Available online at www.sciencedirect.com
ScienceDirect
Procedia - Social and Behavioral Sciences 229 (2016) 96 – 103
Procedia
Social and Behavioral Sciences

5th International Conference on Leadership, Technology, Innovation and Business Management

Effective Project Management with Theory of Constraints

Azar Izmailov[a] , Diana Korneva[b] , Artem Kozhemiakin[c], a[*]

[a,b] *Kazan (Privolzhsky) Federal University, Street Kremlevskaya 18, Kazan, 420008, Russia*
[c] *TOC team consulting, Street Moskovskaya 25/29 , Kazan, 420111, Russia*

Abstract

Critical Chain Project Management (CCPM) is a TOC tool used for planning and project management. It can be used both in one-project and multi-project structures where resources are being used in several projects simultaneously.

In one-project structures, this tool includes:

1) The elimination of the existing behavioral standards that are harmful to achieving the objectives of the project (finishing the job at the last moment, unreasonable delays in order to use maximum available time);
2) Plan (Project Network), which takes into account the relationship between all the resources and tasks, as well as time to perform tasks with attention to "safety net" in time;
3) The schedule of work, which is displays Critical Chain and buffers (half "safety net" time taken from individual tasks).

For multi-project structures, this tool includes all the elements of the same tool designated to be used in a one-project structures, plus a tool to synchronize the implementation of projects - "drum", which can be either physical (resource) or virtual (a rule which states that it is inefficient to work on more than six projects).

Both structures have an additional element that provides control and monitoring, - buffer management. Project Management Critical Chain method requires periodic updating of the time set for the completion of the tasks. This information is used to update the status of the various buffers, and provides information on when it is truly necessary to apply some corrective action.

Peer-review under responsibility of the International Conference on Leadership, Technology, Innovation and Business Management

Keywords: Buffer; Critical chain project management (CCPM); Drum buffer; Multiproject planning; Theory of Constraints (TOC);

[*] Corresponding author. Tel. + 7-917-911-8373 fax. +7-843-514-8081
Email address: azar@tocteam.ru

Peer-review under responsibility of the International Conference on Leadership, Technology, Innovation and Business Management
doi:10.1016/j.sbspro.2016.07.118

1. Introduction

Here follows further instructions for authors. The project is not only the development of, for example, software or construction documentation. Project - is any activity, which has clear time frame, giving a unique result in the form of products, services, achievements and extending according to a predetermined plan. Therefore, almost every leader in his daily work is connected with some projects.

Perhaps you will agree that no matter how long it takes to perform each task within the project, it is important to complete the entire project in time. Regardless of the type of activity, there is always a need to complete several projects faster and at a lower cost. Accelerating construction projects allows you to launch new factories and shops in production faster and allows you to have faster return on investment. Accelerating the development and launch of a new product expands the market share, increase sales, and for many companies may be the difference between the market leader and outsider. In the field of information technologies rapid introduction of new online systems means greater opportunities for customer service, inventory management, and a number of other important management measures. For the majority of companies engaged in strategic projects, accelerating the projects is not just important, but essential.

Despite the wide range of different project types, there is a list of questions common for all project types:

- Projects takes longer than planned
- Permanent budget overruns
- Payments not received in time
- Too many amendments and alterations
- Too much overtime
- All too often resources are not available in time (even if promised)
- The necessary documents are not available in time (information, specifications, materials, design, permits ...)
- The constant change of priorities
- A lot of effort is spent to achieve the interim results
- Superiors requires to increase the number of projects in work

The simple fact that this list is so common, suggesting that a common problem is much more to do with the way companies manage projects than with any technical or specific factors. But there is a positive thing. The existence of a core of common problems gives companies a great opportunity to use a standard solution and make significant progress in the implementation of several projects faster and with fewer resources.

2. Literature Review And Hypotheses

Methodology of the Theory of Constraints for project management, Critical Chain, identifies three factors of project management, which almost inevitably cause negative effects listed above. Here they are:

1. Bad multitasking
2. Student`s syndrome
3. Parkinson's Law

2.1. Bad multitasking

The process of stopping the work before it is completed, in order to do other some work that is perceived as more urgent or important. Each time the task execution is stopped, there are immediate loss of efficiency because of the need to remember details in order to resume the task execution later. Difficult mental tasks may require considerable time to return. Even worse, one task`s execution stop delays the consequent tasks execution as well. As a result, the overall duration of the project increases.

