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應用 TOC CCPM 戰略與戰術圖快速改善多專案管理績效--個案研究 研究成果報告(精簡版)

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Successful Theory of Constraints (TOC) Critical Chain Project Management (CCPM) implementations[1], persons involved in a multi-project management immediately raised two concerns when we presented TOC CCPM [2, 3, 4, 5, 6] to them. (1) TOC CCPM solutions are conceptual only; even success stories lack in depth discussions on how to translate the concept into practice to reach results (how to implement CCPM). Their major concern was the lack of solid implementation steps to effect change. (2) A good management foundation using a combination of PERT/CPM, ISO (International Organization for Standardization), a quality improvement program, an accurate standard operation procedure, standard time and cost, PDM (Product Data Management) or KM (Knowledge Management) is a pre-requisite, and reducing variation is the key. Building or improving the foundation (using management programs such as PERT/CPM, PDM, KM, Lean and 6 Sigma) should be the priority.

Regarding the first concern, Goldratt acknowledged that TOC CCPM has previously not had solid implementation steps. Consequently, he developed Strategy and Tactics (S&T) trees (Goldratt 2006) to provide step by step guidance for effecting change. Although the S&T tree logic developed by Goldratt is quite robust, TOC practitioners and academics have neither researched it extensively nor validated its effectiveness empirically.

With respect to the second concern, Goldratt [6] noted that most variations that occur are local (at a task level). The most significant global variation that occurs in project is variation in on time delivery (OTD) i.e. the ability of the project management system as a whole to deliver the required quantity of the projects on time. Reducing local variations by using management programs such as PERT/CPM, PDM, KM, Lean and Six Sigma, etc, does not automatically guarantee improvement in OTD. He also claimed that in a chaotic system, reducing local variations, adding more resources or giving more lead time do not contribute to improvement in OTD and should not be the first priority; instead, the first priority should be to stabilize the system. TOC CCPM and buffer management (BM) provide mechanisms to stabilize a system and reduce variations in OTD, the only significant global variation in project management. Chang [7] conducted an experiment to examine why it was so difficult to achieve high OTD in multi-project management environment. Thirty teams participated in the experiment involving 210 practitioners; the results indicate that the mode of project planning and execution (unrealistic project planning, a lack of clear working priorities

poor OTD, not uncertainty (net task time variation). The results support Goldratt's above claim. Kapoor [8], Jacob, et al. [9] suggest that the main reason for failures in implementing Lean or Six Sigma in project management improvement is that the improvement is implemented globally instead of locally. Improvement can be implemented in two ways: reducing variability locally before stabilizing the system globally and continuing to use local efficiency measurements (milestone for each task). Following stabilization, a company can initiate a local improvement program (such as Lean or Six Sigma), regulated by TOC BM analysis, to focus on the right places to reduce variation. Pirasteh and Farah [10] conducted an empirical study of improvement using Lean and Six Sigma comparing cases that adopted TOC five focusing steps¹ [11] approach to focus their improvement efforts and those that did not adopt the TOC steps. The results showed that improvements in companies that adopted TOC were 15 times better than those that did not adopt TOC.

However, successful TOC stories published in the past dealt with companies that always had a good management foundation. Often, these companies had even implemented PERT/CPM, PDM, KM, Lean and/or 6 Sigma before adopting the TOC CCPM solutions [1]. As a result, the first concern remains unaddressed. This concern is particularly relevant to manufacturers in China, which typically lack a good management foundation and high level of local variations such as scope creep, delivery delay from suppliers, technology issues, resources and available time for projects are often inadequate, etc. Reducing variability is the focus of their improvement efforts and PDM, KM, Lean and 6 Sigma, etc. are the popular improvement tools. Observation reveals that variation in OTD (global variation in project management) among Chinese manufacturers remains a major issue

Therefore, this paper presents a case study of a Chinese electronic components manufacturer that, like most other Chinese manufacturers, lacked a good management foundation. The company has high levels of variations in scope, suppliers, resources available, technology, etc. It has poor operational performance such as low OTD and long project lead time. This company applied TOC to improve its performance and adopted the CCPM S&T tree developed by Goldratt (2006) following the related logic and implementation steps. The objectives of this case study are to validate that: (1) the logic of the CCPM S&T tree is robust

¹ The 5 focusing steps are 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.



tion is not a pre-requisite for implementing TOC CCPM. The key to achieving successful improvements is to stabilize the system first before kaizen (changing the processes to reduce variability and resources waste etc., using more resources.

2. TOC CCPM Strategy and Tactics tree

Structure of Strategy and Tactics Tree

The TOC Strategy & Tactics tree (S&T tree) developed by Goldratt [12] is the TOC Thinking Process application for facilitating whole-company ongoing improvement. Goldratt defines strategy as simply the answer to the question “what for?” or “what is the purpose (the desired effect) of ?” Tactics are the answer to the question “How do we achieve the strategy/desired effect (using a chosen mode of operation)?” Based on these definitions, S&T entities always exist together; for different levels, S&T entities exist at each level. This means talking about S&T tree is actually talking about a structure that looks something like that shown in **Figure 1** [12]. At the top are the strategy and tactics of the highest level. This study will call it the mission statement. Further down the tree addresses how to achieve the mission set out in the mission statement and goes into the functions with greater and greater detail. Each level must provide the answers to “what for?” and “how.”

The S&T tree is, probably, the most powerful thinking process tool and the logical structure that enables focusing. The S&T trees bring clarity to implementations by enhancing management level communications and synchronizing various departments. The trees considerably shorten the time to reach results and smooth the transition from one implementation stage to the next. They also enable introducing the detailed implementation plan of TOC solutions into the public domain.

CCPM Strategy and Tactics tree



developed by Goldratt [3]. The highest level of the tree shown is the step, "Meeting project promises". Six steps in a group are necessary to achieve the step a level one, including "Reducing bad multi-tasking and WIP", "Full kitting", "Critical chain planning and buffing", "Migrating client's disruption" and "Managing sub-contractors or subcontracted sub-projects". Going down to level three, there are four steps in a group, "Freezing", "Accelerate project completion", "Defrost mechanism" and "Releasing of new projects", that form the necessary steps to achieve the step "Reducing bad multi-tasking and WIP". The three steps, "Preparations according to priorities", "Defining preparations" and "Worried clients" are necessary for the group to achieve the step "Full Kitting". The other three steps, "Building good project plans/PERTs", "Building critical chain plans" and "Staggering project portfolio", are necessary for the group to achieve the step "Critical chain planning and buffing". Finally, the four steps, "Task completion reporting", "Task managers' role in managing execution", "Project managers' role in managing execution" and "Top management role in managing execution" are necessary for the group to achieve the step "Managing execution".

