CHAPTER 2

LITERATURE REVIEWS

This chapter will present literature reviews of techniques and factors focusing on human resource in terms of human resource allocation planning and Microsoft Project.

This means text books, journals, researches and websites are reviews and studied. The resource allocation planning for multi projects and combination of the planning and Microsoft Project will from the reviews will be described.

2.1 Project Management

Project management is *"the means, techniques, and concepts used to run a project and achieve its objectives"* Meredith, J. R. and Mantel, Jr., S. J., 2003. MD's work of MD according to the Thermal power plant project is as a construction project. Therefore, the management for the construction project is necessary. Basic philosophy of construction project management is *"simply stated in three words: plan, organize and control"* (Ritz, J. G., 1994). The activities of the words are:

Plan activities

Plan or project planning activities consists of construction execution plan, time plan, money plans, and resources plan. The details of the plan are:

- Construction execution plan is the master plan starts from bidding to completing for executing the field work.
- Time plan is the itemized working plan to generate the detailed construction schedule for project execution.
- Money plans compose of project budget according to an estimated cost of the project.

- Resources plan is to forecast the requirement of the human, material and systems resources in order to execute the project refer to the master plan and the schedule.

Organizational activities

These activities are to assign the human resources and systems to meet that requirement of the master plan and the project schedule. The activities are:

- Prepare organization charts and personnel loading curves
- Write key position descriptions
- Issue site operating procedures
- Mobilize and motivate the field staff
- Arrange site facilities and systems
- Issue and start control procedures

Control activities

These activities mainly concern on the following area.

- Quality: field engineering, material, and construction
- Time: measured by the construction project schedule
- Money: measured by construction budget and cashflow plan
- Measuring physical progress and productivity
- Project reporting

Buay, S. S., Ann, T. T. and Tiong, O. C. (1997) presents that details about the project management and human resource allocation plan that are necessary for Microsoft Project program and can be detailed as follow:

a. Planning and scheduling the various activities of the project so that it can be completed on time.
b. Allocating the necessary resources.

c. Organizing and motivating the project personnel.

d. Directing the implementation of the project.

e. Monitoring and controlling project progress.

The details of the project management from those authors and others are as follows.

2.2 Critical Path Method (CPM)

The Critical Path Method (CPM) is a method for scheduling planning of the project. It is created from a number of individual activities. The project will complex when some activities can start after the other activities has been finished. CPM is useful for such complex project by applying the following steps (Buay, S. S., Ann, T. T. and Tiong, O. C., 1997).

- Creating a Work Breakdown Structure.
- Creating a Network Diagram of the Project.
- Computing Activity Times and Activity Total Float.
- Computing the Project Duration and Critical Path.
- Creating an Activity Schedule Table.
- Creating a Gantt chart Schedule.

2.2.1 Creating a Work Breakdown Structure

When create a project, the major section of work are needed to list first. Then list the sub item into the major sections. This is the process to create a work break down structure.

Work Breakdown Structure (WBS) is a process to breakdown the activity of work from major sections into sub-items level and layout of WBS is very likely to a document outline. WBS numbers is in consecutively (e.g., 10, 10, 30, 40, 50). Number of the next level is within the number of its parent item (e.g., 10.1, 10.2, 10.3, 10.4).

2.2.2 Creating a Network Diagram of the Project

Creating a network diagram which shows pictorially the sequence of activities and their relationships in order to have the Work Breakdown Structure and defined the activity precedence.

2.2.3 Activity Times and Activity Total Float

There are four important activity times which required for computing starting and finish time (Buay, S. S., Ann, T. T. and Tiong, O. C., 1997).

- Activity Earliest Start Time (EST)
- Activity Earliest Finish Time (EFT)
- Activity Latest Start Time (LST)
- Activity Latest Finish Time (LFT)

"Activity Total Float is the amount of time that an activity can be delayed without affecting the overall project duration" (Buay, S. S., Ann, T. T. and Tiong, O. C., 1997). When the resource is limited but the resource requirement at that time is higher than the resource availability, the activity can be shifted out to a later time but not more than that Activity Total Float.

2.2.4 Project Duration and Critical Path

It can be summarized a project duration and critical path as below (Buay, S. S., Ann, T. T. and Tiong, O. C., 1997).

