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Measuring Project Performance Inspired by Stock Index

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Abstract

A fundamental precept of management is that projects must be measured to be controllable. But existing approaches to capture project performance suffer from various problems – being proprietary, measuring time performance in dollar terms, reaching zero (work left) or one (work done) upon completion, and erasing any notion of progression. Therefore the concept for a unified, generalizable, and scalable performance metric is presented. It can function at levels from individual activities to entire industry sectors. Its inspiration is gleaned from modern portfolio theory, which has long been tracking and successfully comparing highly different companies. An analogy-based methodology will adapt and adopt the financial index *beta* and related concepts and test their functioning on a hypothetical schedule with known progress deviations. Such indicator has the potential to become a vital tool to measure and identify production efficiency, competitiveness, and ultimately the propensity to complete work on time.

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1. Introduction

According to the U.S. Bureau of Labor Statistics, over the past half century the construction industry has experienced an average productivity decline of approximately ½ % annually versus an average increase in productivity of 1¾ % for non-construction industries [1, 2], while a more recent study indicates a very minor growth, extracted adverse factors, and confirmed lagging behind other industries [3]. Schedule performance is of primary importance, because labor consistently accounts for more than half of all construction costs. Yet while a multiplicity of metrics and processes focus on project pricing and acquisition, the construction industry suffers from an inability to measure the schedule aspect, i.e. its ability to complete individual tasks and projects on time, to a similar depth.

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2. Literature Review

2.1. Schedule Performance Measurement in Construction Industry

Schedule performance, which tracks actual versus planned completion times, is a vital indicator of production efficiency, organizational maturity, competitiveness, and ultimately the ability to complete work in a timely manner. Performance is at the core of all managerial functions of decision makers; planning how projects should progress, controlling how they perform, and, if needed, deploying remedies to bring lagging ones back on track. Yet despite, or perhaps because of the size of the construction industry as a major contributor to the U.S. economy, its enormous number of projects, and their variety, no single measure has emerged to provide such a snapshot-in-time assessment. Unless delay claims require a forensic schedule analysis, performance is seldom considered after completion. Nor is it easily possible to forecast expected performance from past projects of a given contractor. Why, because competitive bidding is price-focused to be awarded the next job. This is compounded by a glaring lack of a measure of schedule performance to benchmark the collective performance of contractors across the construction industry. A wealth of literature focuses on pricing and acquisition measures. But performance assessment appears to concentrate on financial aspects of projects within an industry that by some sources experiences a steady decline in productivity [4, 5]. In light of this, schedule performance is of primary importance, because construction is such a labor-intensive industry [6] and it typically encompasses more than half of the entire cost; even more for individual labor-intensive trades.

Currently only a pair of simplistic metrics exists, the Schedule Performance Index (SPI) and Schedule Variance (SV) of the Earned Value Management (EVM) method. With roots in 1960s U.S. Government project management, the earned value divided by planned value is SPI = EV / PV; their difference is SV = EV - PV [7], but they are only indicative and suffer from problems: The SPI simply lists the percentage of total work as ‘value’ that a project has achieved. Its metrics converge to *one* (SPI work completed) or *zero* (SV work remaining) at the project end, so that the mere fact that a project was eventually finished makes it appear successful; any problems that have occurred are forgotten. This gives an overly optimistic, incomplete, and non-predictive view. Worse, by definition EV and PV are expressed rather counterintuitively in monetary terms (dollars, not days), while SPI at least is unitless and scale-free.

Construction practice uses a noteworthy predictive measure, which is unrelated to schedules, but captures safety performance: The Experience Modification Rate (EMR) [8]. It is defined as a moving average ratio of actual occurrences to expected within a three-year period. This determines the insurance premiums that individual contractors must pay. Different from even EVM, the EMR is widely accepted and an integral part of contractor safety quantification.

2.2. Inspiration from Stock Performance Index (β) in Finance

Several early studies contributed to conceiving the capital asset pricing model (CAPM) [9], including original work in Treynor’s [10] unpublished, but widely cited manuscript on how to establish prices for risky assets within a market and Sharpe’s [11] formal CAPM derivation, for which he and other researchers later received a Nobel prize [12]. Further groundbreaking work was contributed by Black and Scholes [13] on pricing options for volatile scenarios. Their premise that historic behavior of the stock market becomes an indicator of its future performance has spawned many ideas. Among them are the efficient market hypothesis [14], groupthink [15], and other irrational behavior, but also empirical statistics-based formulas for price and performance expectations of markets, classes or groups of shares, or individual share values. Within the body of knowledge of financial management the foremost seminal theoretical contribution to describe stock performance in an exchange remains the aforementioned CAPM.

The essence of CAPM is that is provides a mathematical expression for comparing the average expected return of an individual share of financial stock with the average expected value of holding a portfolio that comprises the entire market. Averages are typically established over a longer period; for a market it can use large portfolio-based indices, e.g. the S&P 500 [16]. Both of them are measured above the baseline of the so-called risk-free rate of return, which is assumed as a constant and represented by debt obligations that the U.S. Government routinely issues. Beta is the scaling factor for the variable component of the model that links these two measurements [17]. Black *et al.* [18] have mathematically defined it in Equation 1 (written with the commonly used variable symbols per [19, p. 240]):