

# Impact of Change's Timing on Labor Productivity

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**Abstract:** There are many types of construction changes and each type can have an effect on labor productivity. To a certain extent though the specific type of change is not as important as the mere presence of the change and, as analyzed in this paper, the timing of that change. The research reported in this paper reaffirms that project change is disruptive and detrimental to labor productivity. Data from 162 construction projects were statistically analyzed and a series of three curves are presented in this paper, representing the impact that change has on the labor productivity for early, normal, and late timing situations. The projects are a representative sample of the industry, involving a wide range of sizes, different delivery systems, and industry sectors. Late change is more disruptive of project productivity than early change, all other things being equal. The implications and benefits of this research are clear: if changes are necessary, they should be recognized and incorporated as early as possible. Practitioners can use these data and curves for either forward pricing or retrospective pricing of changes. Other researchers can use these findings to test their own findings and to explore timing issues in further detail.

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## Introduction

Change, especially when it results in protracted disputes and litigation, is a serious and expensive problem for the Construction Industry. Diekmann and Nelson (1985) found that changes were pervasive and added about 6% to the direct cost of 22 government projects. A study of Veterans Administration, Corps of Engineers and Naval Facilities Command (NAVFAC) projects showed comparable experiences: cost increases in the 5.8–11.6% range (NRC 1986). Semple et al. (1974) analyzed 24 Canadian projects and found that averages can be deceiving: 50% of the projects in this data set had cost claims for more than 30% of the original bid value. These projects also had large claims for time extensions, in some cases 80% of the original contract duration.

Though the estimate is almost 10 years old now, one industry group estimated that more than \$60 billion dollars is spent annually on changes in the United States (Dispute Avoidance and Resolution Task Force, personal communication 1995). In the latest United States Corporate census, the value of construction work put in place in 1997 was \$1.3 trillion. (US Census Bureau 2003). A 6% change rate on this \$1.3 trillion would suggest that just the direct costs of change approach \$78 billion/year. In addition there are indirect costs such as higher insurance rates; delayed commissioning of projects; lost opportunity profits from projects that cannot be pursued; the costs of bidding and manag-

ing projects “defensively,” and so forth. There are also intangible costs; for instance, the personal cost to the careers of people who are enmeshed in acrimonious disputes. Of course there are instances where change can actually be a positive thing, and reduce a project's cost or improve its overall lifecycle value. But the wrong type of change can increase the cost of projects and reduce the economic value of a project

Change affects projects in many ways, most importantly by disrupting and impairing a project's labor productivity. Different types of change have been studied by previous researchers: overtime, weather, schedule acceleration, etc. One aspect of change that has not been well researched is the issue of change's timing. Ibbs et al., (1994a) postulated that a change implemented late in a project will have more unsettling impact on labor productivity than the same change implemented earlier in the project. Aside from a case study in Ibbs et al., (1994b), no rigorous analysis of timing effects has been reported. This paper presents such an analysis.

## Prominent Previous Research

A considerable amount of research exists on the subject of construction change and how it affects craft labor productivity. For our purposes here, change is defined as any variation to the original project scope. It can be physical (more units of work) or less tangible (change the reporting requirements or resequence the project schedule to accommodate an earlier opening). Change can be the responsibility of the owner, the contractor, the designer or a third party. And, it can be additive or deductive.

In this paper, we divide the existing research literature into two categories: discrete impacts versus cumulative impacts. For brevity, we review only some of the more prominent studies.

More literature exists on the subject of discrete change's impact than on the subject of cumulative impact. Some of those studies are based on scientific research methodologies where em-

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