- The EST of the END activity is the shortest project duration.

- All activities which is the path composing of all activities with zero total float is the critical path. No delay shall occur in any activity of the critical path.
- The critical path has a shortest duration of the project.
- The critical path is usually labeled by colouring or drawn two small stroked across all activities.

2.2.5 Activity Scheduling

It is possible to derive a schedule for all the activities in the project by compute ESTs, EFTs, LSTs, LFTs and floats on the network diagram.

2.2.6 Creating a Gantt chart Schedule

A Gantt chart is a pictorial display for the activity schedule table. The Gantt chart consists of bar which is plotted separately line of the vertical axis. The horizontal bar starts at the start to finish of each activity. It consists of the number and name assigned to each activity. The length of the bar shows duration of the activity which can be expressed in hours, days, weeks, months and etc. Length of an arrow after the bar illustrates the total float.

2.3 Resource scheduling

CPM produces schedule in term of activity duration. Resource usage chart is firstly plotted for each used resource in the project.

- **Resource Leveling**

Some resources are not available in many projects. It means the resource is constraint. Re-scheduling of activities is required to manage the usage of resources not exceed the limit.

The resource usage leveling can be done by plotting a resource chart. The resource loading is identified in the resource usage chart of MS project program. The leveling will

start at resource overloading, looking for activities using particular resource/period that have float. Then shift such activities to a later time. All shifted activities have to be checked their free floats. Continuity shifting until there has no resource overload.

In order to make a smother distribution of resource usage the resource leveling required to minimize the period-by-period variance in resource. Strength forward is the basically resource leveling. Resource leveling can be used for almost all projects.

2.4 Project and Activity Based Costing

Since some projects, some activities are needed to contract out to subcontractors. The resource usage and the cost of such activity are not concerned. The quoted cost (direct cost) of such activity shall be interested.

Moreover, the cost of maintaining the construction site shall be concerned. It is needed to run site office work, insurance and security for the site. Such cost calls indirect cost.

2.5 PERT

Program evaluation and review technique (PERT) is one of several related techniques for doing project planning. PERT charts specify with task, duration, and dependency information. It starts initiation node of the first task of the project.

In case some changes in the activity durations and cannot be controlled, the exact duration of the project cannot be controlled. PERT is brought to carry out a project duration with a standard deviation of the project.

Three times estimates instead of one have been used for each activity. The mean deviation and standard deviation of the activity duration can be computed.

By using the same network techniques as in CPM, the mean project duration can be found. By making a few assumption and statistical theory, the project duration and completion can be easily computed.

PERT is suitable for R&D projects when the duration of activities are more difficult and uncontrollable variation. CPM is more suitable for the projects that have more certain duration of activity such a construction project.

2.6 Multi projects Resource Scheduling

When there is more than one project, human resources for the projects should be pooled and then scheduled for the projects. The resources should be well managed for the scheduled. However, the problems from the resource scheduling management can be occurred that Gray, C. and Larson, E. (2002) mention about causes of the problems are:

1. The resources are shared for the projects. When one project delays, other projects will be effected and delayed;
2. The resource requirement and schedule are different so that the resources are lower, equal to and more than their requirement and
3. The resource is short because the projects schedules delay.

He also mentions about a method to solve the problems. The method is "first come first serve". This means the resources will be scheduled to a critical work as the first priority. In the same direction, Burke, R. (1999) mentioned about the resource management for multi projects scheduling that the resource will be assigned to the high priority first. This will help the resources fulfill their requirement all the time.

2.7 Human resource allocation

Human resource allocation is to provide the resource to fulfill the resource requirement at each time. Project delay and the high cost of excess resource may be avoided when the resource is smooth used. Therefore, the resource allocation is important for the project (Meredith, J. R. and Mantel, Jr., S. J., 2003).

There are various articles mentioned about resource plan and allocation. The literature reviews conform to the resource allocation are as below.

Gomez-Mejia, L. R., Balkin, D. B. and Cardy, R. L. (2001) mentioned *"Human Resource Planning (HRP) : The process an organization used to ensure that it has the right mount and the right kind of people to deliver a particular level of output or survives in the future"*. This definition is related to the demand-supply and workload planning of the human resource allocation planning.

