MULTI-PROJECT CRITICAL CHAIN AND BUFFER MANAGEMENT FOR CAPITAL AND INNOVATION PROJECTS

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ABSTRACT

The purpose of this paper is to provide an appreciation for Project Management using Critical Chain and Buffer Management in a multi-project, cross-discipline implementation of Capital and Innovation projects.

A Proof of Concept implementation was conducted and the results have shown the relevance and benefits of Theory of Constraints in Project Management for Capital Projects and Marketing and R&D Innovation Projects. The unique nature and requirements of innovation projects surfaced conflicts to which TOC tools were applied.

Following the success of the Proof of Concept implementation Critical Chain will be rolled-out to all Capital Projects.

1. INTRODUCTION

Project Management is an exotic cocktail: one tot prophecy, one tot military general and one tot super-hero. Good project managers are able to make the character change from, prophet to general to super-hero and to apply these different character styles simultaneously to each project as required.

The uncertainty that exists at the beginning of a project is high, particularly when the project scope is undefined or variable. From experience the Project Management role is most critical and adds greatest value when the project hits a crisis and the project needs incisive action to succeed.

Why is it then that much of the Project Management body of knowledge and most software and programming tools concentrate on accuracy at the beginning of the project? Project Management controls are usually established that single-out or punish any change from the project measures established at the time where uncertainty is the greatest - the beginning of the project.

In a multi-project environment, where resources are shared between projects, sites and functions there is a constant clamouring for priority between the project leaders and stakeholders. Resource aggregation tools are built into many project management systems, but few are effective in planning portfolios of projects and even fewer are used. Most experienced project portfolio managers are sceptical about the value of resource levelling tools and prefer to work on their own intuition as to how many projects they can manage with a given number of resources.

A solution is needed that recognises the uncertainty of projects and allows for this in a constructive way. Resource loading and multi-tasking of resources between activities on more than one project needs to be addressed with a project management system that addresses the underlying issues.

2. BACKGROUND

2.1. UNILEVER PROJECTS STRUCTURE AND SYSTEMS

Lever Pond's is an operating company of Unilever South Africa. Capital investment for Lever Pond's varies each year according to the strategic, innovation and ongoing asset replacement needs. Capital expenditure ranges between approximately R60 and R200 million per annum and is split between the factory sites, development and head office. The number of projects run in a financial year will vary; the average number of projects per annum is approximately 500. Project size can vary from a few thousand Rand to over R100 million.

Project resources are regionally and functionally structured. Head office projects are predominantly IT or office equipment purchases and require fewer resources. Innovation projects or product development projects are usually marketing, supply chain or development led using common resources from development and the factories when plant or equipment is to be installed.

In the past project performance has been strong in some areas and weak in others. Typically project timing has been sacrificed and scope creep or curtailment has occurred to fit the budget. Few projects are completed on time, although high priority projects or projects with critical deadlines are achieved, often with significant impact on the project portfolio.

Cost control has normally been good with expenditure carefully controlled and authority required for significant over-expenditure. Contingencies are generally not used except for identified project risks.

Unilever SA has successfully implemented SAP 4.5 as an integrated business system. SAP PS (Project System) has been implemented with varying degrees of depth across the operating companies and sites. The simplest

implementation uses simple WBS structures to capture project costs.

The most complete implementation of SAP PS uses fully developed WBS structure (up to 7-level cost and functional breakdown), network headers and activities, task dependencies, resource allocation and cost allocation. Project planning (cost and scheduling) is performed using SAP tools and Project Management reports are produced using standard and customised SAP reports.

Scheduling and tracking of projects using this fully developed SAP PS system is, however, cumbersome. While resource allocation is possible and resource-loading reports are available there is no functionality for resolving resource contention.

Many project resources work on projects and provide a maintenance support to the factories. Plant availability is critical and some multi-tasking is inevitable where resources have dual responsibility. Resources dedicated to project work would often multi-task due to real or perceived changes in project priority. The result of this multi-tasking was poor efficiency and a lack of focus. Project and Portfolio Management was thus difficult.

Microsoft Project and Timeline are used for project scheduling performed outside of SAP. Innovation projects follow the Unilever IPM process and use InnoPlan™ tools for project and portfolio management.

