# Standard Classification for Cost Estimate Classification System[1, 2]

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## 1. Scope

1.1 This classification provides a generic classification system for cost estimates and provides guidelines for applying the classification to cost estimates.

1.2 This classification maps the phases and stages of cost estimating to a generic maturity and quality matrix, keyed to a degree of project definition, that can be applied across a wide variety of industries.

1.3 The Cost Estimate Classification System has been developed in a way that:

1.3.1 provides a common understanding of the concepts involved with classifying cost estimates;

1.3.2 defines and correlates the major characteristics used in classifying cost estimates, and;

1.3.3 uses the degree of project definition as the primary characteristic used to categorize estimate classes.

## 2. Referenced Documents

2.1 *ASTM Standards:*[3]

E631 Terminology of Building Constructions

E833 Terminology of Building Economics

E1804 Practice for Performing and Reporting Cost Analysis During the Design Phase of a Project

2.2 *Other Standards:*

ANSI Z94.2-1989 Industrial Engineering Terminology: Cost Engineering[4]

AACE International Recommended Practice No 17R-97: Cost Estimate Classification System[5]

AACE International Recommended Practice No 18R-97: Cost Estimate Classification System: As Applied in Engineering, Procurement, and Construction for the Process Industries[5]

AACE International Recommended Practice No 56R-08: Cost Estimate Classification System – As Applied in Building and General Construction Industries[5]

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology E833 and Terminology E631.

## 4. Significance and Use

4.1 Use of this classification will improve communication among all the stakeholders involved with preparing, evaluating, and using cost estimates.

4.2 The various parties that use cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates.

4.3 This classification applies the degree of project definition as the primary characteristic for determining an estimate's classification.

4.4 Using this classification will help those involved with project estimates to avoid misinterpretation of the various classes of cost estimates and to avoid their misapplication and misrepresentation. Improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays, or disputes caused by misunderstandings of cost estimates and what they are expected to represent.

4.5 This classification is intended to be generic and so provide a system for the classification of cost estimates in any industry. There are also references to specific industries, for cost estimate classification as applied in: AACE International, Process Industry 18R-97, and AACE International, Building/General Construction Industry 56R-08.

4.6 Estimate classifications provide valuable additional reporting information when used as an adjunct to Practice E1804.

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[1] This specification 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] This classification is based on the AACE International Recommended Practices 17R–97, 18R-97, and 56R-09 pertaining to Cost Estimate Classification System.

[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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from the Association of the Advancement of Cost Engineering International (AACE International), 209 Prairie Avenue, Suite 100, Morgantown, WV 26501, http://www.aacei.org.

## 5. Basis of Classification

5.1 There are numerous characteristics that can be used to categorize cost estimate types. The most significant of these are degree of project definition, end usage of the estimate, estimating methodology, and the effort and time needed to prepare the estimate. The primary characteristic used in this guideline to define the classification category is the degree of project definition. The other characteristics are secondary.

5.2 The discrete degrees of project definition used for classifying estimates correspond to the typical phases and gates of evaluation, authorization, and execution often used by project stakeholders during a project life cycle.

5.3 Five cost estimate classes have been established. While the degree of project definition is a continuous spectrum, it has been determined from benchmarking industry practices that three to five discrete categories are commonly used. Five categories are established in this standard classification as it is easier to simplify by combining categories than it is to arbitrarily split a standard.

5.4 In Table 1 these estimate class designations are labeled Class 1, 2, 3, 4, and 5. A Class 5 estimate is based upon the lowest degree of project definition, and a Class 1 estimate is closest to full project definition and maturity. This countdown approach considers that estimating is an iterative process whereby successive estimates are prepared until a final estimate closes the process.

5.5 The five estimate classes are presented in Table 1 in relationship to the identified characteristics. It is important to understand that it is only the degree of project definition that determines the estimate class. The other four characteristics are secondary characteristics that are generally correlated with the degree of project definition.

5.6 This generic matrix and guideline provides a high-level estimate classification system that is non-industry specific. The accuracy ranges identified in Table 1 are indicated as index values so that they may be applied generically to just about any particular industry. A more detailed explanation of these index values, including two examples of their possible ranges, can be found in Appendix X1.

## 6. Determination of the Cost Estimate Class

6.1 The cost estimator makes the determination of the estimate class based upon the degree of project definition (design % complete). While the determination of the estimate class is somewhat subjective, the design input data, completeness and quality of the design deliverables serve to make the determination more objective.