Most companies are willing to admit that a bad multitasking takes place, and that people tend to have a lot of simultaneously opened tasks. This quickly leads to the "cascade effect". In other words, the delay spreads like a domino effect in the project, increasing the overall duration and delaying the project. The second and the third factors are directly related to how companies manage spare time in their projects.

Student`s syndrome associated with the phenomenon that most people begin to fully engage in the task only at the last moment before the deadline, like a student begins to study right before the exam. Student`s syndrome is a form of procrastination.

Parkinson's Law is the observation that "work expands to fill all of the time remaining before its completion." Each employee strives to be busy all the time, not to look like a bum. And the bureaucracy will generate enough internal work to keep yourself always "busy" and to justify its existence without commensurate benefit.

Uncertainty is a projects reality. Some actions to reduce uncertainty may be taken, but the complete elimination of uncertainty and variability is simply impossible. Project management can be compared to driving a car in a million city. No matter how well you drive your car, there is always likely to encounter delays (traffic jam, accident, road repair). No one can say exactly how long it takes to get from one place to another. You can only leave early "with a safe time", not to be late. Recall Murphy's Law: if there is a likelihood of some kind of trouble, it will happen.

Most companies often behave as if they can eliminate the inherent variability of the project and uncertainty. They do this by trying to improve the quality of their assessment of the timing of the task. The goal is to learn to identify terms that can realistically be achieved, and at the same time does not have too much reserve, and then impose on the people responsible for the execution of these evaluations. The logical reaction of people responsible for completing some task in time is to give their assessment of the timing, the reality of which they are confident. This means that people should evaluate the duration of the task with sufficient safety margin to account for a significant amount of things "that can go wrong" on the way.

2.2. Student Syndrome

While this makes sense, and this is done with the best intentions, the effect on the project is devastating. As soon as the safety margin incorporates into the assessment of the time the student syndrome arises. First, students request additional time to prepare for the test, and when they get it, it seems that there is a lot of time and urgency removed, they are not being prepared for the test until the next deadline approaches.

Same thing in projects. When people are busy, and estimate that the amount of time to execute the task is enough, they will not have a real reason to get started. As a result, most of the safe time included in each task is wasted at the beginning of its execution. Student Syndrome contributes significantly to the increase in time delays of the projects. It pledged that the safe time is not actually used to perform the work, despite the best intentions of the people. And very often the following situation arises: safe time that was consumed by the "students" in the beginning, becomes necessary in the end to overcome some unexpected obstacles. But it is not exists any more. As a result, the task is delayed, even thought that it was enough time and safety margin to finish it on schedule.

2.3. Parkinson's Law

On the other hand, each task is affected by Parkinson's Law. It ensures that, if the safe time has been added and has not been used up, the task would not be completed before the scheduled time, even if there are not any obstacles. In fact, there are two pitfalls. Firstly, when people have more time to complete the task, they often use that time to "improve" or "polish" it. So that work expands to fill all available time.

Secondly, to finish work early - a disincentive for people. Finishing the task long before the deadline indicates the administration that the assessment of the timing was too "fat", and that in fact it can be done much faster. The next time limit of a task will be reduced to reduce the overall project duration. Taking this into account, workers would not ever finish their tasks earlier than expected to keep their safe time untouched.

As a result, most companies may be noted that the timing of most tasks are usually very close to the estimates, and the number of tasks completed later than planned. From this it is easy to conclude that the company does an excellent job of correct assessment on task duration, and thus, it is not so much room for improvement through better synchronization. But this is very far from reality. There is a variability in a nature of each project. One task can take 10 days, and because of certain obstacles or problems, 15 days next time. Therefore, in reality, trying to predict the duration of the task is like trying to predict the duration trip in a big city. It is understood that the trip will take different times on different days.

This means that if the concrete task or project duration assesment seems very reliable (i.e., they are performed in most cases), there is a significant loss thanks to a large "reserve" time. Consequently, it is possible to significantly reduce the duration and to increase the number of projects without adding new resources.

3. Methodology

Methodology of the Theory of Constraints Critical Chain allows to overcome the three main drivers of negative consequences listed above. In order to reduce the effect of bad multitasking, the company has to reduce the number of available jobs on the pipeline. The very presence of many tasks on each desktop creates too many opportunities for poor multi-tasking and prioritizing work incorrectly. Project managers motivated to complete their projects on time will convince to give them more resources and to change the priorities. Clients and administration will exert their pressure to refocus resources. Workers also tend to choose between a variety of tasks based on their own preferences and motivation. All this ensures poor multi-tasking as a result.