Figure 3a illustrates the strategic and tactic entities of level 1 and level 2. The strategy entity (what for) of level one is "The Company has very high due-date performance without compromising on the content or on the budget", and its corresponding tactic entity (how) is "The Company implements Critical Chain Project Management (CCPM) culture and procedures". To attain the level one objective, "The Company has very high due-date performance without compromising on the content or on the budget", five necessary strategy entities of level two are necessary, including "Flow is the number one consideration (the target is not how many projects the Company succeeds to start working on, rather it is how many projects are completed)", "A project is rarely launched before its preparations are completed", etc. Each "Strategy entity" of level two must have a corresponding "Tactic entity" which details the tactic entity, "The Company implements Critical Chain Project Management (CCPM) culture and procedures" of level one. This includes, "The Company properly controls the number of projects that are open at any given point in time", "The company uses the window of reduced load on resources that do the preparations to ensure that "full kit" practice will become the norm", etc.

Click the button (shown on the bottom in Figure 3a) of steps 2.1, 2.2, 2.3 and 2.4 will go down their lower level. Figure 3b illustrates the strategy and tactic



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the objective set out in step 2.1, “Reducing bad multi-tasking and WIP”, it requires four necessary strategy and 3.11.2 “Accelerate project completion”, 3.11.3 “Defrost mechanism” and 3.11.4 “Releasing of new projects”. Each tactic entity which details the tactic entity of its higher level. Successful implementation of these four steps will lead to successful implementation of step 2.1. Similarly, **Figures 3c-3e** show the strategy and tactics necessary to achieve the objectives set out in steps 2.2 “Full kitting”, 2.3 “Critical chain planning and buffering” and 2.4 “Managing execution”.

In addition to strategic and tactic entities, other components can be added to each step, and all can be considered as explanations: necessary assumption (explains why the given step is necessary (as part of the group) to achieve the higher step), parallel assumption (explains why the step’s tactic will achieve the step’s strategy) and sufficient assumption (explains why all the steps of the corresponding lower level are sufficient to attain this step). **Figure 4** illustrates all the information necessary to form the “Reducing bad multi-tasking and WIP” step. Detailed information of each step of the CCPM S&T tree can be found in [12].

3. Overview of the case company

The case company focuses on developing, manufacturing, and marketing electronic components widely used in 4C products. Its total revenue for 2009 was about 240 million US dollars. The company’s product life cycle is about 3~6 months. Breakthrough technology emerges every 6 months. As a result, the company’s new product development division faces the following challenges:

1. Difficulty maintains a leading position since new technology develops quickly in this industry.
2. Difficulty controlling project schedules and poor on time delivery performance (30% on time delivery).
3. Difficulty evaluating the manpower and productivity of the new products development division.

The company’s current reality before implementing the TOC CCPM included the following problems:

1. A lack of unified planning methods. As a result, projects were released as soon as possible, causing serious bad multi-tasking.
2. When estimating the time required for tasks, they put safety time in every task and at every milestone or checkpoint.



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uted by one engineer, forcing engineers to function more like coordinators than project managers. No support and the division did not operate as a project team.

from every level of management, and different managers asked for different reports from their respective

5. The company's priority mechanism was based on "First in first out" as judged by engineers. However, the engineers had no control over supporting resources, and had to rely on managers to be their mediators. As a result, there was no way to reveal real project urgency.

These factors resulted in poor time to market performance, a long lead time for each project, and high expediting costs. The problems faced by the case company are common to many other electronic components companies in China

4. TOC CCPM S&T tree implementation

The company first knowing the TOC is their top management attended the Viable Vision event conducted by Goldratt in May 2007 in China. After further evaluation of TOC CCPM, they chose to implement TOC CCPM, deciding that improving on time delivery for each new product development project should be the first priority. They contracted with an outside TOC CCPM expert (TOCE) certified by the TOCICO (TOC International Certification Organization). The implementation covered the following three phases:

Phase one: TOC knowledge transfer

The objective of this knowledge transfer phase was for the management team to gain sufficient knowledge and understanding of the relevant TOC generic concepts and CCPM solutions applicable to the company's environment. A company-wide training commenced in **May 2008** for the transfer of the TOC body of knowledge. The entire management team, from the board of directors to project managers, resources managers, task managers and engineers participated in the training. Experience has shown that people may learn but not understand; they may understand but not know how to apply the theory. Hence, examples, practices, role playing, quizzes and tests were crucial in this knowledge transfer phase. Games [7], computer simulation [13] and TOC Insight project management [4] were

The objective of this phase was to use the CCPM S&T tree set out in **Figure 2** (Goldratt 2008) to facilitate the management team reaching a consensus on the adoption of CCPM as their improvement tool and to obtain their commitment for its implementation. The TOCE first led the management team to read the CCPM S&T tree. The TOCE followed four steps in communicating the S&T tree:

Step 1: Start reading the highest level objective i the Strategy or ñwhat for?ò

Step 2: Say something like ñSince any logical tree is only as valid as its assumptions, we need to validate each of the assumptions to check if they can be considered ñFact of life.ò ò Then we will read the Parallel Assumptions (PA) and the ñTacticsò or ñHow toò as a ñlogical conclusionò of these assumptions or ñFacts of life.ò

Step 3: Then read the Sufficiency Assumption (SA) as a ñwarning or reminderò and continue with the Necessary Assumption (NA), Strategy, Parallel Assumption and Tactics of the first lower level S&T entity (most left). Then read the second, third, etc. S&T blocks in the sequence defined from left to right.

Step 4: Continue in this way until the whole tree is completed (reading from left to right), checking with the ñaudienceò regarding whether each assumption can be considered ña fact of lifeò and whether each Strategy & Tactic is a logical conclusion of these assumptions.

According to the communication steps, we follow the CCPM S&T tree (**Figure 2**) and convert goals and plans into actionable instructions. The entity 1 is the highest level goal and the next down level entities 2.1 to 2.6 are necessary steps to accomplish the higher level step, also to accomplish step 2.1 we need to execute the next lower level entities 3.11.1 to 3.11.4. The sequence to execute the CCPM S&T tree starts from entity 1, then 2.1, then 3.11.1, 3.11.2, 3.11.3, 3.11.4, then back to 2.2, then down to 3.12.1, 3.12.2, 3.12.3, etc.