Mawong, C. (2000) studied the human resource development of Control Instrument Project Department, Ratchaburi Cycle Plant Project, by using Microsoft Project as a tool. As a result, compared with the present method being used, new proposed method helps increase effciency of workload planning, utilization planning as well as budget planning. This method is beneficial for human resource allocation planning especially for the priority, expenditure and skill. By the research, the method consists of six planning steps (see Figure 2.1) which are as follows:

- Step 1: Situation Analysis
    - Project Schedule
    - Department structure
    - Human Resource Framework
    - Human Resource Cost
- Step 2: Demand Analysis
- Step 3: Supply Analysis
- Step 4: Gap Analysis
- Step 5: Solution Analysis
    - Resolve human resource gap
    - Establish human resource plan
- Step 6: Plan Elevation
    - Define tracking progress
    - Compare the base line to actual data

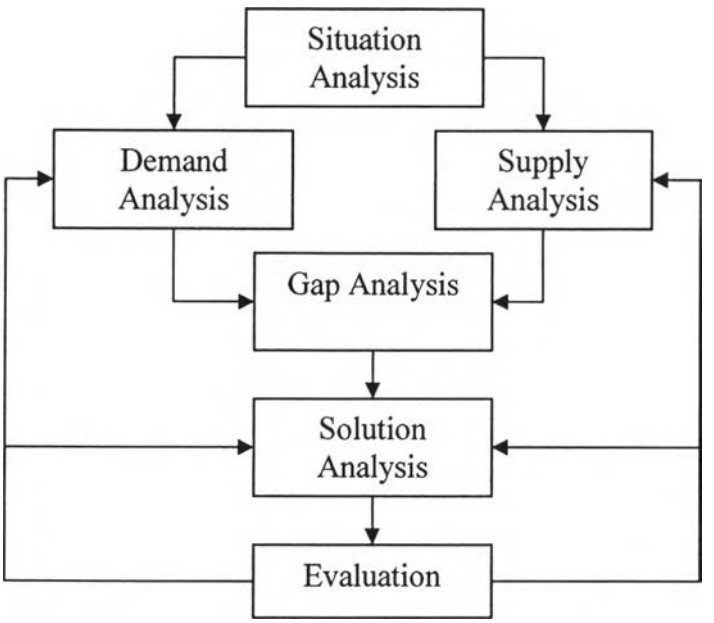

Figure 2.1: Human Resource allocation planning method (Source: Mawong, C., 2000)

Hendrichson, C. (June 1998). Project Management for Construction, Chapter 10 Fundamental Scheduling Procedures.

This web provided the very useful overviews, principals and example of human resource allocation planning. The key findings from the study are as follows.

1. The Resource oriented scheduling should be applied when:

    - There are various project activities at the same time but human resources are limited available.
    - Multiple projects are managed with fixed resources.
    - Unique resources are to be used.
    - Particular resources need a reservation system.

2. Scheduling with Resources Constraints and Procedures.

Resource constrained scheduling problems such as fixed resource and cost problem is suggested to solve by using numerous heuristic methods. The Procedure is as follows.

A Resource-Oriented Scheduling Procedure

Step 1: Rank all resources from the most important to the least important, and number the resources.
Step 2: Set the scheduled start time for each activity to the earliest start time.
Step 3: Start at the project beginning.
Step 4: Compute the demand from resource at time by summing up the requirement for resource for all activities scheduled to be underway at time.

If demand for source in time is greater than the resource availability, then select the activity with the greatest late start time requiring source at time, and shift its scheduled start time to time. Repeat Step 4 until the resource constraint at time for resource is satisfied.
Step 5: Repeat step 4 for each project period in turn.

2.8 Control of change

Construction project is a dynamic project. This means the project can be changed all the time depending on many factors such as material delivery delay, lack of worker, the precedence work delay and so on. In order to meet target of the project which is to finish the project within time, the control of change is necessary for concern parties especially the top management who responds to the project. Hall, E. with Johnson, J. (2003) propose the guidelines to control the changes. The guidelines can be summarized as follows.

1. Any one who associates with the project can request the change.
2. The request has to be evaluated to determine the effect to the project.
3. The project manager and team have to consider the resource required in order to substitute the change.
4. The project manger has to inform the impact of the change in terms of cost, scheduling and performance to the customer.
5. In case the change is approved, the client and the manager authorize the team to make the requested change.
6. The project plan has to be revised for implementation.

