A New Buffer Sizing Approach Based on ELENA Project Management Guidance

Mehrasa Mosallami and S. H. Yakhchali

***Abstract*—Critical chain method for overcoming the variability of project scheduling in execution phase, introduces buffers which are added at the end of critical chain and non-critical chains. So the proper buffer size has positive effect on applying critical chain project management method. The new approach of buffer sizing which is proposed in this paper is originated from ELENA project management guidance. Based on this guidance, a new concept of buffer management is introduced, so by focusing on that concept and by specifying effective factors, we could find a proper approach of buffer sizing. Finally the aim of this paper will be achieved.**

***Keywords*— critical chain project management, buffer sizing, ELENA project guidance.**

I. Introduction

In 1997, Dr. Gorldratt introduced critical chain project management (CCPM) concept by applying theory of constraints (TOCs) into project management [3]. It has shown to provide a new technique to construct a proper project schedule with considering resource constraints and make robust schedule and consider uncertainty of project by inserting various types of buffers. There are three kinds of buffers in CCPM method, including project buffer (PB), feeding buffer (FB) and resource buffer (RB). PB is a time buffer added at the end of critical chain to protect the whole delay of project. FB is also a time buffer, but it added at the end of noncritical chains in order to protect critical chain from probable delays of caused by noncritical chains, RB kind of warning systems, ensures that the required resources are ready to be assigned to critical task, when is time to work [12]. The management of buffer consumption during project progress is a valuable technique in project controlling during the execution phase which in known buffer management BM [8].

Because the effective role of buffer sizing in successful implementing of CCPM method, in both scheduling and controlling phase, there are some researches about presenting a proper buffer sizing method. In this research by considering a new concept of buffer in managing of real projects based on ELENA project guidance, we introduce an innovative buffer sizing approach taken in to account the characteristics of project and organization.

The remainder of this paper is organized as follows: section two provides a review of literature dealing with critical chain and different buffer sizing methods. Then the new concept of buffer and its characteristics based on ELENA project guidance are provided in section three. In section four the suggested buffer sizing approach is explained. In the last section the summary of this research is provided.

Mehrasa Mosallami, School of Industrial Engineering, College of Engineering, University of Tehran, Tehran, Iran..

Siamak Haji Yakhchali, School of Industrial Engineering, College of Engineering, University of Tehran, Tehran, Iran..

II. Literature Review

As mentioned before buffers are in to CC to deal with uncertainty and play role as a valuable tool for scheduling and controlling phase. There are wide ranges of studies about providing a method for calculating buffer sizes. Two popular and classic buffer sizing techniques named, cut a paste method (C&PM) and route and square error method (RSEM) that respectively mentioned in [3] and [11]. In C&PM method, the half of the estimated time is as the average time of the activities. However, considering the 50% of critical chain as a PB may cause the PB to be long and the waste of resources and the loss of business opportunities may occurred [6] and [7]. In RSEM method, the central limit theorem is implemented and assumed the durations of activities are mutually independent. So the buffer calculated by RSEM method is smaller than necessary. Then in [12] two method of buffer sizing are proposed, including adaptive procedure with resource tightness (APRT) and the adaptive procedure with density (APD). One of them considers resource tightness and the other incorporates network complexity. So they seem to be more reliable than previous method.in [10] proposed a method with generic algorithm and fuzzy theory which is proper choice when the experts are due to the lack of historical data about estimation of activities durations. Authors in [1] developed a new method by considering the activity dependence durations. In [2] and [13] by considering the management risk preferences factor, a new buffer sizing method is introduced while in incorporates resource tightness and network complexity. A buffer sizing method proposed in [14], is adjusted and determined by means of comprehensive resource tightness which consist of physical resource tightness and information resource tightness. In [9], an effective method for determining buffer size based on post density factor whit regard to limit resources, location of activity in network, environmental risk and risk of each task is proposed and proved it could be a proper method for specifying size of buffer.

As can see from overview, through the buffer sizing developed in recent years, there is a lack of considering the related characteristics of project oriented organization in buffer

sizing method. The goal of this study is to introduce a new buffer sizing approach which considers the both of related characteristics of project and project oriented organization to provide a proper approach to specify size of buffer in different projects and different organizations. To develop of this approach, we should explain a new concept of buffer based on ELENA project guidance

III. ELENA PROJECT GUIDANCE

A. *Introduction*

ELENA project guidance is a structured system for project management and a reference source of Iranian project guidance and management. This native Iranian model describes the principles, concepts, processes and tools required for project management along with their utilization in project with different characteristics. ELENA project guidance integrates both PMBOK standard and PRINCE2 methodology to keep their advantages in addition to improve each of them [5].

