Designation: E2691 – 20

Standard Practice for Job Productivity Measurement[1]

This standard is issued under the fixed designation E2691; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Job Productivity Measurement (JPM) measures both construction productivity differential on an ongoing and periodic basis and average productivity over the life of the construction project.

JPM calculates the ratio of output per unit of input: how much work—Construction Put In Place (CPIP)—was produced by how many labor hours. Additionally, JPM is an early warning signal for construction performance. It measures ongoing productivity changes, trends, and anomalies resulting from changes on a construction jobsite, which enables contractors, project managers, supervisors, and foremen to react and improve productivity as the construction project unfolds.

1. Scope

1.1 Based on the UNIFORMAT II format for organizing building data, established in Classification E1557, and depending on the level where measurement is applied (industry, total job, or building element), JPM measures construction productivity at three levels: task, project, and industry (shown in Fig. 1). By comparing labor hours used against CPIP, JPM allows for unified measurement of established building elements (according to the UNIFORMAT II format. This practice establishes a process for measuring construction job productivity by comparing labor usage to CPIP.

1.2 JPM measures labor productivity of the installation processes on a construction job.[2]

1.3 CPIP is measured with input from the labor performing the installation, utilizing elements of statistical process control (SPC) and industrial engineering.

1.4 JPM takes into account the difficulty of installation at any given point on a job.

1.5 JPM evaluates relative productivity changes using trend monitoring.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

E631 Terminology of Building Constructions

E833 Terminology of Building Economics

E1557 Classification for Building Elements and Related Sitework—UNIFORMAT II

E1946 Practice for Measuring Cost Risk of Buildings and Building Systems and Other Constructed Projects

E2166 Practice for Organizing and Managing Building Data

E2587 Practice for Use of Control Charts in Statistical Process Control

2.2 *ASTM Manual:*[4]

MNL 65 Application of ASTM E2691 Standard Practice for Job Productivity Measurement

3. Terminology

3.1 *Definitions*—For definition of general terms related to building construction used in this practice, refer to Terminology E631; and for general terms related to building economics, refer to Terminology E833.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *baseline labor hour budget, n*—a budget of direct labor hours created at the onset of a new construction project

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.81 on Building Economics.

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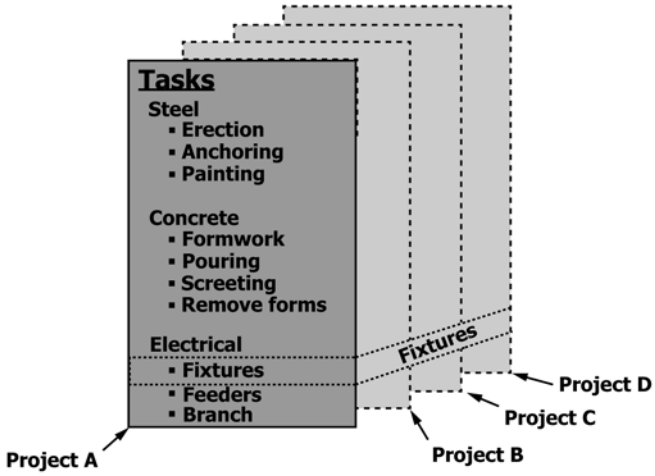
[2] JPM is based on the application of Job Productivity Assurance and Control (JPAC), which has been used in industry for more than fifteen years, resulting in 20 to 30 % improvement in productivity for contractors using it.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] Available from ASTM International Headquarters. Order MNL65-EB.



Measurement at the **task** and **project** level (above) aggregate to provide measurement at the industry level (below).