2.2. THEORY OF CONSTRAINS AND STAKEHOLDERS

Unilever uses Theory of Constraints (Operations and Supply Chain) in regional training for Operations Managers. The author was introduced to TOC Operations principles through attending this course and recognised that the principles were applicable to Project Management. Further research into Project Management training and Critical Chain and Buffer Management led to the conclusion that the TOC tools could be applied to Project Management in Unilever.

A Project Management Task Team was established. This included a core team of Unilever Project Managers, Facilitators and Engineers. An extended stakeholder group that included Unilever Factory Engineers, Innovation Process Owners, Training Managers and other key personnel was also identified.

The core team met regularly with the objectives of networking best practice for project management, identifying project management training suitable for Unilever and embarking on a process of continuous improvement for project management. Presentations by Henning du Preez of AGI SA and reading of Critical Chain exposed the core team (and other invitees) to the principles of TOC and Critical Chain.

A decision was made by the Project Management Task Team (PMTT) to implement Critical Chain on a Proof of Concept basis. This Proof of Concept process started in October 2001 and continued until January 2002.

The role of this group was, and continues to be, important in the development and implementation of a project management solution for Unilever. While the Proof of Concept implementation was performed mainly at one site the involvement of the PMTT enabled the evaluation to be relevant to the wider group and aligned with the stakeholder needs and expectations.

3. PROOF OF CONCEPT IMPLEMENTATION

3.1. PROJECT SELECTION

A group of projects was identified for the Proof of Concept (PoC) implementation. The majority of the projects were capital projects at the Lever Pond's, Maydon Wharf, Durban factory. Other projects were included from the Boksburg and Head Office sites including innovation projects.

Of the 24 Maydon Wharf projects 17 projects were included in the multi-project portfolio, that is projects that shared one or more resources. Seven single projects were included in the proof of concept phase. Three projects from the Boksburg site and one innovation project were included. Further Innovation Projects were included in the PoC portfolio during implementation.

To kick off the PoC implementation training was run covering the basics of TOC, Critical Chain and Buffer Management, and PS8. Project Leaders and Resources involved in the projects included in the PoC (and other interested parties) attended this training. The attendance of some project resources was affected by the need for them to work on critical projects or maintenance tasks.

3.2. DEVELOPING CRITICAL CHAIN SCHEDULE

The PoC projects were then scheduled using CC on PS8. PS8 software was recommended by AGI and provided free-of-charge by MPS. Buffered CC schedules were developed for each project as single projects. Project and Feeding buffers were set at 50% of the safety removed. The CC project duration was approximately 75% of the Critical Path duration although the number of fixed duration activities in the project influences this.

3.3. DEVELOPING THE STAGGERED PORTFOLIO

The Drawing Office was chosen as drum resource and was used to stagger projects. The choice of the Drawing Office was based on the number of projects in which they were involved and the knowledge that there was much bad multi-tasking and inefficiency amongst the draughtsmen.

The projects were prioritised based on urgency and benefit to the business by meeting with the project leaders and agreeing the portfolio priorities. A Capacity Buffer was inserted between Drum resource tasks on successive projects. The Capacity Buffer was sized at 100% of the CC safety removed. A buffered, staggered project portfolio was thus achieved.

3.4. PROJECT EXECUTION AND CONTROL

Projects were then executed according to the buffered portfolio schedule. Emphasis was placed on resource behaviour to induce starting tasks as scheduled and eliminating or reducing multi-tasking especially for the drum resource.

Weekly progress meeting were scheduled for resources involved in the PoC. Resources who were unable to attend were contacted telephonically. The following information was requested:

- Has the scheduled task started?
- Has the task been completed and if so on what date?
- If the task has started what is the remaining duration?

Finish dates were not communicated or emphasised.

3.5. BUFFER MANAGEMENT

The management of projects was done according to the buffer status only. For projects where the buffer status was amber or red action plans were developed to prevent further buffer incursion. For projects with a red buffer status these action plans were implemented and progress tracked frequently.

This enabled some projects with red buffer status to be completed within the original project duration. One project had an initial duration of 5.5 months. Due to business constraints the project end date was brought forward by 2 months. The project status immediately became red. An action plan was developed and implemented and the project was completed within 3 months saving 2.5 months.

In another case the action plan was not implemented effectively and the project buffer was consumed. However there was still a greater focus on the project and the result was better than would have been possible using conventional tools.

3.6. CONSTRAINT TASKS

During the implementation projects that required special treatment were identified: Innovation / R&D Projects and Maintenance projects. In these projects activities called Constraint Tasks existed where the project benefit was only realisable if these Constraint Tasks were executed within a window of time.