Critical Chain stimulates the reduction of the number of active projects by freezing a large part of the projects in the pipeline. By reducing multitasking people stay focused and perform tasks much more quickly, allowing them to move quickly from one stage to another, faced with much less work queue. Freezing at least 25% of the projects are usually enough to speed up the progress of work and, therefore, projects completion time. When initially selected projects comes to the end, the frozen projects can be activated and executed much faster. This mechanism itself usually leads to a significant increase in the number of projects completed on time, without delays of any projects (even if the former were frozen initially).

3.1. Coordination of the conveyor of projects with restriction

After the initial freezing process, in order to achieve stable working state, it is important to ensure that new projects are launched in metered amounts, so that the number of active projects remains relatively low and declining bad multitasking. TOC indicates that the production line in any system or project can get as much work as it can get through the weakest link (restriction) in the chain of operations. Running more work than the constraint can serve will only lead to the accumulation of work in the front of limitation, not to an increase in the number of completed projects per time unit.

Critical Chain requires new working processes to be started according to the capacity of the weakest link in the system (the most loaded resource) and to be coordinated in time with it.

3.2. Time planning of the project implementation

The second important aspect of the Critical Chain is the projects safety time planning so that the extra time was not wasted, and so that the planned life of the project were as short as possible, while ensuring the reliability of their performance. This is achieved by defining of the longest chain of dependent tasks and resources for the project at the very beginning of its planning. This is very similar to the well-known method of the Critical Path. However, the Critical Path for a number of projects does not allow to take into account the situation where the same resource is required for simultaneous execution of parallel tasks. As a result, Critical Path may give a more optimistic outlook for the end of the project compared with the Critical Chain, but a realistic time frame, as shown in the figure will increase and the plan will correspond to Critical Chain (See Figure 1).

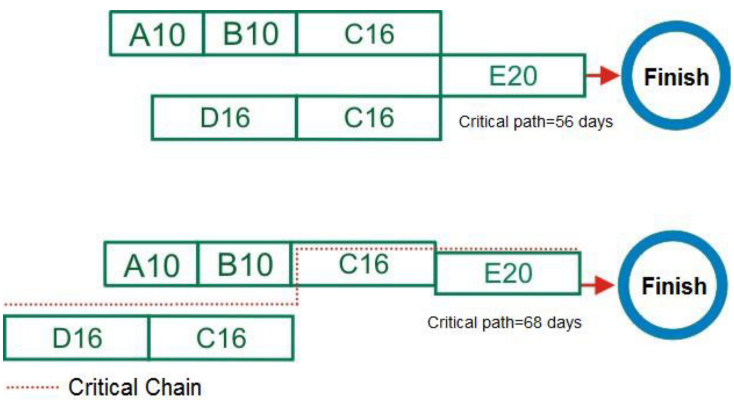

Figure 1. Critical Chain vs Critical Path.

If the scheduled time will be real, its assessment would obviously be greater, because for all tasks on the Critical Path execution time estimate is usually reduced by 50%, and this shortened time is placed at the end of the project into a common safety buffer and the small tasks feeding buffers are placed in the end of each branch circuit at the points integrating this chain part into the main Critical Chain (See Figure 2). Cutting a large part of the tasks estimated time and placing it at the end makes the overall buffer time much more suitable for the purposes of project management and available for any task on the Critical Chain, which can be delayed.

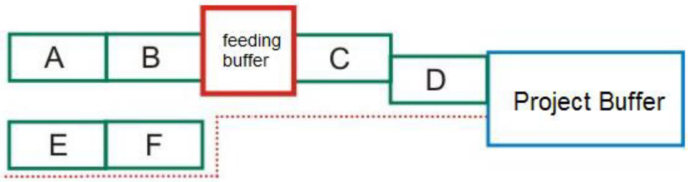

Figure 2. Buffers.

When the buffer is the same for all security tasks, task time is much shorter (and therefore less likely to cause a syndrome of the student or Parkinson's Law), much less than the delay resulting from the multitasking required total safety time is greatly reduced. The probability of a collision with a delay on any given task is very high, but the probability to encounter a delay in all tasks simultaneously is very low. Critical Chain allows to halve the guard time in the project buffer. Experience shows that that amount of time is enough for almost every organization.

3.3. Using buffers for management decisions

The last key element of the Critical Chain methodology is about how buffers are used to make management decisions in the implementation of projects.