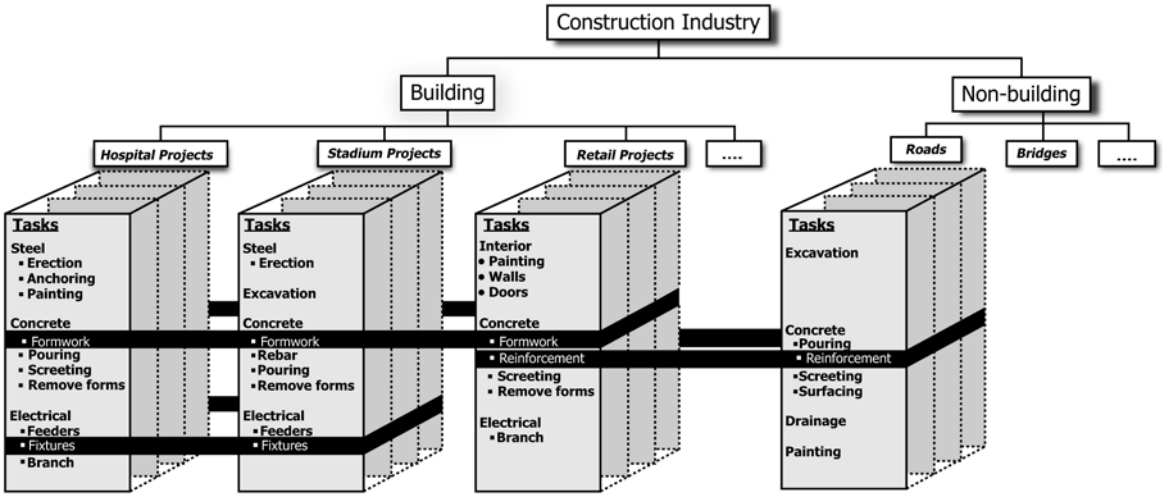


FIG. 1 Measurement of Productivity at the Industry, Project, and Task Level

that approximates how many hours will be spent on any defined part of the project.

3.2.1.1 *Discussion*—The budgeted hours are first assigned to the tasks on the project, and can be summed to determine budgeted hours for any cost code or for the entire project.

3.2.2 *control signal, n*—in construction, any series of data points which indicates deviation from the expected job progress in relation to labor, material, or finance, and indicates anomalies on the jobsite to the contractor, project manager, or job supervisor.

3.2.2.1 *Discussion*—In the Job Productivity Measurement Standard Practice, a control signal identifies any deviation from the labor productivity reference point.

3.2.3 *labor productivity reference point, n*—a ratio calculated at the beginning of a construction project, for the hours needed to complete one percent of the construction, based on the baseline labor hour budget.

3.2.4 *non-installation hours, n*—labor hours spent on activities other than installation, removal, or erection of material on the jobsite including, but not limited to, hours spent on prefabrication, preassembly, job-layout, supervision, or job planning.

3.2.5 *observed percent complete, n*—a percentage number estimate, based on physical observation, that documents what portion of a jobsite task, cost code, or entire project has been completed.

3.2.6 *productivity differential, n*—in JPM, a measurement of the percent difference between the labor productivity reference point and the current labor productivity for the given timeframe.

3.2.6.1 *Discussion*—In the Job Productivity Measurement Standard Practice, job productivity is defined as the rate of production over time, and measures the ongoing and periodic changes in productivity over time. If more hours are used than

planned due to the difficulty of installation, errors, or rework, the job productivity differential will be negative. If fewer hours are used than planned, the job productivity differential will be positive.

3.2.7 *system productivity, n*—the ratio of the labor hours allocated to physical construction put in place,[5] over the total labor hours used for completion of the project.

4. Summary of Practice

4.1 This practice is organized as follows:

4.1.1 *Section 1, Scope*—Identifies coverage.

4.1.2 *Section 2, Referenced Documents*—Lists ASTM standards referenced in this practice.

4.1.3 *Section 3, Terminology*—Addresses definitions of terms used in this practice.

4.1.4 *Section 4, Summary of Practice*—Outlines the contents of this practice.

4.1.5 *Section 5, Significance and Use*—Explains significance of measuring job productivity and of using the JPM practice to do so.