Innovation project Constraint Tasks include Launch, Ship To Trade and other (internal) milestones or merge points. Maintenance Project Constraint Tasks are those activities that can only be performed during a planned period of plant downtime or allocated non-production time.

The following diagram represents the Conflict for Constraint Tasks.

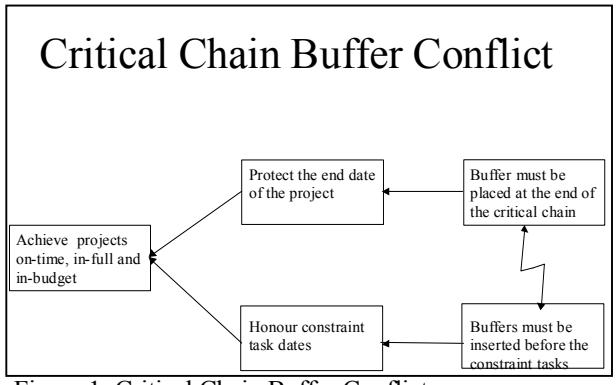

Figure 1: Critical Chain Buffer Conflict

A different approach is required for managing Constraint Tasks depending on whether:

- it is necessary to predict a reliable window in which the task will occur (Floating Constraint Tasks) or,
- the window is known and the preceding tasks must be scheduled to ensure a high probability that this is achieved (Fixed Date Constraint Tasks).

Constraint Task Buffers were introduced to schedule projects containing Constraint Tasks. Constraint Task Buffers are inserted before Constraint Tasks and sized according to the position of these tasks in the schedule.

3.7. BEHAVIOURAL CHANGES

Multi-tasking of resources, students' syndrome and Parkinson's law are behavioural issues that need to be addressed to improve project execution. The following elements of Critical Chain and Buffer Management assist in changing project resource behaviour:

- Prioritisation of projects in the portfolio
- Staggering projects using the drum resource
- Placing emphasis on task start date
- Buffer Management as a transparent mechanism of prioritisation
- Changing measures and performance indicators
- Change in Project Management style.

During the proof of concept changes in behaviour were varied. The reasons for this will be discussed in detail in the symposium and recommendations made as to how this can be further improved.

3.8. RESULTS

The following results were obtained from the PoC implementation:

- Portfolio / Project Management was more focussed due to portfolio prioritising and Buffer Management
- Single Project Planned Duration was reduced by up to 25%

- Project lead-time for the multi-project portfolio was reduced significantly by staggering the portfolio
- 67% of Projects completed were completed within this reduced duration
- Resource multi-tasking was reduced especially drum resources.
- Action planning for red buffer status projects was effective for normal causes.
- Constraint Tasks required special treatment using Constraint Tasks Buffers

3.9. ROLLOUT PLANS

After the conclusion of the PoC implementation the results were presented to the stakeholders and agreement reached to rollout the implementation to capital projects. The implementation will be led by the PMTT and will have two primary objectives: A process of Continuous Improvement in Unilever SA Capital Projects and the implementation of Critical Chain and Buffer Management.

Project Facilitators and Project Managers will participate in a weeklong workshop to identify the core conflicts and the solutions to these conflicts. The Project Facilitators will be chosen from each of the Unilever sites that manage Capital Projects. The Project Facilitators will attend a second week workshop to develop systems and measures for the implementation. These Project Facilitators, with the help of their respective Project / Portfolio Managers, will establish and run a Project Office for each site according to the outcomes of the workshop.

Internal and external support will be available to assist the Facilitators and Project Managers with the implementation, but the objective is that each Project Office will be able to function autonomously. The PMTT will remain active to network best practice.

4. CONCLUSION

Before embarking on a Theory of Constraints implementation it is important to identify and involve stakeholders and project practitioners and to predict the likely impact of the implementation of the business.

The PoC showed that Critical Chain and Buffer Management is effective in a multi-project, cross-discipline environment of Capital and Innovation projects. This requires portfolio management, project scheduling and staggering suing Critical Chain techniques.

Project duration can be reduced or the reliability of achieving project objectives improved by working according to Critical Chain schedules and using Buffer Management to prioritise resource activities.

Behavioural changes are required for the implementation of Critical Chain to be successful. These behavioural changes must be under-pinned by changes in performance measurement and management style.

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7 AUTHOR

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