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the TOCE asked management to raise reservations. Reservations are either negative branches (side effects) or the S&T tree entities. In preparation for the review, the participants were taught how to verbalize their reservations. The management team then split into smaller working groups. Each group worked on verbalizing the reservations raised by its members. The TOCE worked with each group to come up with the appropriate verbalized reservations, which were then presented to the whole management team. The management team then effectively dealt with the reservations with the help of the TOCE.

Broadly speaking, there are three types of reservations: a lack of knowledge; misunderstanding of or disagreement with an S&T entity; or a lack of commitment. Through the review of the S&T tree process described above, sufficient knowledge should have been conveyed to the participants and any misunderstanding of, or disagreement with, an S&T entity dealt with. An in depth understanding of the S&T tree and having addressed the potential obstacles and negative side effects eliminates reservations for its adoption and helps instill commitment for its implementation. Strong support by top management further helps secure commitment at lower levels.

The S&T tree sets out the minimum mandatory changes required in a system to ensure the company is solidly on a process of ongoing improvement. The S&T tree provides a clear road map of all the changes that can be easily understood. The S&T tree also fully explains the logic for making the changes. Fully explaining the logic makes the S&T tree an effective communication tool across hierarchy, across functions and over time. This helps achieve consensus and secure support and commitment.

The TOCE made sure the assumptions were reviewed by the participants and were accepted by them as fact of life. Management agreed that the resulting strategy/tactics were appropriate.

Phase three: Implementation

Having reached consensus and obtained commitment on the CCPM S&T tree, the TOCE explained the implementation sequence. An implementation team



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launched in **July** 2008. The intensive coaching and mentoring by the TOCE ended in **October** 2008 with limited

The company started the implementation process by training the project and task managers. Entity 2.1, “Reducing bad multi-tasking and WIP,” was then immediately executed, and the actions taken as below:

Freezing: At the end of May 2008, there were more than 50 projects in the pipeline caused bad multi-tasking behavior. Prolific bad multi-tasking drastically increases the lead time of tasks and of projects, which leads to further missed commitments. The top manager in-charge of all projects was asked to determine the prioritization of projects and instruct to freeze (cease activities on) enough of the lowest priority projects. The currently released projects were then sorted by the determined priorities and 25% of the whole projects were decided to be frozen. The proper actions were taken to ensure full adherence to the freezing decision.

Accelerate project completion and Defrost mechanism: The optimal number of the various types of resources needed for each open project was determined and the freed resources from the frozen projects were used to prudently strengthen the open projects. Proper manning decisions were also done for the frozen and to be released new projects. When a project completed a frozen project is defrosted. The sequence of defrosting projects is according to the agreed projects prioritization determined in the “Freezing” step.

Releasing of new projects: When the time arrives to release new projects, steps 2.12 “Full Kitting” and 2.13 “Critical chain planning and buffering” should be in place. At that stage, a system to release new projects using the CCPM concepts is ready.

As soon as the 25% of open projects were frozen, the case company began implementing entity 2.2 “Full kitting” as below:

Preparations according to priorities: A Full-Kit manager was appointed. The relevant resources were instructed to complete the preparation steps first for the running - not frozen “ projects, then to complete the preparations for frozen projects. Only when (most of) the above was done they were guided to work on the preparations for the new projects waiting to be released. They always follow the projects priority.



manager officially defined those activities which should be titled preparations. The company then took the actions to preparations and project managers of frozen and unreleased projects) are guided and monitored to work only on the and not allowed to be released into the system if the project does not have all its pieces in place. Same rule for tasks within the system, and this is managed by the task managers.

Entities 2.1 and 2.2 took about two months and the case company moved on to implementing entity 2.3 “Critical chain planning and buffering”.

Building good project plans/PERTs: Several project network building workshops were conducted to create project network templates. All relevant projects (projects which are not to be soon completed and the projects to be released in the near horizon) were considered in order to determine the generic projects. The implementation team constructed the templates per each generic project making sure that the resulting PERT will be properly detailed. Optimal number of resources per task and per project was determined. Per each relevant project its project manager worked with the key people that constructed the template to properly modify the template to fit the specific project. Four templates were developed. The objectives, deliverables and successful criteria of each template were discussed and defined clearly, common goals were shared by the developed team.

Building critical chain plans: An advanced CCPM workshop was conducted for implementation team. For each relevant project the project-planning-team continued by following the Critical-Chain process to turn the initial PERT into a Critical-Chain-PERT. The templates were finalized.

Staggering projects portfolio: The project-planning-team chose the final test as the drum (heavy loaded resources) to work as a staggering mechanism to plan project start date and completion date. Actions were taken to ensure that projects are released according to the plan (legs having different lead-times are released at correspondingly different dates). Actions are taken to ensure that due dates for new projects are committed only according to the staggering mechanism (or top management’s decision to postpone a specific existing project).

Entity 2.3 “Critical chain planning and buffering” took about two months too. After entity 2.3 completed, entity 2.4 “Managing execution” was launched as

Explaining the task completion reporting system was given to all task managers: what is required from them to go to be used and that they will, at last, be able to obey only the formal priority list. The company then launched the daily reporting (by task managers - not by the resources) procedure and relentlessly enforces it.

Task managers' role in managing execution: Every day the task manager gets two lists of tasks: The list of tasks currently being executed and the list of tasks that are incoming, both sorted according to their up-to-date priorities. Following the priorities, task managers assign the optimal number of resources to tasks. Based on the tasks' priority of currently executed tasks the task managers, aimed at minimizing/eliminating delays, decide on the level and type of intervention. For each incoming task, the task manager ensures the necessary conditions to start the task are in place: approvals, designs, (uninterrupted) resources etc.

Project managers' role in managing execution: Project managers review daily the list of tasks penetrating the most into the project buffer and check if recovery actions are taken or required to ensure that the project is effectively progressing. In extreme cases the project's Critical Chain PERT (and even the template) will be updated.

Buffer meetings: The buffer meeting provided feedbacks and information to assist in decision making. These meetings reviewed project progress, ensured the correct implementation of all steps, and used feedback provided by the buffer status for remedial actions. The case company held daily buffer management meetings to expedite the task or project that were red.

Top management role in managing execution: Top management reviews periodically (every two weeks) the projects' status. For projects whose progress is not satisfactory, the recovery actions are examined.