7. The information of all approved, unapproved and deferred changed have to be informed to the team by the manager.
8. The Project Change Request Form has to be logged, regardless of its approval or denial.

2.9 Monitoring and Project Performance

Gray, C. and Larson, E. (2002) mentioned that monitoring can be used for control project performance. The monitoring point depends on an objective of the projects management. For example, progress of projects is monitored when the project has to be finished no later than its finished date. The monitoring consists of four steps:

1. Setting a base line plan

Elements of measuring performance are provided by base line plan. The base line is comes from work breakdown structure database. The project work schedule, resources, and budgets are identified in the base line plan.

2. Measuring progress and performance

This steps measures project time and cost. The time is measured in progress of the project. The cost is measured related to the time. Then the result will present performance of the project management.

3. Comparing plan against actual

Data of the actual time and cost of will be compared to base line plan. The data will be clarified whether it is less, same or higher than of the plan. Monitoring and report should be done in this step.

4. Taking action

In case the actual data is not the same as of the plan, it means the data deviate from the plan and project changed occurs. The change should be corrected. The correction can be bringing the project back to the plan or adjusting the plan.

2.10 Information and reporting

Information of projects such duration time, budget and resource utilization, etc. should be known by the involved person. Communication for the information is necessary. Jack presents that information of the projects such as human resource utilization, time, cost and so on will be communicated among involved people by report and meetings.

2.10.1 Report

The reports have to be containing relevant data. The data, which consists of the logic of the planning, budgeting and scheduling systems, can be used to control the projects. Benefits of the report are (Meredith, J. R. and Mantel, Jr., S. J., 2003):

- Manual understanding of the goals of the project.
- Awareness of the progress of parallel activities and of the problems associated with coordination among activities.
- More realistic planning for the needs of all groups and individuals working on the project.
- Understanding the relationships of individual tasks to one another and to the overall project.
- Early warning signals of potential problems and delays in the project.
- Minimizing the confusion associated with change by reducing delays in communicating the change.
- Faster management action in response to unacceptable or inappropriate work.
- Higher visibility to top management, including attention directed to the immediate needs of the project.

- Up to date on project and inform to the client.

2.10.2 Meeting

This process means face-to-face meeting among involved people. The most relevant subject will be touched in the meeting. The people can know status and details of project. If there is a problem occurs, the solved decision can be made in the meeting.

2.11 Project Management Software

Project management software tools are worldwide used for managing project. The software can help manager meet the objective of the management. Gantt chart can be made by using the software. Task in the Gantt chart illustrating the project data such as job activities, duration time, cost, resource and etc., which are necessary for the management, are presented by using the software. The manager can change detail data of the project and looks for result of the change. Moreover, report of the information can be gained.

2.12 Project management and Microsoft Project

Microsoft (MS) Project program is one of the software used as a tool to control time, cost and quality of the project. Project scheduling, budgeting, tracking, analysis, reporting and communication can be gained from the program. Moreover, the program can be used for management of single project and multi projects. Therefore, the program is useful for the person who manages the project (Courter, G. and Marquis, A., 2000).

Gray, C. and Larson, E. (2002) stated the Assessing Resource Allocation by using MS Project programme. The modified steps used of human resource allocation for the Mechanical Department in this study are as follows:

1. Assess whether it has overallocation problems.
2. Identify where and when conflicts occur by examining the resource usage view.
3. Resolve the problem by:

a. Replacing overallocated resources with appropriate resources that are available. Then ask if this solves the problem.

   If not:

b. Use the leveling tool and choose the level within slack option.

   i. Does this solve the problem (are resources still overalocated?)

   ii. Check the sensitivity of the network and ask if this is acceptable.

   If not:

c. Consider splitting tasks

   i. Make sure to re-adjust task durations to take into account additional start and finish time.

4. If 3 does not work, then either:

   a. Use the level tool default option and ask if the project can be finished with the new completion date.

   If not:

   b. Negotiate for additional resources to complete the project.

   If not possible:

   c. Consider reducing project scope to meet deadline.