## 7. Estimate Characteristics

7.1 The following are brief discussions of the various estimate characteristics used in the estimate classification matrix, Table 1. For the secondary characteristics, the overall trend of how each characteristic varies with the degree of project definition (the primary characteristic) is provided.

7.2 *Degree of Project Definition (Primary Characteristic):*

7.2.1 This characteristic is based upon the level of completion of project definition (roughly corresponding to the percentage completion of architectural/engineering detail and design). The degree of project definition defines maturity, or the extent and types, of input information available to the estimating process. Such inputs include project scope definition, requirements documents, specifications, project plans, drawings, calculations, knowledge and experience gained from past projects, reconnaissance data, and other information that must be used, and developed, to define the project. Each industry will have a typical set of deliverables that are used to support the type of estimates used in that industry. The set of deliverables becomes more definitive and complete as the degree of project definition (such as architecture and engineering) progresses.

7.3 *End Usage (Secondary Characteristic):*

7.3.1 The various classes (or phases) of cost estimates prepared for a project typically have different end uses or purposes. As the degree of project definition increases, the end

**TABLE 1 Generic Cost Estimate Classification Matrix**

| | Primary Characteristic | Secondary Characteristic | | | |
|---|---|---|---|---|---|
| ESTIMATED CLASS | DEGREE OF PROJECTION DEFINITION | END USAGE | METHODOLOGY | EXPECTED ACCURACY RANGE | PREPARATION EFFORT |
| | Expressed as % of complete definition | Typical purpose of estimate | Typical estimating method | Typical ± range relative to index of 1 (that is, Class 1 estimate)^A^ | Typical degree of effort relative to least cost index of 1^B^ |
| Class 5 | 0 % to 2 % | Screening or feasibility | Stochastic (factors or models, or both) or judgment | 4 to 20 | 1 |
| Class 4 | 1 % to 15 % | Concept study or feasibility | Primarily stochastic | 3 to 12 | 2 to 4 |
| Class 3 | 10 % to 40 % | Budget authorization or control | Mixed but primarily stochastic | 2 to 6 | 3 to 10 |
| Class 2 | 30 % to 70 % | Control or bid/tender | Primarily deterministic | 1 to 3 | 5 to 20 |
| Class 1 | 70 % to 100 % | Check estimate or bid/tender | Deterministic | 1 | 10 to 100 |

^A^ If the expected accuracy range index value of "1" represents +10/-5 %, then an index value of "10" represents +100/-50 %.
^B^ If the preparation effort index value of "1" represents 0.005 % of project costs, then an index value of "100" represents 0.5 %.

usage of an estimate typically progresses from strategic evaluation and feasibility studies to funding authorization and budgeting, to project control.

7.4 *Estimating Methodology (Secondary Characteristic)*

7.4.1 Estimating methodologies fall into two broad categories: stochastic and deterministic. In stochastic methods, the independent variable(s) used in the cost estimating algorithms are generally something other than a direct measure of the units of the item being estimated. The cost estimating relationships used in stochastic methods are often based on factors, metrics, models, etc. With deterministic methods, the independent variable(s) are more or less a definitive measure of the item being estimated (can include, detailed takeoff, quotes, bids, etc.). A deterministic methodology reduces the level of conjecture inherent in an estimate. As the degree of project definition increases, the estimating methodology tends to progress from stochastic to deterministic methods.

7.5 *Expected Accuracy Range (Secondary Characteristic):*

7.5.1 Estimate accuracy range is an indication of the degree to which the final cost outcome for a given project could vary from the estimated cost. Accuracy is traditionally expressed as a ± percentage range around the point estimate, after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (± measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). As the degree of project definition increases, the expected accuracy of the estimate tends to improve, as indicated by a narrower ± range. Additionally, industry experience shows that a percentage range should also vary with the cost magnitude of the project. In addition to the degree of project definition, estimate accuracy is also subject to:

7.5.1.1 Level of non-familiar technology in the project.

7.5.1.2 Complexity of the project.

7.5.1.3 Quality of reference cost estimating data.

7.5.1.4 Quality of assumptions used in preparing the estimate.

7.5.1.5 Experience and skill level of the estimator.

7.5.1.6 Estimating techniques employed.

7.5.1.7 Time and level of effort budgeted to prepare the estimate.

NOTE 1—In Table 1, the values in the accuracy range column do not represent plus or minus percentages, but instead represent an index value relative to a best range index value of 1. If, for a particular industry, a Class 1 estimate has an accuracy range of +10/-5 percent, then a Class 5 estimate in that same industry may have an accuracy range of +100/-50 percent.