A commercial CCPM software system (planning and execution of multi-project) was introduced before starting the step 2.3 to manage the project planning and execution. Several workshops were conducted to train relevant people to use the system. Detailed procedures to implement step 2.5 "Migrating clients'



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tors or sub-contracted sub-project” were also developed. The time to implement all these entities totaled about Section 5).

ation as follows: (1) Monitor the work of all the projects. (2) Daily buffer meetings with implementation teams to monitor progress and ensure they were on track. (3) Weekly meetings with top management to keep them updated and secure their continued commitment. (4) Management team being involved in all the major decisions in the implementation process. (5) Escalating issues to top management whenever the issues might risk the successful completion of implementation.

5. Results

After four months of implementing “Reducing bad multi-tasking and WIP” and “Full kitting”, unfrozen projects flew smoothly, several potential delay projects were identified, recovered and completed on time. Partial of the resources from the frozen projects were used to prudently strengthen the open projects and partial of them were instructed to complete the preparation steps first for the running - not frozen projects, then to complete the preparations for frozen projects. More projects completed on time and early. The rapid and significant improvements created the momentum (confidence and interest) for the case company management team to charge on with other improvement initiatives. They then implemented “Critical chain planning and buffering” and “Managing execution”. Over the eight months period, the following results were achieved:

1. Project due date performance increased from <30% to >85%
2. Increased advantage of time to market, in addition to technology
3. Reduced project lead time by approximately 30~50%
4. On-time risk management and effective decision-making
5. Better controls of resource loading and improved R&D schedule and cost evaluation



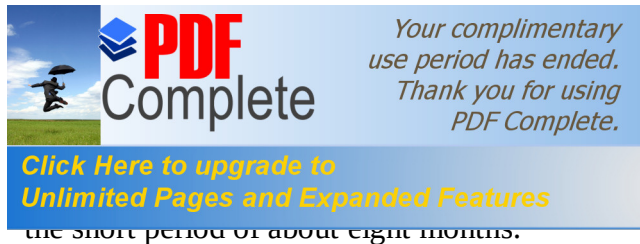
s with a holistic view, forming an effective management model for the new products development division.

Improvements can be achieved swiftly by following TOC strategies and tactics despite the lack of a strong project manpower or equipment.

Other positive side effects followed. At the start of implementation, far too many projects had been released. The system was overloaded and engineers were so many tasks on hand (the highest is 20 tasks--very bad multi-tasking behavior). Freezing of projects enabled the engineers to complete and clear out pre-existing tasks. Engineers saw tasks complete fast and more to an extent they had never seen before and were enthusiastic to continue with the ensuing improvement initiatives.

At the start of implementation, there were a large number of overdue projects and the engineers were overloaded. No system was in place to prioritize different tasks and frequent switching of task priorities in response to project managers (or top management) complaints aggravated the problem. Many urgent tasks made engineers tense. With the introduction of CCPM, tasks were released and processed in the order of delivery dates and the priority of different tasks was clearly understood by all the involved people from the senior management to the engineers. Switching task priorities only occurred after receiving a new urgent task. Less shouting and expediting took place among project managers, significantly reducing tension. Highlighting the status of urgent tasks using red or yellow colors further aided visible task priorities. The case company was able to achieve >80% on time delivery within eight months of implementation.

Previously, Case company management had to keep expediting overdue projects and decide, on an arbitrary basis, the priorities of overdue tasks. Engineer's tension was visible and management had to spend time reducing frictions on them. With a clearly understood system that set tasks priorities in line with their urgency, the number of overdue projects reduced, and management no longer needed to deal with expediting overdue tasks and was able to focus time and effort on long term planning.



case company, without the following key success factors, the case company could not have achieved the results in

the short period of about eight months.

Top management support and commitment

For the case company, implementing CCPM involved multi-paradigm shifts and company-wide changes. Securing strong support and commitment from top management was imperative as the company made one change after another. The commitment of top management was not just lip service, but was real. (1) Management committed a whole month of time and fully participated in the TOC knowledge transfer and CCPM S&T verification process. The implementation of the program involved changes in working habits and culture. Even with the robust logic of the S&T tree, there can be occasional hesitations and reversions to old practices. In these situations, without a thorough understanding of the TOC knowledge and CCPM S&T tree, it would be impossible for top management to support the program and require subordinates to make the necessary changes. (2) Management also committed to staying focused on implementing the CCPM S&T tree. This means the general manager and his top management team decided to stop all other initiatives requiring management attention that were not part of the CCPM S&T tree. Given the multi-paradigm shifts and company-wide changes required, the author believes the single most important success factor is the support and commitment of top management.

Stick to the CCPM S&T Tree

The CCPM S&T tree provides robust and complete implementation steps and leads to desired results if properly followed. Previous TOC implementation experiences show that the various CCPM S&T tree must be implemented in a specific order. Although the CCPM S&T tree sets out the order of implementation, when reservations arise, the participants often use their personal experience to modify the solution to deal with their reservations. This leads to deviations from the CCPM S&T tree and improper implementation. An improper implementation inevitably delays achievement of the target results and weakens the commitment



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ization must strictly adhere to the order of implementation. Only proceed to the following step after confirming successful implementation generates certain signals. By observing these signals, buffer management meetings can mented an entity.

For instance, upon successful implementation of “Reduced Bad Multi-tasking and WIP” and “Full Kitting”, number of open projects and project lead time should both decrease; the number of live tasks should start to clear up as the WIP level drops. If a company starts to implement “Managing execution” without having successfully implemented “Reduced Bad Multi-tasking and WIP” and “Full Kitting”, there will be so many red tasks(urgent tasks) that it will be impossible to implement “Managing execution”.

Must have quick and noticeable wins

The most important assumption in the CCPM S&T tree concerning implementation is this: to ensure an outstanding start of a major project, it is vital that each of the first substantial actions results in immediate substantial benefits. The CCPM S&T is designed to ensure that the implementation follows the logic of the tree a step at a time. The first step is designed to have no relevant obstacles to implementation. The successive steps are easy to implement after the first one has demonstrated substantial benefits. Hence, getting significant and noticeable wins quickly turns resistance to change into momentum for change and is a key success factor. In the case company, within two months of “Reduced Bad Multi-tasking and WIP” and “Full Kitting” implementation, both management and engineers could see the improvements and benefits. They were thus motivated to continue implementing the other changes.

Collaboration through sharing the buffer

It is a valuable lesson to learn that by showing the schedule without safety and by sharing the buffer, cooperation/teamwork is much enhanced. This can be attributed to the fact that by revealing the true picture, communication among project members and top management was accelerated. Most people have the impression that communication is greatly enhanced thanks to buffer management. They regard CCPM as a communication vehicle. In this case, it seems the



communication and creates teamwork throughout project environment.