2.13 Articles and Papers in Various Journal

An efficient method for scheduling construction projects with resource constraints
International Journal of Project Management 19 (2001) 29-45
Chelaka, M., Abeyasinghe L., Greenwood, D. J. and Johansen, D.E.

In order to minimum the project duration when activities require common resources that are in limited quantity, an efficient allocation algorithm (LINRES) has been proposed by the author of this paper. From his study, the experiment was conducted with small network examples and compared result with those generated by existing heuristic rules. As a result, the general performance of proposed LINRES algorithm is found to be satisfactory.

Data envelopment analysis based decision model for optimal operator allocation in CMS

European journal of operation research 164 (2005) 800–810

Ertay, T. and Ruan, D.

The paper shows how to manage the efficient number of operator and the efficient measurement of labor assignment for cellular manufacturing system (CMS). It also proposes a frame work based on data envelopment analysis (DEA) for the most suitable operator allocation in CMS. The concept is by allocating a group of operators who are multi-skilled and trained to assist with several processes inside the same cell. DEA can be use as a tool technical or operational for decision-making in the manufacturing.

Human resource allocation in a multi project R&D environment

International Journal of Project Management Vol. 17, No. 3, pp. 181-188, 1999

Hendriks, MHA., Voeten, B. and Kroep, L.

The author of this article describes on how to optimize an existing resource allocation process by using the 'project scatter factor' and the 'resource dedication profile' applied in a large R&D organization and five elements which vital in the set up of an adequate resource allocation process. As a result, the factor and the profile can help the organization to optimize the allocation process. Five elements consist of

- long-term-resource-allocation;
- medium-term-resource-allocation;
- short-term-resource-allocation;
- links and
- feedback.

The relationship between five elements is shown in figure 2.2.

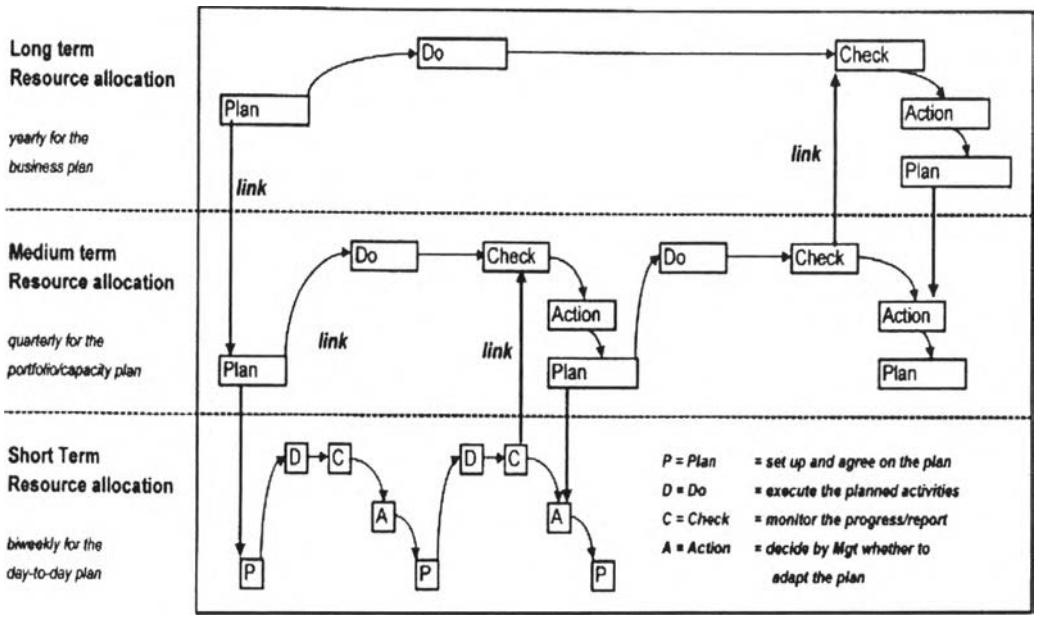

Figure 2.2: Link between the various resource allocation process (Hendriks, MHA., Voeten, B. and Kroep, L., 1999)

Petroleum pipeline construction planning: a conceptual framework

International Journal of Project Management Vol. 14, No. 4, pp. 231-240, 1996

Dey, P. K. and Tabucanon, M. T.

