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# The concept of float calculation based on the site occupation using the chronographical logic

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**Abstract**

Precedence logic's consider time as the only constraint for float computation. By neglecting resource and working areas availabilities, the accuracy of the schedule is affected. The overuse of labor regardless of location may create workspace congestion, affect negatively the productivity and create an optimistic critical path. Conversely, the underuse of work locations can unnecessarily lengthen the critical path. The margin computation will inherit such optimism/pessimism. This paper explains the concept of margin calculation based on the site occupation using the Chronographical modelling. The critical path is leveled, according to the occupancy rate of the site, by relaxing or compressing the project. The rate considers the category of location (e.g. corridor or closed room) and the activity type (e.g. divisions, flooring or electrical finishing works). The method proposes five levels of layers for spaces management according to the stage of construction, namely the creation of spaces (e.g. addition of new floors); the systems (e.g. ventilation ducts); the division of spaces (e.g. partitions); the finishing (e.g. painting) and the closing of spaces (e.g. carpet laying'). Compression or relaxation could be achieved by decreasing or extending the activities durations' by adjusting the working hours or the number of teams or peoples, or by varying the overlap rates between activities. The method thus establishes a level of risk of the completion of the project duration according to the level of criticality of the activities and locations occupation rates according to the choices made by the user. The proposed coordination method demonstrates the relevance of using other measures, including the workspace occupation rates or by freeing or blocking zones, for the scheduling calculations. The proposed chronographic logic and margin computations can then be used to simulate the project's real conditions.


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## 1. Background

For nearly four decades, the same story has been repeated with respect to the shortcomings of the widely used Activity-on-Node (AON) scheduling method, as known as the Precedence Diagram Method (PDM). This story starts with the negative impact of the reverse critical path on the network calculations [1-3]; includes the erroneous


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calculations associated with the incorrect use of lags to simulate production and dependencies that overlap with activities [4-6] and ends with the impact of multiple calendars on scheduling calculations [7].

At the beginning of the 21st century, the Chronographic logic provided the first solution to these limitations by proposing internal divisions of activities depending on quantities and the point-to-point relation, generating realistic dependencies and new types of floats [4-6]. The same logic was used in many other studies, such as the relationship diagramming method [8]; the interval-to-interval format proposed by the intermediate function of temporal logic [9]; the graphical diagramming method [10]; the automatic transformation of schemes in a PDM network, such as non-finish-to-start relationships, into their equivalent PDM relations [11]; the probabilistic dependencies between activities proposed by the Chronographic production-based relation [12]; the bee-line diagram's (BDM) graphical representation using a bee-line relation [13]; the Chronographic production-based dynamic function that follows interdependencies between two in-progress activities using sectional mathematical functions [14]; the continuous precedence relations for better modeling of overlapping activities [15]; the introduction of influence lines in project planning and characterization of the nine possible types of critical activities [3]; calculation of the network and margins with the Chronographic logic using external (time) and internal (quantity of work) scales [16]; proposal of the path-float-based critical path method (PFCPM) [17]; integration of the impact of working areas on margin calculations [18]; and modeling of operation, process and work uncertainties using the Chronographic time-scaled, point-to-point relations, production-based dynamic relations, and function dependencies [19].

In addition, the Precedence logic considers time to be the only constraint for float computation. Neglecting the availability of resource and working areas and affecting the accuracy of the schedule. Overusing labor regardless of location may create workspace congestion, negatively affect productivity and create an optimistic critical path. Conversely, underusing work locations may unnecessarily lengthen the critical path. The computation margin will inherit such optimism and pessimism.

This paper contributes to the existing body of knowledge by studying the impact of resources and working area management on float computation, and by introducing margin calculation based on site occupation using the Chronographic logic. The critical path is leveled by relaxing or compressing the project depending on the site's occupancy rate. Compression and relaxation can be achieved by decreasing or extending the duration of activities, which is achieved in turn by adjusting the working hours, number of teams or people, or by varying the overlap rates between activities. Overlapping and compressing activities generally increases uncertainty in the project and may lead to changes in construction methods or resumption of work, or to additional costs due to the lack of available data. Successor activities in the event of overlapping begin with incomplete information. The planner thus could establish a level of risk of the completion of the project within the planned duration depending on the criticality level for activities and location occupation rates.

## 2. Computing Precedence Floats

### *2.1. Margins and buffers*

The critical path network, including the PDM, defines four types of floats: total floats, free floats, interfering floats and independent floats. These floats are based on the premise that each activity is a single integral entity. However, according to the Chronographic logic, each activity represents an execution process, and its various sections can be affected differently. To represent this reality, the Chronographic Method allows for internal division of activities, thus generating six new types of floats [6]: i) the complete float, which considers the entire activity as a single integral entity; ii) the start float and the finish float, which can affect the beginning and end of an activity differently; and iii) the partial float, which concerns the various sections of any activity and can be a partial complete float, partial start float or partial finish float.

When we add those floats to the traditional floats (total, free, independent and interference), we obtain a total of 24 types of floats. These 24 floats are purely theoretical classifications. In real life, only six floats (total and free partial floats) are expected to be used regularly [6].

To reduce the risk of delays in the schedule, planners may impose time buffering at the end of the project or at some strategic point during the project. Time buffering is one of a variety of buffering strategies; other such strategies include inventory and capacity [20]. Buffering tasks reduce schedule risk and increase schedule stability.