Sustainability is the key to achieving significant improvement. Sharing the benefits of improvement with employees through bonuses and pay raises provides momentum for sustainability. Holding a daily buffer meeting is an important method for sustaining improvements. During buffer meetings, all participants can see the process of change, the obstacles, the negative side effects and the benefits of the improvements. The participants also share with each other what they have learned during implementation that reinforces the upward spiral. At case company, the implementation phase took place within three months after the participants first learned about TOC. Inevitably, participants's understanding of the TOC body of knowledge was limited. To sustain improvement efforts under these circumstances, it is important that follow-on training by TOC experts be conducted during the first year of implementation to reinforce TOC knowledge and ensure that participants do not revert to previous work practices.

7. Conclusions

This paper presents a case study of a Taiwan high tech electronic components manufacturing company that, like most other high tech electronic components companies, had same problems such as high levels of local variations and poor operational performance such as low OTD and a long project lead time. By following the CCPM S&T tree developed by Goldratt, within eight months the company achieved significant improved results. Project lead time was significantly reduced and OTD reached over 85 percent. This successful case provides evidence that: (1) the logic of the CCPM S&T tree is robust and effective, and (2) the key to achieving high OTD in a multi-project environment is to establish mechanisms to stabilize the system first before adopting continuous improvement programs to reduce variability (which is the focus of Lean and 6 Sigma) or assigning more resources.



Management Results- As reported by Realization's clients, http://realization.com/pdf/PF2009_Postscript.pdf 2009.

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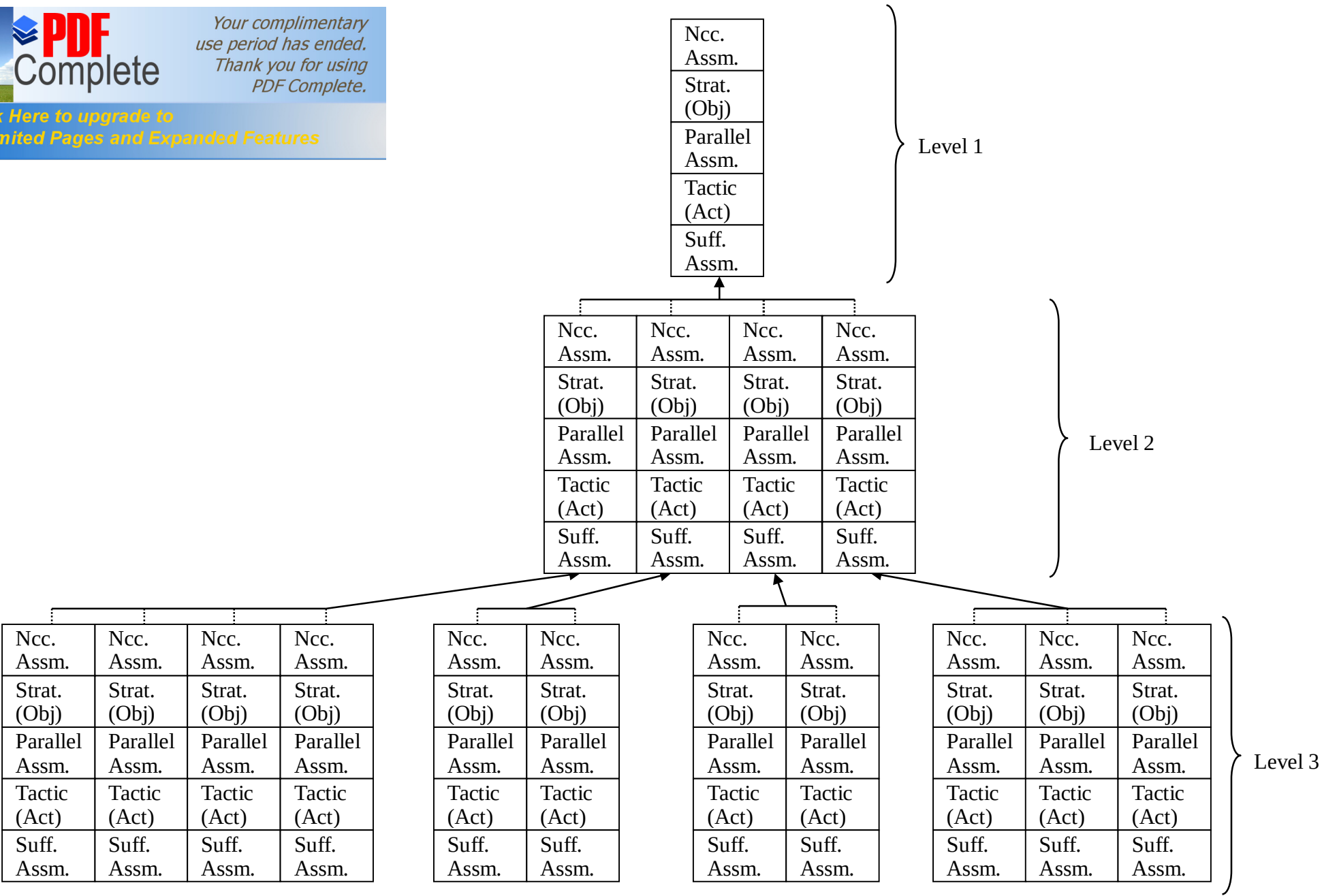