Since the pipeline construction project concerns with uncertain environment not only its enormous size, complexity in design (physical, manpower requirement and financial value) but also the involvement of external factors. So this paper has proposed the methodology for project control through risk analysis, contingency allocation and hierarchical planning models. The methodology for control changes is described as follows.

1. Determination of the scope of the project.
2. Preparation of a work breakdown structure (WBS) for the project.
3. Preparation of an organization breakdown structure (OBS).
4. Identification of risk factors related to specific work packages.

5. Assessment of the effect of risk factors on project objectives by estimating the probability and severity of risk factors for each work package from the construction perspective.
6. Establishment of project breakdown structure through a logical responsibility matrix.
7. Derivation of contingency provisions for the work packages using the results of risk analysis and activity analysis.
8. Cost and scope control through contingency appropriation.
9. Formulation of a strategic execution planning model for controlling changes in project parameters due to risk environment during execution stages.

The hierarchical planning model has been made separately in three levels-projects as shown in the figure 2.3.

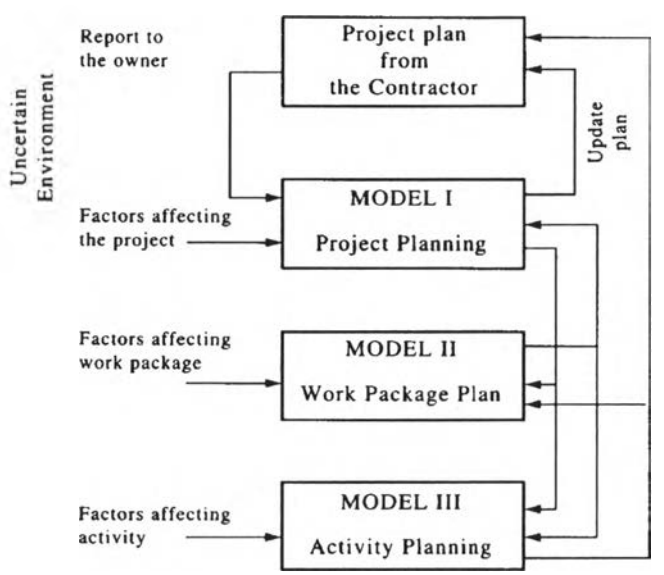

Figure 2.3: Hierarchical planning model (Source: Dey, P. K. and Tabucanon, M. T., 2000)

Project management applications of the theory of constraints beyond critical chain scheduling

International Journal of Project Management 20(2002) 75-80

Steyn, H.

The theory of constraints (TOC) is applied to develop specific management techniques. The application is to allocate resources that are shared by concurrent projects which maintaining the principles for reducing project duration on each individual project. Reduction of risk is proposed in figure 2.4.