If there are delays on the Critical Chain, than part of the safety buffer at the end of the project will be consumed. Watching the percentage of work performed on the Critical Chain and the percentage of buffer's time consumed, project managers can see the risks for all projects. When the project's buffer time consumed more rapidly than the work is performed on the Critical Chain, than the buffer is in the red state, or in other words the project runs the risk of being late. When the two, buffer and Critical Chain, moving at the same speed, buffer is yellow, which is good. When the work is done at a faster pace than the buffer is consumed - the project goes ahead and the buffer is green (See Figure 3). At a glance project manager can understand which of his projects are going well, which are in danger, and decide where and when to intervene.

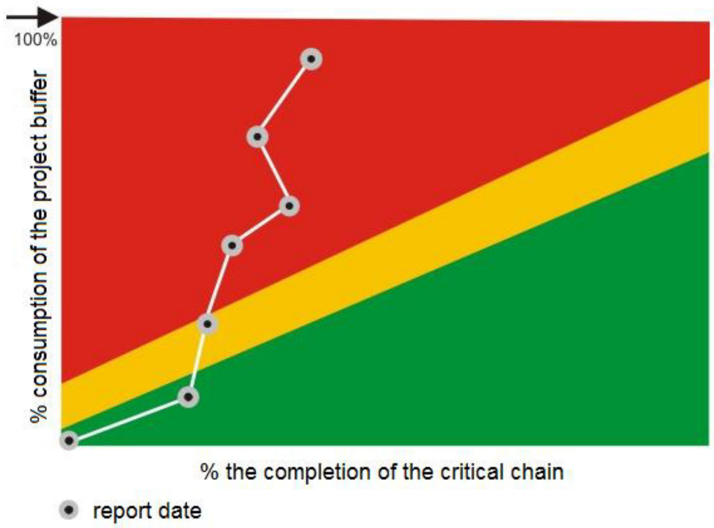

Figure 3. Decision making on the basis of the buffer.

For project managers, who are responsible for completing projects on time, it is important to see that the problem consumes buffer faster than the work is performed. They need to understand what problem delays the work to take the necessary action to bring the project back to the yellow or green zone. By monitoring the buffer for trends (becoming more green, or becoming more red), they can easily see the effect of the corrective actions taken by them.

For the heads of departments (resources), it is a central question to set priorities and load people and environment with optimal amount of work. Given that each task is listed in the buffer of the project, they can see if the task execution goes well (green buffer), or if there is a problem (red buffer). Project tasks that are red, receive a higher priority than green, that can wait, because they have more guard time. Heads of divisions can thus allocate their resources based on the status of all projects and eliminate the constant battles over priorities. Looking at the challenges ahead for their department and their status, managers are able to plan and allocate resources for the tasks based on the load and relative urgency.

Finally, the Critical Chain method provides a model for the functioning of the resources themselves, the people who do the work on the projects. Visibility of each buffer status for each task allows people to clearly see what are the most important tasks right now, allowing them to make informed decisions about priorities without the "help" of senior management. They can also see that it is important to seek help if there is a delay. Red task should require clear objectives for assistance when there is an obstacle, whereas the green task can wait without compromising the project.

Of course, it is important to give some details about the projects to ensure that the necessary information is up to date and accurate. Most approaches to project management are based on measuring the performance as a percentage of completed work, or on the time spent. Unfortunately, these measurements do not indicate how much time is required to complete the task. The reality is that in practice many managers are faced with a situation, when the completion of the last 10% of the problem is as necessary and important as the first 90%.

To combat this problem we have a task manager, which report the time remaining to complete the task. In most cases, it is much easier and more accurate than counting the percentage of completed work or hours spent. Knowing remaining time until the completion of all tasks, it is easy to fold the remaining time on the Critical Chain and compare it with the size of the buffer consumed. There are several software packages available on the market that automatically provide information and reports, as described above, which greatly facilitates the use of Critical Chain in the organization.

4. Conclusion

The result of applying these three key steps (implementation of the project in accordance with the limits of the pipeline, project planning method, Critical Chain buffers and management decisions based on that buffers) is a significant acceleration of the flow of work and completion of the project.

Companies using this approach, usually complete more than 95% of the projects on time, project duration is reduced by 25-50%. They achieve these results by synchronizing workflows through existing resources without adding people and investments in their systems. Reducing the duration of the projects means completion of more projects in the same amount of time, which significantly increases the return on investment in projects and the acceleration of the passage.

