this software. For resources constraint management, because of no optimum priority list for optimum result, it is typically accepted that heuristic approach with a set of decision rules will always provide a better schedule than the "ad hoc" approach.

Converting the network plan to production schedule of each process against the time table provides better project monitoring and control on the day-to-day basis. PS program developed can facilitate the scheduling computational process with great accuracy.

Daily monitoring system is effective. Because it provides required information to make timely decision that will keep project performance as close as possible to the project plan. Hence, there is still time for corrective measures. The project manager is able to anticipate problems or catch them just as they begin to occur.

The data collection and report are developed in an attempt to maintain the current report and data collection system as much as possible, to get commitment

from workers, to comply ISO-9002 requirements with little added works and no confusion. These reports are simple and friendly. They are single-paged documents, which are reported against defined criteria for control, requiring simple numeric and easy to use to ensure accuracy. The worker spend little time to fill in. Besides the measurement in term of EU which has been modified is easy, appropriate, and more accuracy than traditional approach.

Each production leader has the responsibility to send daily production report to the office and to report the results on his/her Production Centre Monitoring Board. This promotes workers' participation and improves their morale by knowing what they have done and what they must do. Besides, placing monitoring and control as close as possible to the work being controlled with the desired simple possible mechanism is a good rule to achieve in monitoring and control.

The operation control application can show the progress, status, timing, and phasing of the interrelated processes. These interesting data support management with a method of comparing actual performance with plan, whether or not the objectives of the whole project are being met. Therefore, section manager is able to pinpoint activities deviating from the plan and those which are not in balance with the rest of activities, so as to determine the severity of these deviations and the magnitude of corrective actions needed to put the project back on schedule.

Percentage completion indicator with applied weighting can represent the project status in overview with more accuracy. While due to the wide range of order size, Project performance ratio has ability to reduce the distortion of variances between actual and target due to the size of the project when the project is carried out. Forecasted project duration with an early warning to predict the project completion day comparing with baseline duration is advantageous. While

Cumulative actual final assembly to delivery contract comparison can show executives how many distribution transformers have already been finished and are prompt to be delivered to customers according to the delivery contract. All of these indicators on Project Monitoring Boards in the office allow the executives to know the project status and determine trends at a glance.

PMC program, which has been developed is capable of automatic calculation and is graphically depicting progress of every production centre, all project monitoring indicators, EU results of the Insulation production and the Core cutting production centre with great accuracy and is keeping them as baseline database in form of both numeric and graphic forms. These database can benefit as historical data for future projects.

Keeping original targets of every production centre as fixed baseline in computer database to measure against progress is an advantage. Because, if the plan is updated to reflect current progress, it will be impossible to calculate variances, and control will be lost. Comparing the differences between desired and actual performance levels is useful as a basis to indicate trends and to further account for why such differences exist. Furthermore, these database can benefit as references for future projects.

Computer-based project management information system with adopted and developed software has an immense power for handling large and complex projects. It is capable of not only keeping database but also processing large volumes of data with not only in a short space of time but also with low risk of errors. Furthermore, it releases project managers from processing large amounts of data manually and, thus, allows he/she to have more accurate information and to have more time to concentrate on managing the project effectively.

4.3 Recommendations

Although the project-based production planning and control is developed to fit the requirement of the distribution transformer division of PEM, there are still some recommendations for further improvement as follows:

1) The study was conducted in the distribution transformer division of PEM. The system developed here may be applied to other divisions because they have similar nature of operations.

2) In this study, the criterion for evaluating the system is delivery with the assumption that it will have positive effects on other performances. However, due to trade off among project objectives, the system may be extended to evaluate other performances such as quality and cost to improve decision making.

3) Although the time and the quantity of materials are precisely planned with network planning model and the MRS program, material delivery delay in many cases are inevitable. Therefore, the company should develop supplier customer relationship to improve material delivery performance. Moreover, the follow-up of delivery must be strictly performed.

4) Although he activity duration in the project is estimated as deterministic, the company may apply probability theory of the PERT statistical procedure. Three time estimates, namely an optimistic time, a most likely time and a pessimistic time may be employed to get a measure of the uncertainty associated with the actual time required to perform each activity in project. This can reduce chances that crashing will be needed because they include uncertainties that are sometimes forgotten or ignored when making deterministic time estimates.

5) When the system has been implemented on each project, its data should be kept to establish standards or threshold variances for each production centre, for later projects.

6) Project planning and control technique is a management tool and is not a substitute for management. Then the project review meeting should be held regularly at fixed intervals to make group decisions or get input for important problems. Meeting must be formalized with people invited because they have something to contribute. It should be held at many levels of hierarchy. The frequency of meeting may vary depending upon the risk, and the point in the project life cycle.