Abstract: Problem statement: Taiwan is located in the tropical ocean areas. The strong typhoon in summer often causes the collapse of electric transmission towers and results in power outages that seriously affect people’s lives and industrial production. Approach: In light of this situation, this study aims to employ project management techniques of Theory of Constraints (TOC) to develop a practical TOC model to quickly repair the towers and restore power supplied system. Results: The actual application had verified that the research model could not only shorten the duration of work but also save the manpower and material expenses. Conclusion: It once again proved the excellent results of reparation operations by applying TOC to project management.

Key words: Theory of Constraints (TOC), buffer management, project management, critical path method, Program Evaluation and Review Technique (PERT), electric transmission
When an organization cannot accelerate to achieve the goal, they should deeply explore the reason. They should find that such constraints are related with organization’s own policy, performance evaluation, management thinking and organizational structure. The constraints prevent the entire operational chain from better output. The TOC have been developed following five focusing steps: (1) identify the system’s constraint; (2) decide how to exploit the system’s constraint; (3) subordinate everything else to the above decision; (4) Elevate the system’s constraint and (5) if in the previous steps a constraint has been broken, go back to step 1.

**Project management solution of TOC:** Uncertainty is a common characteristic of project management that in planning project, you must first take into account the uncertain factors and expand slightly the completion time and budget to ensure that the promised completion time, contents and budget meet the requirement of the planning. Then find out critical path that is the longest path in the project network in which if any single operation in the path cannot complete on schedule, the entire project will be delayed. So the total time of the entire project is the total amount of complete time of each single operation. Therefore, in implementing the project management, you only have to control the complete time of each single operation to complete the entire project on schedule. However, the actual situation is not the case. According to Gutierrez and Kouvelis (1991) the statement of Parkinson’s Law, if the project staff feel there is plenty of time to complete it, they will slow down the pace of work or add some other works that will waste time allocated for the project and delay instead the deadlines for completing the project management. Also based on the “student syndrome” mentioned by Goldratt (1999) that the project staffs usually rush to work until the completion datelines approaching just like students who usually study hard until an examination approaching. So if we give the staff plenty time for completion in planning a project, the staff may lose their positive attitude toward the project and finally not only use up all of the allowable time but also delay the completion time for the entire project. Therefore, Schragenheim and Ronen (1991) introduced buffer management that when the implementation of project deviated from the promised, it should be immediately corrected.

Besides, Goldratt (1997) also introduced the management strategy for critical chain scheduling. That is, during the scheduling, in addition to taking account of the interdependency of resources for the operation, the management should also appropriately integrate the operations. When we determine a path as the critical chain scheduling, we should take the interdependency of resources into consideration.

**RESULTS AND DISCUSSION**

It is important to repair the power supply system as soon as possible to satisfy the demand of people’s livelihood and industry after the disasters. This study employed TOC to introduce five focusing steps in the resource investigation.
It found that the tower materials, iron fittings, wire, construction equipment and manpower were limited. So we sufficiently integrated the all resources and made breakthroughs. With reference of Kerzner (2009) projection management, the relationship between the preceding operation and the succeeding operation in Table 1 and the network diagram of construction project were established as Fig. 2. Then we figured out 18.5 days for restoring electricity transmission on sea-line and 21.0 days on mountain-line.

Finally we find out critical path according to construction scheduling for the project in Table 2.
Step 1: Inspect power outage  
Step 2: Dismantle damaged tower and assembly new tower  
Step 3: Move the sea-line cable  
Step 4: Prepare power transmission on sea-line

When the sea-line transmits the electricity on schedule, the operations of step 5 to step 8 are still under way. The reparation work should give special attention to the safety distance to avoid any electric shock accident and ensure the smooth operation. Due to the proper precautionary measures in advance, the mountain-line restored power supply within the time frame too that in 21 days the power supply had restored to normal from the poor quality caused by the typhoon:

Step 5: Power transmission on sea-line  
Step 6: Move the cable of mountain-line  
Step 7: Prepare power transmission on mountain-line  
Step 8: Transmission on mountain-line

CONCLUSION

Before the implementation of this project, several discussions and assessment concluded that it would need at least 60 days to restore power supply that not only people would not be able to tolerate the pain caused by long-time power outage but also the corporate could not afford to the loss. So it is necessary to restore power supply in the shortest time. After understanding the situations after the typhoon, this study used TOC to produce five focusing steps and find out possible bottlenecks the construction of project may face before considering how to make a breakthrough and pull all the non-bottleneck support to do it.

During emergent reparation operations, a full investigation on the location of available resources and possible difficulties was conducted. Through buffer management mechanism, it brought all resources and uncertain factors under effective control to fully support the reparation work and ensure it will be carried out smoothly. Thus under the full support of resources and in-time application of the management strategy of critical chain scheduling, the single circuit successfully transmitted in 18.5 days and the full transmission through two circuits was completed in 21 days. It once again proved the excellent results by applying TOC to project management.

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