Figure 1

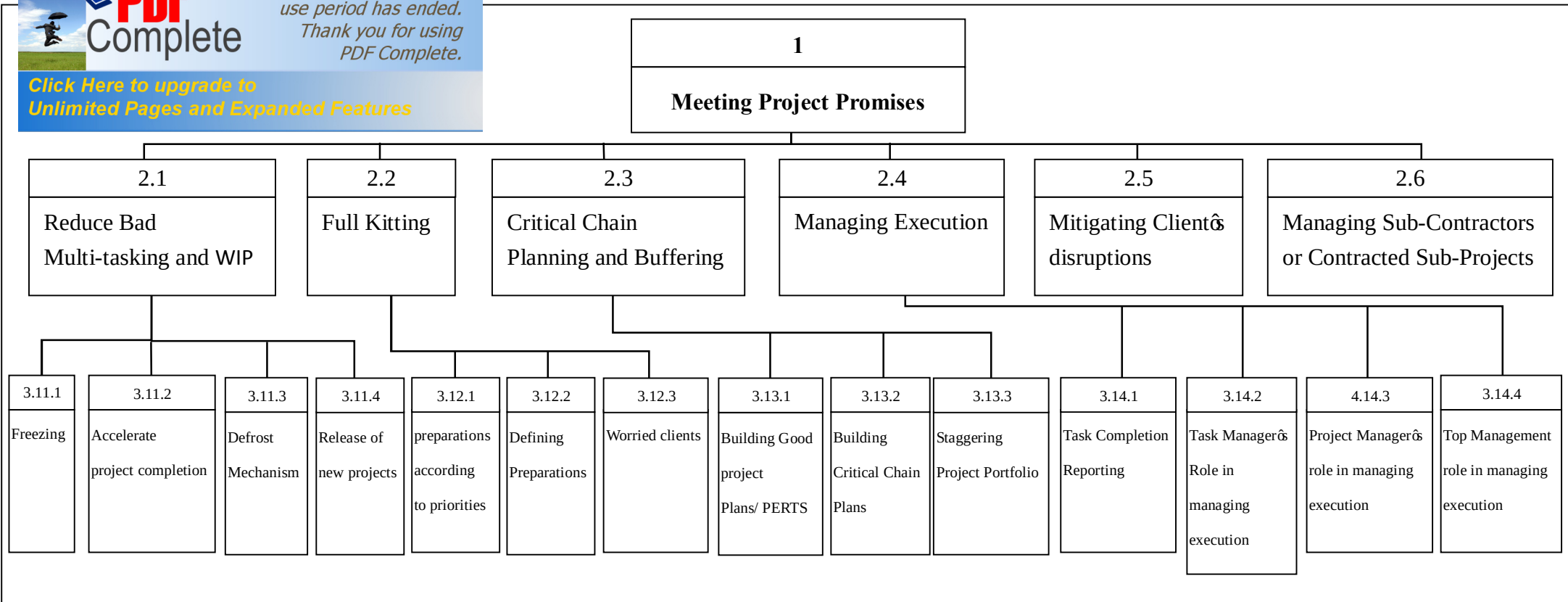


Figure 2

1 Meeting Project Promises

The Company has very high due-date performance without compromising on the content or on the budget.

The Company implements Critical Chain Project Management (CCPM) culture and procedures.

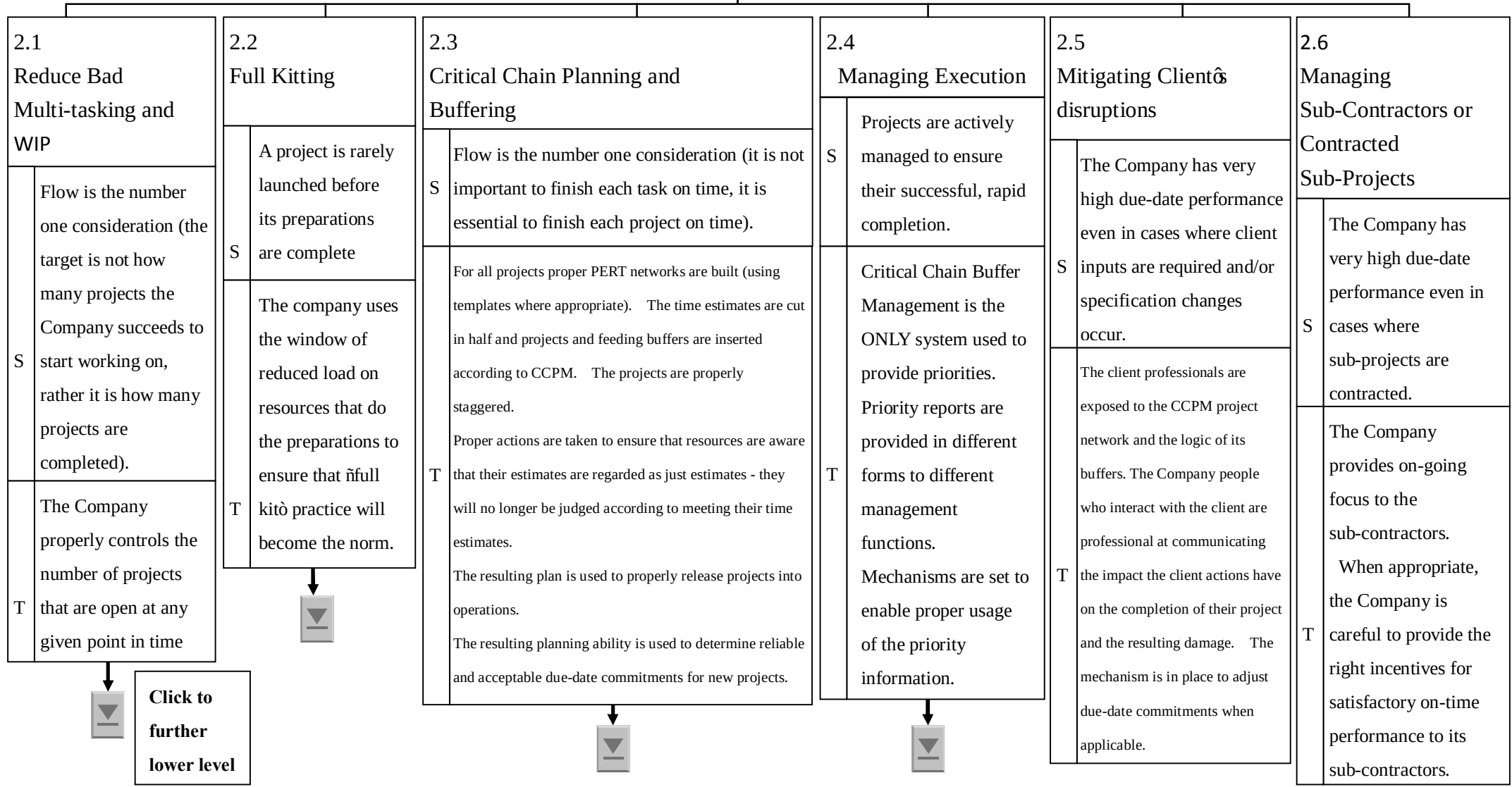


Figure 3a

1 Meeting Project Promises

2.2
Full Kitting

2.3
Critical Chain
Planning and
Buffering

2.4
Managing Execution

2.5
Mitigating Client's
disruptions

2.6
Managing
Sub-Contractors or
Contracted Sub-Projects

Reduce Bad Multi-tasking and WIP

S Flow is the number one consideration (the target is not how many projects the Company succeeds to start working on, rather it is how many projects are completed).