B. *The application of buffer management in ELENA project guidance*

ELENA project guidance provides project management structure with four levels including portfolio or program management, directing, managing and operating. For each level, a clear description of responsibilities, goals, limits of authorities, skills, knowledge and experience required for all roles were determined and delegated. the concept authority limits of ELENA project guidance delegated to each level for both deciding on project changes, stages or work packages (depending on the level) and coping with variability is similar to buffer concept of critical chain project management (fig.1). Five kinds of authority limits based on project performance objectives including scope, time, cost, quality and risk, are identified. The amount of authority limits for each level is calculated by considering the specific characteristics of project and related characteristics of project oriented organization. Therefore, based on the effective factors on the amount of authority limits, the new approach of buffer sizing will be proposed in this study.

IV. DETERMINATION OF THE AMOUNT OF AUTHORITY LIMITS

According to ELENA Portfolio, program and project offices guidance, the proper amount of quality limits are correlating with centralization dimension of organizational structure. [4]

In this section we will first provide a brief explanation of dimensions of project oriented organizational structure, second describe about centralization, and then the proposed approach of determination of the amount of authority limits is introduced.

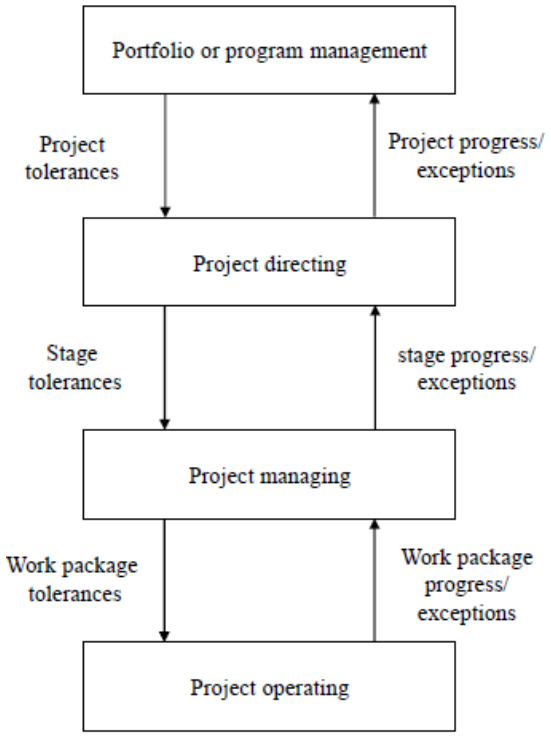

Fig 1: Decision making tolerances in project organization structure

A. *The dimensions of project oriented organizational structure*

The dimensions of project oriented organizational structure defined the specific characteristics of each organizational structure. the dimensions of project oriented organizational structure are categorized into two groups including structural and contextual dimensions [4].

1) Structural dimensions: this group of dimensions describe internal characteristics of an organizations.

2) Contextual dimensions: this group of dimensions are characteristics of the organizational setting that influence and shape the structural dimensions.

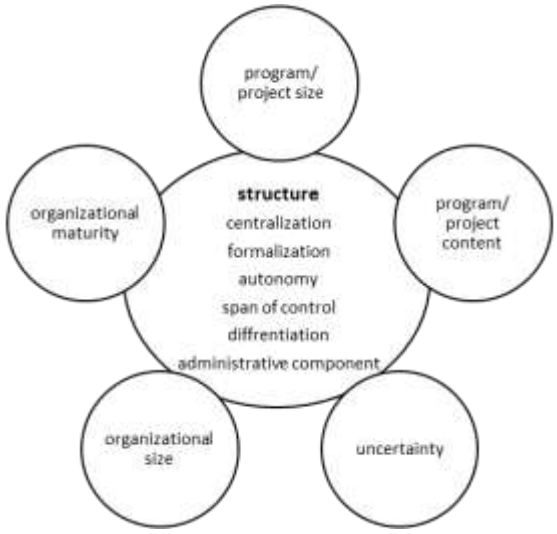

Fig 2: Structral and contextual dimensions of organization

B. Centralization

Centralization is the degree to which decision making authority is concentrated at higher levels in an organization. In centralized companies, many important decisions are made and problems are solved at lower levels by employees who are closer to the problem.

