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Lessons learnt from managing a project using the THEORY of CONSTRAINTS/CRITICAL CHAIN

By Karl Fuchs*

With this article I would like to share with readers the significant advantages that I have gained by applying the Theory of Constraints Critical Chain Project Management Methodology. I will also share my personal experience and the lessons learnt from managing a project the Theory of Constraints way

There will be no attempt to explain the TOC Critical Chain methodology here – the reader should refer to the Tools and Techniques section of PROJECTPRO magazine Vol 8 numbers 1, 2, 3 and 4, and also to Goldratt; *Critical Chain*, The North River Press, 1997.

I will start off by introducing the problematic project, moving on to the problems that I experienced through managing the project before introducing this new methodology. I will then highlight some important steps taken during the implementation of the TOC methodology and discuss the lessons learnt and observations that were made, concluding with the results.

Project in Jeopardy
The Council for Scientific and Industrial Research (CSIR) was involved in the development of a radar signal processor for a client in the South African defence industry. This signal processor is intended to be the new main computer of a much-needed radar system. Signal processors used in modern radar systems require state-of-the-art technology and the transfer of this technology into a product is very important to the South African defense industry and the CSIR.

Part of the project that I want to focus on was running from 1 April 1997 to 31 March 1998. The goal for this period was to complete the development of eleven hardware and software modules needed for the signal processor and to start the integration of these modules by 1 March 1998. The activities included manufacturing, assembling and testing of the modules before the integration date.

This part of the greater project had a budget of a couple of million rand. The Gantt chart contained 112 tasks and a team of between 10 and 14 electronics engineers and technicians were involved.

All sorts of problems
After four months of project execution, we had all sorts of problems. Contractual milestone dates were constantly not met. I believed that this was due to the technical risks and interaction between tasks. Murphy's Law thrives in such an environment, and we just did not build in enough contingencies.

A lot of changes and rework were constantly required, due to technology limitations. A more innovative approach was required to overcome the technological limitations. This in itself required more resources than planned for. Resources were never available when needed, especially regarding design software and test equipment.

The printed circuit board facility was unable to deliver on time and became a serious bottleneck. We believed that our problem originated here, and we spent a lot of time and money to upgrade the facility.

The team was stressed and overloaded, as everybody constantly worked overtime. This did not seem to help at all, as new problems emerged every day. The original Gantt chart and its updates became irrelevant because of the frequency of the changes. Crisis management and "fire fighting" became common practice.

The total project's due date was already extended by a year, and during an overall project evaluation in July 1997, it seemed that our part of the project was already three months behind schedule. This resulted in possible failure to meet the integration date of 1 March 1998. A further extension of the total project's due date was imminent.

A new beginning

The situation called for drastic measures, and I started to doubt my abilities as a project manager. It was during this dark and gloomy period that I shared my troubles with our quality representative. Within a day or two he presented me with the book *Critical Chain* by Eli Goldratt, and challenged me to read it.

This book read like a novel, and I was very impressed with the new methodology it presented. I immediately thought that it would be an excellent solution to my problems, but I had no idea how to put theory into practice. Things were still out of control; I shelved the book and returned to the "fire-fight".

Early in August 1997, I met Dr Dirk Grobler of the CSIR's Environmentek Division, who was busy implementing the Critical Chain methodology in his division. He also presented a series of one-week implementation workshops, one of which I attended, where he taught me to implement the methodology.

By the middle of August 1997, I was able to convince my team that we should implement the TOC Critical Chain Project Management Methodology on our project. I explained the concept to the project team, involved them in planning, and acquired software to help with the scheduling, monitoring and control of the project.

Observations and lessons learnt

We involved the whole team in the two-week planning effort. Our aim was to build a common understanding of our project goal, giving smaller parts to individuals to plan for themselves. We again integrated all the parts into the bigger project, and discussed any changes with the people that supplied the estimates and sequence between tasks. I would recommend involving the team; it creates buy-in and commitment.