T The Company properly controls the number of projects that are open at any given point in time

3.11.1 Freezing

S The number of open projects is quickly reduced to be more inline with better flow and throughput.

T ♦ The top manager in-charge of all projects, after consulting with his subordinates, determines the prioritization of projects and instructs to freeze (cease activities on) enough* of the lowest priority projects.
* Enough means: responsible for at least 25% of the load.
♦ The proper actions are taken to ensure full adherence to the freezing decision.

3.11.2 Accelerate project completion

S There is good (sufficient for accelerate project completion) assignment of resources to projects.

T ♦ The optimal number of the various types of resources needed for each open project is determined. The freed resources are used to prudently strengthen the open projects.
♦ Proper manning decisions are also done for the frozen and to be released projects.

3.11.3 Defrost Mechanism

S Frozen projects are defrosted at a pace that maintains the reduced load

T The company chooses integration (or part of it) as the VIRTUAL DRUM : The number of projects allowed in that section is restricted to be, at most, 75% of the current number. When a project completes this integration a frozen project is defrosted. The sequence of defrosting projects is according to the agreed projects prioritization.

3.11.4 Releasing of new Projects

S The timing for the release of each new project takes into account the lead-time of the leg.

T When the time arrives to release new projects, steps 2.2 and 2.3 should be in place. At that stage, a system to release new projects using the CCPM concepts is ready.

Figure 3b

1 Meeting Project Promises

2.1

Reduce Bad
Multi-tasking and WIP

2.2

Full Kitting

S

A project is rarely launched before its
preparations are complete

T

The company uses the window of reduced
load on resources that do the preparations
to ensure that "full kit" practice will
become the norm.

2.3

Critical Chain
Planning and
Buffering

2.4

Managing Execution

2.5

Mitigating Client's
disruptions

2.6

Managing
Sub-Contractors or
Contracted Sub-Projects

3.12.1 Preparations according to priorities

S

Resources and project leaders are used to working on
projects whose preparations are (almost) fully completed.

T

A Full-Kit manager is appointed. The relevant resources
are instructed to complete the preparation steps first for
the running - not frozen - projects. Then to complete the
preparations for frozen projects. Only when (most of)
the above is done they are guided to work on the
preparations for the new projects waiting to be released.
They always follow the projects priority.

3.12.2 Defining Preparations

S

The permission (or even demand) to work on
preparations does not violate the freeze and/or
controlled release intentions.

T

- ◆ The activities which should be
titled preparations are officially defined as such.
- ◆ The company takes the actions to
ensure that resources (those conducting the
preparations and project managers of frozen and
unreleased projects) are guided and monitored to
work only on the preparation activities as defined.

3.12.3 Worried Clients

S

The threat of losing projects
due to a late start is alleviated.

T

The Company relentlessly
completes all preparations
(closes the gaps) on running and
frozen projects.

