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Standard Practice for Measuring Cost Risk of Buildings and Building Systems[1]

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1. Scope

1.1 This practice establishes a procedure for measuring cost risk for buildings and building systems, using the Monte Carlo simulation technique as described in Guide E 1369.

1.2 A computer program is required for the Monte Carlo simulation. This can be one of the commercially available software programs for cost risk analysis, or one constructed by the user.

2. Referenced Documents

2.1 *ASTM Standards:*

E 833 Terminology of Building Economics[2]

E 1369 Guide for Selecting Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Buildings and Building Systems[2]

E 1557 Classification for Building Elements and Related Sitework - UNIFORMAT II[2]

E 2168 Classification for Allowance, Contingency and Reserve Sums in Building Construction Estimating[3]

3. Terminology

3.1 *Definitions*—For definition of terms used in this guide, refer to Terminology E 833.

4. Summary of Practice

4.1 The procedure for calculating building cost risk consists of the following steps:

4.1.1 Identify critical cost elements.

4.1.2 Eliminate interdependencies between critical elements.

4.1.3 Select Probability Density Function.

4.1.4 Quantify risk in critical elements.

4.1.5 Create a cost model.

4.1.6 Conduct a Monte Carlo simulation.

4.1.7 Interpret the results.

4.1.8 Conduct a sensitivity analysis.

5. Significance and Use

5.1 Building cost risk analysis (BCRA) provides a tool for building owners, architects, engineers, and contractors to measure and evaluate the cost risk exposures of their building construction projects.[4] Specifically, BCRA helps answer the following questions:

5.1.1 What are the probabilities for the construction contract to be bid above or below the estimated value?

5.1.2 How low or high can the total project cost be?

5.1.3 What is the appropriate amount of contingency to use?

5.1.4 What cost elements have the greatest impact on the building's cost risk exposure?

5.2 BCRA can be applied to a building project's contract cost, construction cost (contract cost plus construction change orders), and project cost (construction cost plus owner's cost), depending on the users' perspectives and needs. This practice shall refer to these different terms generally as "building cost."

6. Procedure

6.1 *Identify Critical Cost Elements*:

6.1.1 A building cost estimate consists of many variables. Even though each variable contributes to the total building cost risk, not every variable makes a significant enough contribution to warrant inclusion in the cost model. Identify the critical elements in order to simplify the cost risk model.

6.1.2 A critical element is one which varies up or down enough to cause the total building cost to vary by an amount greater than the total building cost's critical variation, and one which is not composed of any other element which qualifies as a critical element. This criterion is expressed as:

$$IF\ V_Y > V_{CRIT} \tag{1}$$

AND Y contains no other element X where $V_X > V_{CRIT}$

THEN Y is a critical element

where:

$$V_Y = \frac{\text{(Max. percentage variation of the element Y) * (Y's anticipated cost)}}{\text{Total Building cost}} \tag{2}$$

[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] *Annual Book of ASTM Standards*, Vol 04.11.

[3] *Annual Book of ASTM Standards*, Vol 04.12.

[4] This practice is based, in part, on the article, "Measuring Cost Risk of Building Projects," by Douglas N. Mitten and Benson Kwong, Project Management Services, Inc., Rockville, MD, 1996.

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