NOTE 2—Appendix A provides an illustrative example of estimate accuracy ranges for two particular industries.

7.6 *Effort to Prepare Estimate (Secondary Characteristic):*

7.6.1 The level of effort needed to prepare a given estimate is an indication of the cost, time, and resources required. The cost measure of that effort is typically expressed as a percentage of the total project costs for a given project size. As the degree of project definition increases, the amount of effort to prepare an estimate increases, as does its cost relative to the total project cost. The effort to develop the project deliverables is not included in these effort metrics; they only cover the cost to prepare the cost estimate itself.

## 8. Relationships and Variations of Estimate Characteristics: Discussion

8.1 There are a myriad of complex relationships that may be exhibited among the estimate characteristics within the estimate classifications. The overall trend of how the secondary characteristics vary with the degree of project definition was provided above. This section explores those trends in more detail. Typically, there are commonalties in the secondary characteristics between one estimate and the next, but in any given situation there may be wide variations in usage, methodology, accuracy, and effort.

8.1.1 The level of project definition is the driver of the other characteristics. Typically, all of the secondary characteristics have the level of project definition as a primary determinant. While the other characteristics are important to categorization, they lack complete consensus. For example, one estimator's bid might be another's budget. Characteristics such as methodology and accuracy can vary markedly from one industry to another and even from estimator to estimator within a given industry.

8.2 *Degree of Project Definition:*

8.2.1 Each project (or industry grouping) will have a typical set of deliverables that are used to support a given class of estimate. The availability of these deliverables is directly related to the level of project definition achieved. The variations in the deliverables required for an estimate are too broad to cover in detail here; however, it is important to understand what drives the variations. Each industry group tends to focus on a defining project element that drives the estimate maturity level. For instance, chemical industry projects are process equipment-centric; such as, the level of project definition and subsequent estimate maturity level is significantly determined by how well the equipment is defined. Architectural projects tend to be structure-centric, software projects tend to be function-centric, and so forth. Understanding these drivers puts the differences that may appear in the more detailed industry addenda into perspective.

8.3 *End Usage:*

8.3.1 While there are common end usages of an estimate among different stakeholders, usage is often relative to the stakeholders identity. For instance, an owner company may use a given class of estimate to support project funding, while a contractor may use the same class of estimate to support a contract bid or tender. It is not at all uncommon to find stakeholders categorizing their estimates by usage-related headings such as budget, study, or bid. Depending on the stakeholders perspective and needs, it is important to understand that these may actually be all the same class of estimate (based on the primary characteristic of degree of project definition achieved).

8.4 *Estimating Methodology:*

8.4.1 As stated previously, estimating methodologies fall into two broad categories: stochastic and deterministic. These broad categories encompass scores of individual methodologies. Stochastic methods often involve simple or complex modeling based on inferred or statistical relationships between costs and programmatic or technical parameters, or both.

Deterministic methods tend to be straightforward counts or measures of units of items multiplied by known unit costs or factors. It is important to realize that any combination of methods may be found in any given class of estimate. For example, if a stochastic method is known to be suitably accurate, it may be used in place of a deterministic method even when there is sufficient input information based on the degree of project definition to support a deterministic method. This may be due to the lower level of effort required to prepare an estimate using stochastic methods.

8.5 *Expected Accuracy Range:*

8.5.1 The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and the estimating process. The extent of the input information as measured by percentage completion (and related to degree of project definition) is a highly important determinant of accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

8.5.2 *State of Technology*—Technology varies considerably between industries, and thus affects estimate accuracy. The state of technology used here refers primarily to the programmatic or technical uniqueness and complexity of the project. Procedurally, having full extent and maturity in the estimate basis deliverables is deceptive if the deliverables are based upon assumptions regarding uncertain technology. For a first-of-a-kind project there is a lower level of confidence that the execution of the project will be successful (all else being equal). There is generally a higher confidence level for projects that repeat past practices. Projects for which research and development are still under way at the time that the estimate is prepared are particularly subject to low accuracy expectations. The state of technology may have an order of magnitude (10 to 1) effect on the accuracy range.

8.5.3 *Quality of Reference Cost Estimating Data*—Accuracy is also dependent on the quality of reference cost data and history. It is possible to have a project with common practice in technology, but with little cost history available concerning projects using that technology. In addition, the estimating process typically employs a number of factors to adjust for market conditions, project location, environmental considerations, and other estimate-specific conditions that are often uncertain and difficult to assess. The accuracy of the estimate will be better when verified empirical data and statistics are employed as a basis for the estimating process, rather than assumptions.