4.1.6 *Section 6, Procedure*—Lists the steps for conducting JPM.

4.1.7 *Section 7, Data Sources and Assumptions*—Describes raw data used in calculation of JPM.

4.1.8 *Section 8, Calculation of Labor Productivity Reference Point (LPRP)*—Describes calculation of LPRP, using data gathered according to Section 7, and with output provided for Section 9.

4.1.9 *Section 9, Calculation of JPM*—Provides algorithms for determining JPM.

4.1.10 *Section 10, Report*—Describes various types of reporting output for JPM.

4.1.11 *Section 11, Applications*—Describes where and how JPM information can be used.

4.1.12 *Section 12, Keywords*—Lists related words and phrases.

5. Significance and Use

5.1 JPM produces two measurements: construction production rate and productivity.

5.1.1 JPM measures the overall production rate by comparing CPIP to the time elapsed in the construction schedule.

5.1.2 JPM measures overall job productivity through a comparison of labor usage to a reference point.

5.2 JPM issues early warning signals for construction.

5.2.1 JPM identifies productivity deviations in the form of any gains or losses in productivity, and anomalies indicating a special cause, from the productivity reference point.

5.2.2 JPM measures the productivity changes to individual building elements (according to the UNIFORMAT II format for organizing building data, in Classification E1557) with the same methodology used for overall job productivity measurement.

5.2.3 JPM measures ongoing changes in labor usage.

5.3 JPM measures productivity wherever the labor is used in construction by:

5.3.1 Any contractor or construction manager directly or indirectly responsible for the productivity of the labor and its usage.

5.3.2 Any contractor or construction manager conducting self performance on any portion of the construction job.

5.3.3 Any contractor or construction manager supervising labor performance on any portion of a construction job.

6. Procedure

6.1 Establish a baseline labor hour budget (BLHB) for the scope of the construction job being measured using a Work Breakdown Structure (WBS) and reference to the UNIFORMAT II Classification E1557.

6.2 Evaluate the BLHB for appropriate level of detail.

6.3 Establish the labor productivity reference point (LPRP).

6.4 Once any labor hours are expended on the job (even before installation commences, with activities such as planning, layout, pre-assembly), begin tracking the JPM.

6.5 Report the JPM productivity differential and review the results for signals of special causes[6] impacting the productivity.

7. Data Sources and Assumptions

7.1 There are four data sources required for the calculation of JPM:

7.1.1 An estimate of the scope of construction to be put in place (see 7.2).

7.1.2 The BLHB developed from a work breakdown structure (WBS) (see 7.3).

7.1.3 Expended labor hours (see 7.4).

7.1.4 CPIP, measured by observed percent complete (see 7.5).

7.2 The estimate of the labor required for installation is established prior to establishing the BLHB.

7.2.1 Profit on the project is calculated based on estimated labor cost with given labor hours; therefore, the BLHB must not exceed the estimated labor hours.

7.3 A WBS comprised of cost codes and tasks is needed to establish the BLHB as described in Section 8.

7.3.1 The UNIFORMAT II Classification E1557 provides a format for creating a WBS by defining a hierarchy of building elements; Practice E2166 provides a practice for organizing building data based on UNIFORMAT II.[7]

7.3.1.1 JPM users managing several contractors or subcontractors have subcontractors reporting JPM for each of the major group elements and group elements defined in UNIFORMAT II.

7.3.1.2 Contractors and subcontractors directly managing installation report JPM for major group elements, using cost

[5] Construction put in place is defined in the C30 series report from the U.S. Census Bureau on "Value of Construction Put in Place," http://www.census.gov/.

[6] As defined by Practice E2587, a special cause (or unassignable cause) is a factor that contributes to variation in a process or product output that is feasible to detect and identify. In JPM measurement, the factor contributes to variation in productivity or deviation from the productivity reference point.

[7] UNIFORMAT II is limited to building construction, whereas JPM applies to all types of construction, including roads and bridges, tunnels, dams, and railroads.