The removal of multi-tasking within the project was immediately accepted as a good way of planning. People intuitively feel that they are very unproductive when working on more than one task at a time. Multi-tasking did, however, not disappear overnight. A rule was emphasized that "project members are only allowed to start a task when told to, work as fast as possible to complete the task and only stop when told to, or when the task has been completed.

The project manager gets his biggest surprise during Critical Chain project scheduling when he realizes that he promised an unrealistic project due date. Better allocation of resources is a quick way to solve this phenomenon.

Reduced task times provided some urgency in the project team. I believe that this happens because people now believe that they do not have enough time to complete their tasks. They forget that the safety duration that they have built into the tasks for

themselves is now accumulated in project buffers and feeding buffers. This behaviour is good, because it eliminates the "work expands to fill the available time" syndrome.

A very important function is to regularly report on task status. Both the manager and team members fear the uncomfortable interaction that is experienced between the project manager and the person performing the task when getting feedback. Progress becomes extremely visible, and people used to old measures fear the worst when they realize that they are not going to "make it".

This called for a simplified buffer management rule: the buffers were divided into three equal parts. A green, yellow and red zone (see Figure 1). Penetration into the first third, or green part, was considered to be acceptable. People did not have to fear anything when the buffer was in the green zone.

Green	Yellow	Red

Figure 1: The three zones

Penetration into the yellow zone required the project manager and the person performing the task to prepare plans to recover lost time in the event of the penetration going into the red zone. The helpful project manager did much to remove fears and restore confidence levels by doing buffer management this way.

The question "how many days remaining before the task will be completed?" produced very interesting behaviour. A team member would start off by explaining that he or she would complete the work by some future date, given that they overcome all sorts of problems.

We are so used to being punished by "Murphy" that we buy ourselves some time by promising a future date, and then also protect ourselves against the risk by adding some qualifier. We had to constantly remind the person reporting not to explain, but to only answer the question, and that we would address all the other issues through buffer management. This behaviour changed to the desired state when we proved our intentions with the green, yellow and red buffers.

Buffer management also provides a tool for better decision-making. Expediting becomes a simple task, because resources within the project can be removed from tasks that are not threatening the project due date, and can be allocated to tasks that require attention.

"It was difficult to explain the way we all felt after the results started to become apparent. You are on your way to crash and burn, and then suddenly the aircraft levels out, right above the tree tops."

I have also noticed that the project manager ends up with a static schedule. During the eight months that the schedule was used, the project was only rescheduled once. Suddenly the schedule becomes a very powerful communication and decision-making tool.

Team motivation increased, thanks to the static schedule and clear progress indication that the buffers provided.

The only real problems that we experienced were around unrealistic task estimates. There were times when people became very upset, because they did not want to be held

responsible for the risk of inaccurate task estimates. I can only suggest that you pay careful attention to the estimation of task duration.

The probability of completing the project on time is greatly enhanced by scheduling it according to the Theory of Constraints Critical Chain Methodology. This powerful method does not, however, protect you from underestimating the work, or just simply doing the wrong things in the first place. Not defining your project objective and not ensuring that you do enough of the right things in the correct sequence, will invite disaster.

Results speak for themselves

It is difficult to explain the way we all felt after the results started to become apparent. You are on your way to crash and burn, and then suddenly the aircraft levels out, right above the treetops.

On our contractual milestones we delivered:

• 27% late (less than four weeks);
• 46% on time;
• 27% early.

Overtime was reduced by more than 60%, and the project team regained their strength and morale. *We started our integration effort one full month earlier*. This meant a swing of four months! The client was surprised, but sceptical.

During March 1998 we scheduled the next financial year's activities – this time making sure that we did it the Theory of Constraints way. A major contractual milestone was set for 31 July 1998. Guess what? We delivered on 17 July 1998, two weeks early. This time we removed the client's entire scepticism. The client admitted that the best delivery date that they hoped for would be 31 August 1998, in their minds we were six weeks early. . .

I firmly believe that the results speak for themselves. Try this methodology, it is no empty promise.

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