8.5.4 In summary, estimate accuracy will generally be correlated with estimate classification (and therefore the degree of project definition), all else being equal. However, specific accuracy ranges will typically vary by industry. Also, the accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as differing technological maturity, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process.

8.6 *Effort to Prepare Estimate:*

8.6.1 The effort to prepare an estimate is usually determined by the extent of the input information available. The effort will normally increase as the number and complexity of the project definition deliverables that are produced and assessed increase. However, with an efficient estimating methodology on repetitive projects, this relationship may be less defined. For instance, there are combination design/estimating tools in the process industries that can often automate much of the design and estimating process. These tools can often generate Class 3 deliverables and estimates from the most basic input parameters for repetitive-type projects. There may be similar tools in other industry groupings.

NOTE 3—Estimate preparation costs as a percentage of total project costs will vary inversely with project size in a nonlinear fashion. For a given class of estimate, the preparation cost percentage will decrease as the total project costs increase. Also, at each class of estimate, the preparation costs in different industries will vary markedly. Metrics of estimate preparation costs normally exclude the effort to prepare the defining project deliverables.

## 9. Keywords

9.1 Bid/tender; Class 1 estimate; Class 2 estimate; Class 3 estimate; Class 4 estimate; Class 5 estimate; Class of estimate; Cost estimate; Cost estimate classification methodology; Degree of project definition; Deterministic; Effort to prepare estimates; End usage; Estimate classification; Estimate classification matrix; Estimating methodology; Expected accuracy range; Life cycle; Maturity and quality matrix; Project; Stochastic

# APPENDIX

## (Nonmandatory Information)

## X1. GUIDANCE NOTES

X1.1 The accuracy ranges identified in Table 1, above, are indicated as index values so that they may be applied generically to just about any particular industry. Any particular industry may have typical norms associated with the accuracy level expected for each class of estimate. The accuracy ranges typically associated with the building and general construction industry will generally be tighter than the accuracy ranges associated with the process industry (see Table X1.1). Both will have tighter accuracy ranges than those associated with the software development industry.

X1.2 Table X1.1, that follows, illustrates typical accuracy ranges that may be associated with the process and general building and construction industries. Depending on the technical and project deliverables associated with each estimate, the accuracy range for any particular estimate is expected to fall into the ranges identified.

X1.3 As noted above in Section 8, there are a myriad of complex relationships that come into play when drafting any statement of accuracy levels for each estimate class. The many sectors of the construction industry do vary significantly in their design, procurement and implementation methodologies, as well as the technologies they employ, the range in their scope, and the magnitude of their funding needs.

X1.4 Another way to look at the variability associated with estimate accuracy ranges is shown in Fig. X1.1 and Fig. X1.2, that follow. Depending upon the technical complexity of the project, the availability of appropriate cost reference information, the degree of project definition, and the inclusion of appropriate contingency determination, a typical Class 5 estimate for a process industry project may have an accuracy range as broad as –50 % to +100 %, or as narrow as –20 % to +30 %.

X1.5 In these figures, you can also see that the estimating accuracy ranges overlap the estimate classes. There are cases where a Class 5 estimate for a particular project may be as accurate as a Class 3 estimate for a different project. This may be the case if the Class 5 estimate was based on a repeat project with good cost history and data, whereas the Class 3 estimate was for a project involving new technology. It is for this reason that Table 1 provides a range in index values. This permits application of the specific circumstances inherent in a project, and an industry sector, to the indication of realistic estimate class accuracy range percentages.

**TABLE X1.1 Illustrative Example of Typical Accuracy Ranges for the Process and General Building Construction Industries**

| | Primary Characteristic | Secondary Characteristic | |
|---|---|---|---|
| | DEGREE OF PROJECTION DEFINITION | EXPECTED ACCURACY RANGE Typical variation in low and high ranges[A] | |
| Estimated Class | Expressed as % of complete definition | Process Industry | Building Construction and General Construction Industry |
| Class 5 | 0 % to 2 % | L: –20 % to –50 %<br>H: +30 % to +100 % | L: –20 % to –30 %<br>H: +30 % to + 50 % |
| Class 4 | 1 % to 15 % | L: –15 % to –30 %<br>H: +20 % to +100 % | L: –10 % to –20 %<br>H: +20 % to +30 % |
| Class 3 | 10 % to 40 % | L: –10 % to –20 %<br>H: _10 to +50 | L: –5 % to –15 %<br>H: +10 % to +20 % |
| Class 2 | 30 % to 70 % | L: –5 % to –15 %<br>H: +5 % to +20 % | L: –5 % to –10 %<br>H: +5 % to +15 % |
| Class 1 | 70 % to 100 % | L: –3 % to –10 %<br>H: +3 % to +15 % | L: –3 % to –5 %<br>H: +3 % to +10 % |

[A] The state of process technology and availability of applicable reference cost data affect the range markedly. The ± value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50 % level of confidence) for a given scope.