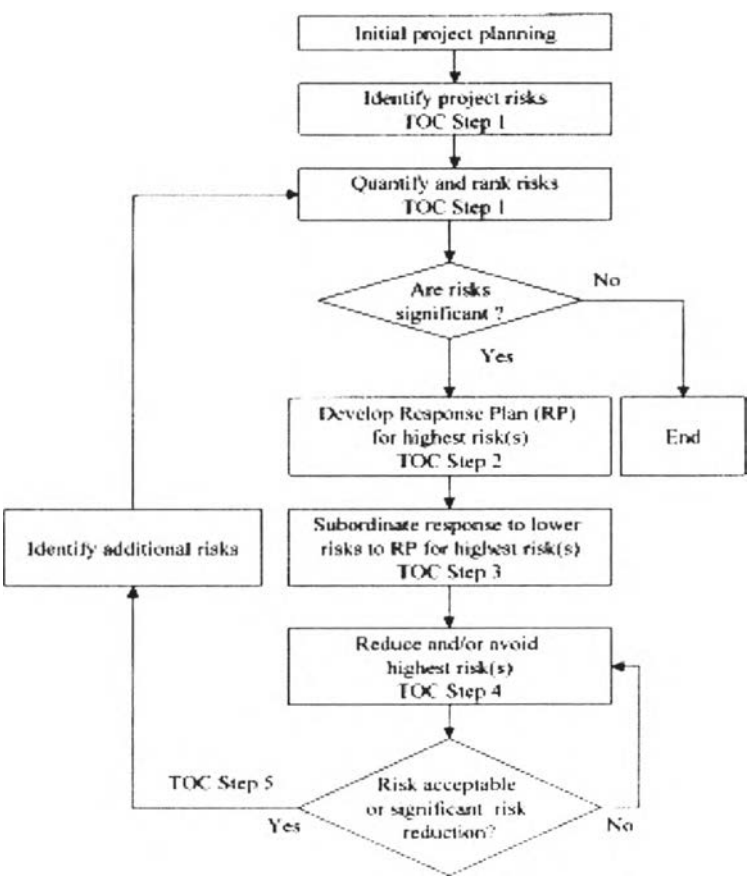

Figure 2.4: Proposed risk management model for systematic risk reduction (Steyn, H., 2002)

Real-time schedule adjustment decisions: a case study

Omega 32 (2004) 333 – 344

Hur, D., Mabert, V. A. and Bretthauer, K. M.

This article has described his study on how the manager make decision for addressing real time work schedule which made necessary by demand uncertainty and/or labor supply disruption. The correct information which derived from the analysis and evaluation via a controlled experiment is beneficial for schedule adjustment. Flow chart of the process from the article is shown in Figure 2.5.

It is responsibility of the manager to control the available capacity to match with the actual demand. The case study is based on a McDonald's franchise comprised of six restaurants. The result can tell that whether the adjustment decisions by the senior manager or the junior manager has the same profit. The experiment is useful and quick reference data source to assist in making a no-adjustment/adjustment decision.

In conclusion, matching demand and supply is a particularly challenging task in many service industries, as demonstrated by the article with quick restaurant.

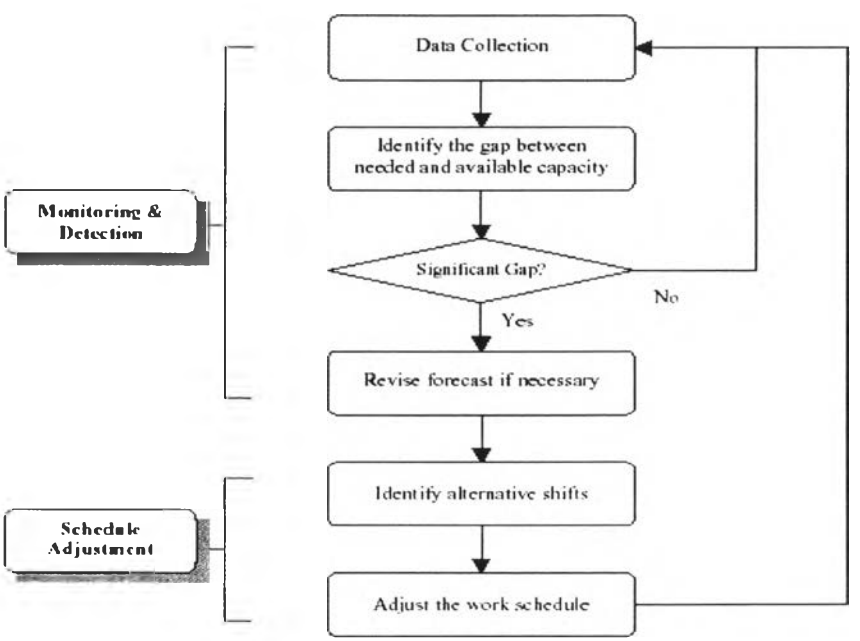

Figure 2.5: The process of real-time schedule adjustment. (Hur, D., Mabert, V. A. and Bretthauer, K. M., 2004)

Resource constrained scheduling simulation model for alternative stochastic network projects

Mathematics and Computers in Simulation 63 (2003) 105–117

Golenko-Ginzburg, D., Gonik, A. and Laslo, Z.

The paper proposed heuristic for resource constrained network project scheduling. The purpose is to minimizing the project duration by determining for each activity, its starting time. The resource will be based on decision making in the course of monitoring the subject.

In conclusion, the heuristic algorithm can be successfully used for monitoring complicated medium size projects with alternative structure and topology and with limited activity related renewable resources. The algorithm is performed in real time and adopted a wide range of revisions, alterations, overtime in the course of the project realization.