Figure 3c

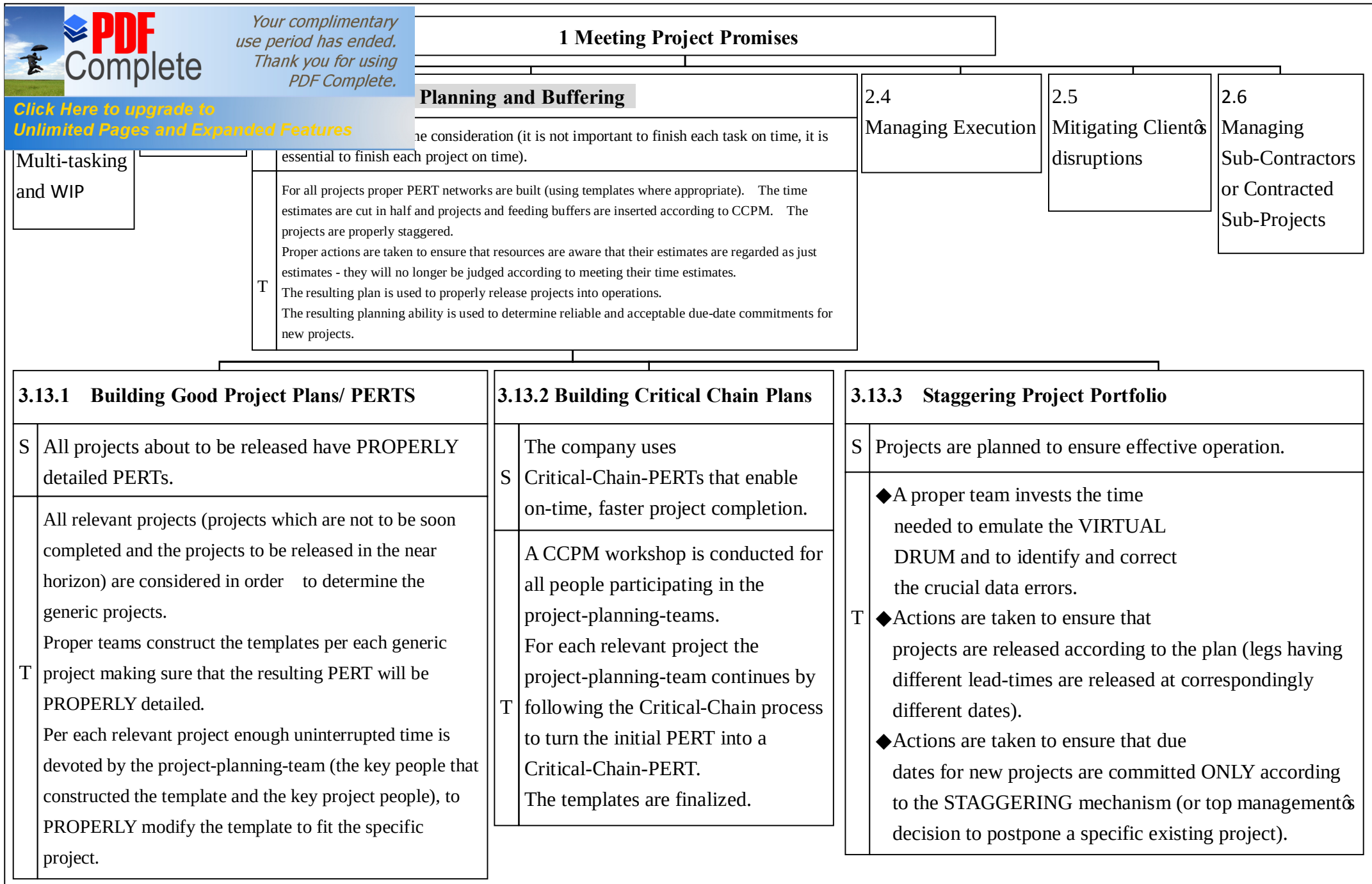
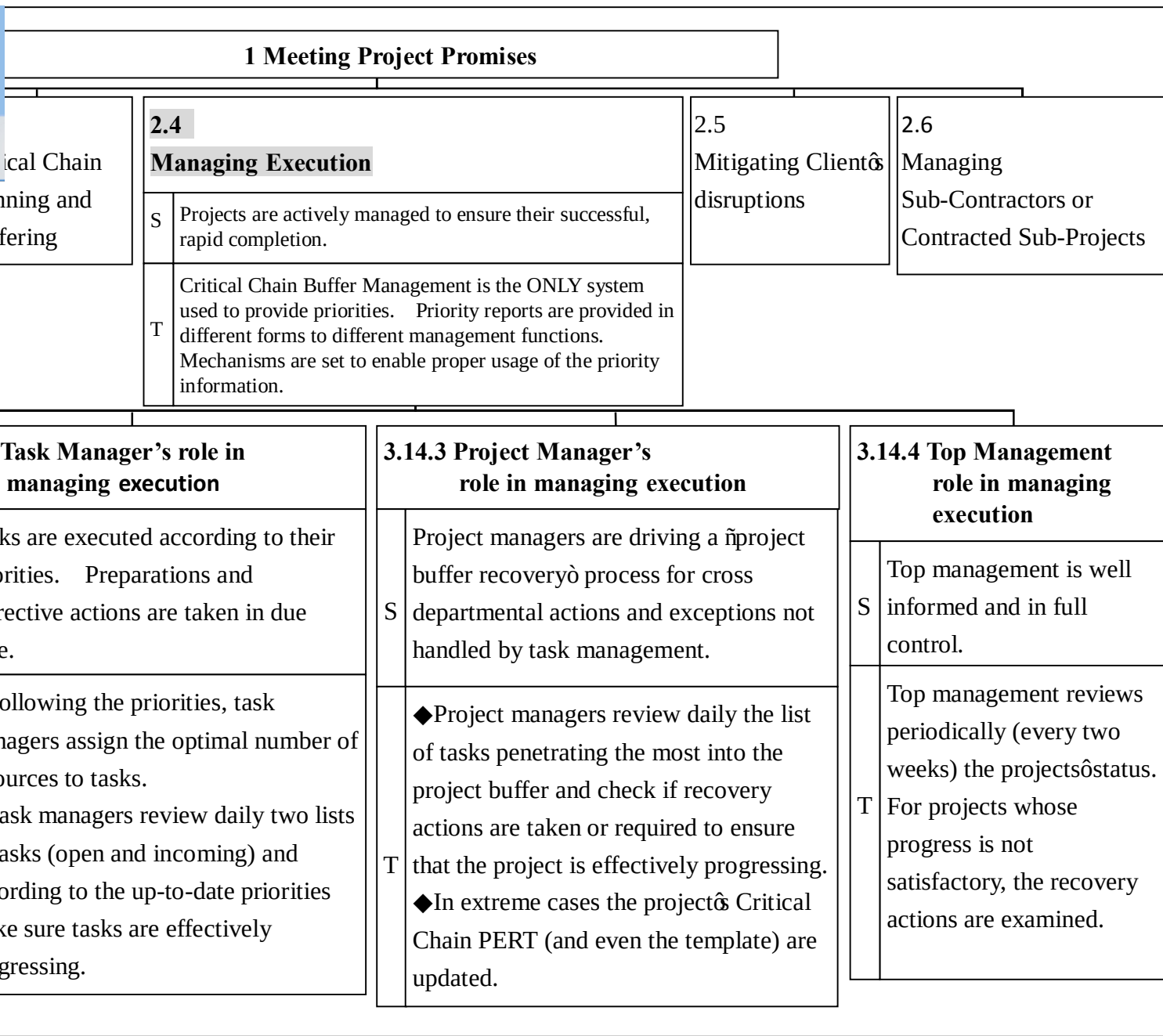


Figure 3d



Reduce Bad Multi-Tasking & WIP

Too many projects are executed simultaneously many resources will find themselves under pressure to do more than one task - bad multi-tasking is unavoidable.

➤ Bad multi-tasking significantly prolongs each project's lead-time.

Strategy	Flow is the number one consideration (the target is not how many projects the Company succeeds to start working on, rather it is how many projects are completed).
Parallel assumptions	◆ The statement, "the earlier we start each project, the earlier each project will be finished," is not correct for multi-project environments (not only the first elephant but also the last elephant will go through a door much faster if they go in procession). ◆ Vast experience shows that in multi-project environments, reducing the number of open projects can reduce bad multi-tasking without causing starvation of work and therefore significantly reduces the lead time of all projects - it increases the flow.
Tactic	The Company properly controls the number of projects that are open at any given point in time
Sufficiency assumption	Adjusting the amount of work is not enough. The company must also ensure that as time passes the proper amount of work will be always maintained.

Figure 4

國科會補助計畫衍生研發成果推廣資料表

日期:2011/09/30

國科會補助計畫	計畫名稱：應用TOC CCPM戰略與戰術圖快速改善多專案管理績效--個案研究	
	計畫主持人：李榮貴	
	計畫編號：99-2221-E-009-115-	學門領域：生產系統規劃與管制
無研發成果推廣資料		

99 年度專題研究計畫研究成果彙整表

計畫主持人：李榮貴			計畫編號：99-2221-E-009-115-				
計畫名稱：應用 TOC CCPM 戰略與戰術圖快速改善多專案管理績效--個案研究							
成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	1	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	0	0	100%	人次	
		博士生	0	1	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	0	1	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	對產業證明 TOC CCPM 戰略與戰術圖的可行性與有效性
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	成果項目	量化	名稱或內容性質簡述
科 教 處 計 畫 加 填 項 目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

☒達成目標

☐未達成目標（請說明，以 100 字為限）

☐實驗失敗

☐因故實驗中斷

☐其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：☐已發表 ☒未發表之文稿 ☐撰寫中 ☐無

專利：☐已獲得 ☐申請中 ☒無

技轉：☐已技轉 ☐洽談中 ☒無

其他：（以 100 字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

此研究驗證 TOC CCPM 戰略與戰術的有效性，依戰略與戰術圖執行可有效與快速得到顯著改善成果