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## Safety, space and structure quality requirements in construction scheduling

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### Abstract

Quality assessment of a construction project schedule can be a challenging task for project stakeholders. A little research work has addressed quality of schedules though a good project schedule can be considered as one of the key factors of project success. The development of a reliable and easy to perform construction schedule quality assessment procedure seems to be a challenging task. Since Schedule Health Assessment of a construction project has to be strictly related to process requirements, it is used the 3 “S” rule as a starting point and framework for obtaining improved understanding of quality of construction schedules. The 3 “S” are Safety, Space and Structure, meaning that the planned process should provide a safe working environment to construction workers, sufficient space to perform construction activities and the required sequence of construction operations and project phases. The aim of the study is to implement a schedule quality assessment method that takes into account the 3”S” rule of construction process. The 3”S” requirements can be successfully integrated in a Schedule Health Assessment method, but to facilitate their implementation and control a flow-line chart is needed, thus the schedule tool becomes a new requirement for construction schedule quality control.

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### 1. Introduction

Construction planning, scheduling and controlling are main tasks of construction project managers. A good quality construction schedule does not assure project success achievement, but it can be a good path forward.

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A sound project schedule merge cost and technical data to influence project management decisions and actions. Several studies showed the impact of adequate planning on the eventual outcomes of construction project, and standards for good scheduling practice followed (Griffith, 2005, PMSC, 2007, GAO 2012).

Understanding the organization of the various materials, trades, and subcontractors in the project processes is an ability acquired only after years of study and experience (Callahan, Quackenbush, Rowings, 1992). Thus a tool to understand schedule quality during the scheduling process and to guide the scheduler to develop the final product, or to perform a quality control, can be a valuable instrument to enhance project performance.

The aim of the paper is to assess construction schedule quality through construction process-oriented quality requirements definition. Although a set of quality requirements of a project schedule can be easily defined by literature review and by scheduling standards, the development of a reliable and easy to perform construction schedule quality assessment procedure seems to be a challenging task. In a previous research by the authors a set of seventy five schedule quality requirements has been defined and a construction schedule quality assessment procedure was developed. This includes classification of schedule requirements in five groups termed as Schedule Health Indicators: general requirements, construction process, schedule mechanics, cost and resources, and control process. It is believed that construction process requirements play a major role in the quality assessment procedure, thus they need to be highlighted.

Concerning sound preparation of project schedule from the construction process viewpoint, a well-known rule-of-thumb for construction scheduling is the 3 “S” rule. The 3 “S” are Safety, Space and Structure, meaning that the planned process should provide a safe working environment to construction workers, sufficient space to perform construction activities and the required sequence of construction operations and project phases. These requirements are of capital importance for schedule effectivity. The present research work aims at implementing a Schedule Health Assessment Method that takes into account the 3”S” rule of construction process. The study is limited to the proper implementation of the 3”S” rule in scheduling process, without examining in depth other quality related scheduling features. In fact, many schedule characteristics should be checked in order to achieve a good quality level of the schedule and the 3”S” rule should not be considered without the others quality requirements. Another sub-aim of the paper is to integrate the 3”S” rule – related requirements in a framework of the five Schedule Health Assessment indicators previously defined. The research work first analyses the schedule quality problem, as approached by pertinent literature and standards, then the 3”S” rule for construction scheduling is examined in relation to the work of Callahan, Quackenbush and Rowings (1992) that first defined the 3”S” rule scheduling approach. It also addresses the seminal works of Kenley and Seppanen (2010) about Location-Based Management System for construction and of Akinci, Fisher, Levitt and Carlson (2002) who investigated time-space conflicts in construction projects.

The research method is based upon inductive reasoning. The study starts from time-space conflicts definition and, through detailed analysis of a sample project schedule, seeks to supply evidence of 3”S” rule importance for scheduling quality. The 3”S” requirements are then integrated in a more general Schedule Health Assessment Method. Sample project data are derived from a simple case-study of an existing building refurbishment project.

## **2. The schedule quality problem**

Quality is the level of accomplishment of a product or a process to a set of performance requirements (ISO 9000:2005). Project success i.e. the achievement of project objectives is the main goal of project quality assessment. Griffith (2005) and the guide of the United States Government Accountability Office (GAO) report that there is a significant relationship between good scheduling practices used early in the project life cycle and the ultimate success of the project (GAO, 2009). Quality of the scheduling process and quality of the schedule itself can play an important role in the achievement of project success and represents a key process of construction project management.

Project scheduling has also an impact on safety (Larsen, Whyte, 2013, Saurin et alii, 2004). In Europe directive 92/57/EU (Temporary and mobile construction sites) requires an health and safety plan, and Suraji et al. (2001) found the planning and control failures related both to safety and production itself were major contributing factors to accidents in construction sites in the UK. In the U.S.A. Hinze (2002) has consistently found that pre-project and pre-task safety planning are among the critical measures required to achieve a zero accident target.

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