According to figure 2, it is one of dimensions of structural group and influenced by contextual dimensions. The influences of contextual dimensions on centralization are as follows [4]:

1. Program/ project size: size is typically measured by number of human resources allocated to program or project at all levels. Other measures such as estimated cost of program or project may reflect the program or project size. Generally, it is accepted that size is actually negatively correlated with centralization, it means that by increasing size of project, centralization should be decreased.
2. Program/project content: there are different types of project according to contents (for instance: IT, civil, research and development, oil, gas and petrochemicals and etc.). The content of program/ project influence the form of authority to exercise. For example, because of high uncertainty of R&D projects, centralization should be decrease .But in civil projects, because of the number of similar projects, the project organizations are more centralized.
3. Uncertainty: uncertainty is an integral part of most projects and different projects may have different degrees of uncertainties. By rising the levels of project uncertainties, the number of issues would be increased. Therefore in centralized organization, the number of exceptions reported to the upper level of project organization and time of decision making about them would be increased, finally the project progress will be led to delay. So it is recommended that in projects faced higher uncertainties, centralization should be decreased and vice versa.
4. Organizational size: besides of program/ project size, the size of organization also affects program/project organizational structure. By increasing the size of organization, the amount of centralization would be decreased. Because in larger organization, the number of projects and programs would be increased, therefore it is required to delegate proper authorities to make decisions timely.
5. Organizational maturity: Organizational maturity is a measure of an organization's readiness and capability expressed through its available resources in order to meet strategic goals and profits. In higher maturity levels, the amount of centralization dimension will be decreased and major degrees of organizational decision will be made by mature processes implementing.

C. Proposed approach

According to previous section, 5 factors affecting centralization dimension of organizational structure including program/project size, program/project content, uncertainty, organizational size and organizational maturity, were defined. Based on these factors, a proper amount of authorities within different levels of project organization can be calculated.

V. Conclusion

In this paper, a new approach of specifying size of buffer is proposed. This approach is provided based on a new concept of buffer management naming authority limits, originated from ELENA project guidance. By analyzing factors affecting the degrees of authority limits, the goal of this paper is met. In future research, the proposed approach should be developed and the buffer sizing method based on this approach should be provided and testified effectiveness.

References

[1] L. Bie, N. Cui, and X. Zhang, "Buffer sizing approach with dependence assumption between activities in critical chain scheduling," *International Journal of Production Research*, vol. 50, pp. 7343-7356, 2012 https://doi.org/10.1080/00207543.2011.649096

[2] C. C. Chue, "Buffer sizing and critical chain project management," *Computer Integrated Manufactoring Systems,* vol 14, pp. 1029-1035.

[3] E. M. Goldratt, *Critical chain: A business novel*: North River Press Great Barrington, MA, 1997.

[4] S. Haji Yakhchali, Elena portfolio, program and project offices guidance. Tehran: Obour press, 2014.

[5] S. Haji Yakhchali, *Elena project guidance.* Tehran: Obour press, 2014.

[6] C. Herreloen, R. Leus, "On the merits and pitfalls of critical chain scheduling," *Journal of operations management*, vol. 19, no. 5, pp. 559-577, 2001. https://doi.org/10.1016/S0272-6963(01)00054-7

[7] C. Herreloen, R. Leus, "Project scheduling under uncertainty: survey and research potentials," *European journal of operation research*, vol. 165, no. 2, pp. 289-306, 2005. https://doi.org/10.1016/j.ejor.2004.04.002

[8] X. Hue, N. Cue, E. Demeulemeester, "Effective expediting to improve project due date and cost performance through buffer management," *International journal of production research,* vol. 53, no. 6, pp. 688-698, 2015. https://doi.org/10.1080/00207543.2014.948972

[9] H. Iranmanesh, F. Mansourian, S. Kouchaki, "Critical chain scheduling: a new approach for feeding buffer sizing," *International journal of operational research*, vol. 25, no. 1, pp. 114-130, 2016. https://doi.org/10.1504/IJOR.2016.073254

[10] L.D. Long, A. Ohsato, "Fuzzy critical chain method for project scheduling under resource constraints and uncertainty," *International journal of project management*, vol. 26, no. 1, pp. 114-130, 2008. https://doi.org/10.1016/j.ijproman.2007.09.012

[11] R. C. Newbold, Project management in the fast lane-applying the theory of constraint. Boca Raton: The St. Lucie Press, 1998.

[12] O. L. Tukel, W. O. Rom, S. D. Eksioglu, "An Investigation of Buffer Sizing Techniques in Critical Chain Scheduling," *European Journal of Operational Research*, vol. 172, no. 2, pp. 401-416, 2006. https://doi.org/10.1016/j.ejor.2004.10.019

[13] Z. Y. Zhao, W. Y. You, and J, Zuo, "Application of innovative critical chain method for project planning and control under resource constraints and uncertainty," *Journal of Construction Engineering and Management*, vol. 136, no. 9, pp. 1056-1060, 2010. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000209

[14] J. Zhang, X. Song, and E. Diaz, "Project buffer sizing of a critical chain based on comprehensive resource tightness," *European Journal of Operational Research*, vol. 284, pp. 174-182, 2016. https://doi.org/10.1016/j.ejor.2015.07.009