Measuring High-Level Project Productivity for Alberta Capital Projects

Sungmin Yun*, Stephen P. Mulva, Dae Y. Kim

Sungmin Yun, Ph.D.

Construction Industry Institute
The University of Texas at Austin
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Introduction

What is the most appropriate metric for measuring high-level project productivity, if you choose only one?

Objectives

• To identify the most appropriate single, high-level project productivity metric for Alberta’s capital projects in order to gauge overall status and trends across the industry

• To compare high-level project productivity between Alberta and U.S. projects
Introduction

**Metric Requirements:**

- Provide a single, “high level” Productivity Metric.
- To challenge the status quo, and formulate “out of the box” thinking to improve Alberta Megaproject productivity.
- The output measure would enable trending over time.
- Owners and Contractors need to be supportive to make it successful.
Introduction

- **Data Sources**
  - CII General Benchmarking Database
  - COAA Major Project Benchmarking Database

- **Scope**
  - Projects with midpoint of construction since 2001 (2001~2013)
  - Capital Projects in North America (U.S. and Canada)
Macroeconomic Productivity Trends

Labor Productivity = \frac{\text{Real Gross Domestic Product}}{\text{Hours Worked}}

Labor Productivity in Construction
(Real GDP/hour worked, constant $CAD in 2007)

Statistics Canada (2015)
Approaches for Project Level Productivity Measures

- **Quantity-Based Approach**
  
  Discipline-Level Productivity  
  \[
  \text{Discipline-Level Productivity} = \frac{\text{Work-Hours}}{\text{Installed Quantity}}
  \]

  Project-Level Construction Productivity Metrics  
  \[
  \text{Project-Level Construction Productivity Metrics} = \frac{\sum_{i=1}^{n} (WH_i \times z_i)}{\sum_{i=1}^{n} WH_i}
  \]

  *z* = z score of transformed discipline-level productivity

- **Cost-Based Approach**
  
  Option 1: Project Level Productivity  
  \[
  \text{Option 1: Project Level Productivity} = \frac{\text{Cost for Construction Activities}}{\text{Hours Worked}}
  \]

  Option 2: Project Level Productivity  
  \[
  \text{Option 2: Project Level Productivity} = \frac{\text{Construction Cost}}{\text{Procurement Cost}}
  \]
Project-Level Construction Productivity

DISCIPLINE-LEVEL PRODUCTIVITY

Concrete Field Productivity
Structural Steel Field Productivity
Electrical Field Productivity
Piping Field Productivity
Instrumentation Field Productivity
Equipment Field Productivity
Insulation Field Productivity

Transformation (Log Transformation) ➔
Standardization (Z-score) ➔
Aggregation (Weighted Z-score)

PROJECT-LEVEL CONSTRUCTION PRODUCTIVITY
Project Level Productivity Measurement Scales

Example:
If a project's project level productivity score is -1, the percentile rank of the project will 15.9% from the best. This indicates that the project has better productivity than 84.1% of sample projects.
Analysis Results

- Quantity-Based Project Productivity Metric

![Box plot showing CII Project Level Construction Productivity comparison between Alberta (N=30) and USA (N=97), with a p-value of 0.021*. The median productivity in Alberta is 0.30, and in the USA it is 0.03, indicating a 26.6% difference.](image)
Analysis Results

- Cost-Based Project Productivity Metrics
Conclusions

• Quantity-based project productivity metric meets the requirements for dis-aggregatable measurement and shows statistically significance.

• Relatively lower productivity in Alberta’ capital projects causes various factors such as management deficiency in scope, time, quality, cost, productivity tools, scaffold, equipment, materials, and lack of leadership, etc. (Jergeas 2009)

• High-level project productivity metric needs to be more elaborated and improved for capturing impacts of off-site construction, use of modularization, indirect labors and works, quality of engineering deliverables, owner’s inputs, etc.