Although these changes are conceptually easy to understand, their implementation in practice, faces a number of serious problems. Great courage is required to change long-standing practices, procedures and measures used for project management at all levels. The transition from starting projects in the pipeline as soon as possible, to launching them in accordance with the limits, means a change in the widely held belief that the sooner you start the project the sooner it will be completed. All this need the appropriate support of senior management and cooperation with the sales department, otherwise you will be under pressure to run more and more projects that will paralyze the pipeline and ensure the negative return of bad multitasking.

The introduction of buffers in the project requires executive support based on the understanding of basic principles, otherwise it will lead to the destruction of the buffers and the launch of unrealistic plans. Project management and setting priorities in accordance with the buffers means that managers need to consider the allocation of resources between the objectives depending on the buffer status of each task as the primary means of control. The magnitude of these cultural changes are significant, as each change requires overcoming the inertia of old practices and beliefs, each of which could undermine the process of change.

References

Cox, Jeff; Goldratt, Eliyahu M. (1986). The goal: a process of ongoing improvement. North River Press. ISBN 0 88427-061-0.
Goldratt EM, Cox J. (1993) The goal, 2nd ed. Aldershot, England: Gower. ISBN: 978-0884270614
Goldratt EM. (1994) It's not luck. Aldershot, England: Gower. ISBN: 978-0884271154
Cather H. (1997) Is the `critical chain' the missing link? Project Mgmt Today; Nov/Dec:22-5.
Goldratt, Eliyahu M. (1997). Critical Chain. Great Barrington, MA: North River Press. ISBN 0-88427-153-6.
Paul H. Selden (1997). Sales Process Engineering: A Personal Workshop. Milwaukee, WI: ASQ Quality Press. pp. 33–35, 264–268. ISBN 0-87389-418-9.
Newbold, R.C. (1998). Project Management in the Fast Lane – applying the theory of constraints. St Lucie Press.
Leach, L.P. (1999). Critical Chain Project Management Improves Project Performance. Project Management Journal, June, 39-51.
Steyn, H. (2000). An Investigation into the Fundamentals of Critical Chain Project Scheduling.
Eli Schragenheim and H. William Dettmer (2000). Simplified Drum-Buffer-Rope: A Whole System Approach to High Velocity Manufacturing. Retrieved 2007-12-08.
Raz, T., Barnes, R., Dvir, D. (2003). A Critical Look at Critical Chain Project Management. Project Management Journal. Dec, 24-32
Leach L.P. (2004). Critical Chain Project Management. Artech House.
Eliyahu M. Goldratt (2004). Essays on the Theory of Constraints. North River Press. ISBN 0-88427-159-5.
Eliyahu M. Goldratt (2004). _The Goal: A Process of Ongoing Improvement, ISBN 978-0-88427-178-9. Theory of Constraints Handbook (2005), ISBN 978-0-07-166554-4, p. 8
Lechler, T.G., Ronen, B., Stohr, E.A. (2005). Critical Chain: A new project management paradigm or old wine in new bottles? Engineering Management Journal, 17 (4), 45-58.
Eliyahu M. Goldratt (2007). Viewer Notebook: The Goldratt Webcast Program on Project Management – the strategy and tactics tree for projects 4.7.1. Goldratt Group Publication.
Eliyahu M. Goldratt (2008). The Choice. The North River Press, MA.
Newbold R.C. (2008). The Billion Dollar Solution; Secrets of Prochain Project Management. ProChain Press.
Steyn, Herman (2009). "An Investigation Into the Fundamentals of Critical Chain Project Scheduling.". International Journal of Project Management (19): 363–369.
Azar Izmailov (2014). If Your Company is Considering the Theory of Constraints. Procedia - Social and Behavioral Sciences. Volume 150, 15 September 2014, Pages 925–929
Ma, G., Gu, L., and Li, N. (2015). "Scenario-Based Proactive Robust Optimization for Critical-Chain Project Scheduling." Journal of Construction Engineering and Management, 10.1061/(ASCE)CO.1943-7862.0001003, 04015030.
Pawan, P. and Lorterapong, P. (2015). "A Fuzzy-Based Integrated Framework for Assessing Time Contingency in Construction Projects." Journal of Construction Engineering and Management, 10.1061/(ASCE)CO.1943-7862.0001073, 04015083.

Ghaffari, M. and Emsley, M. (2015). "Current status and future potential of the research on Critical Chain Project Management." Surveys in Operations Research and Management Science, 10.1016/j.sorms.2015.10.001, 43-54.
Hu, X., Cui, N., Demeulemeester, E., and Bie, L. (2015). "Incorporation of activity sensitivity measures into buffer management to manage project schedule risk." European Journal of Operational Research, 10.1016/j.ejor.2015.08.066, 717-727.