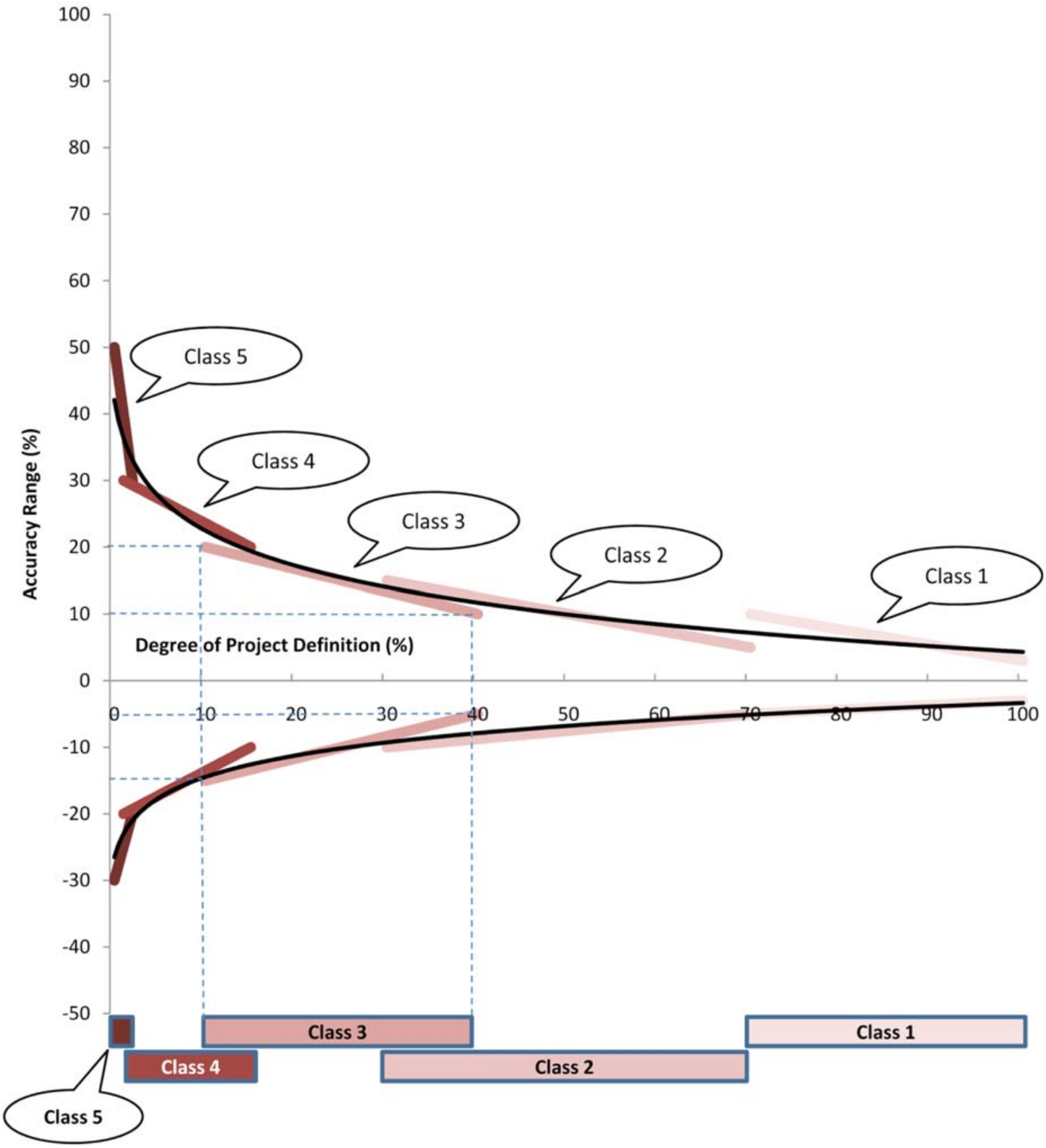


FIG. X1.1 Example of the Variability in Accuracy Ranges for a Building and General Construction Industry Estimate

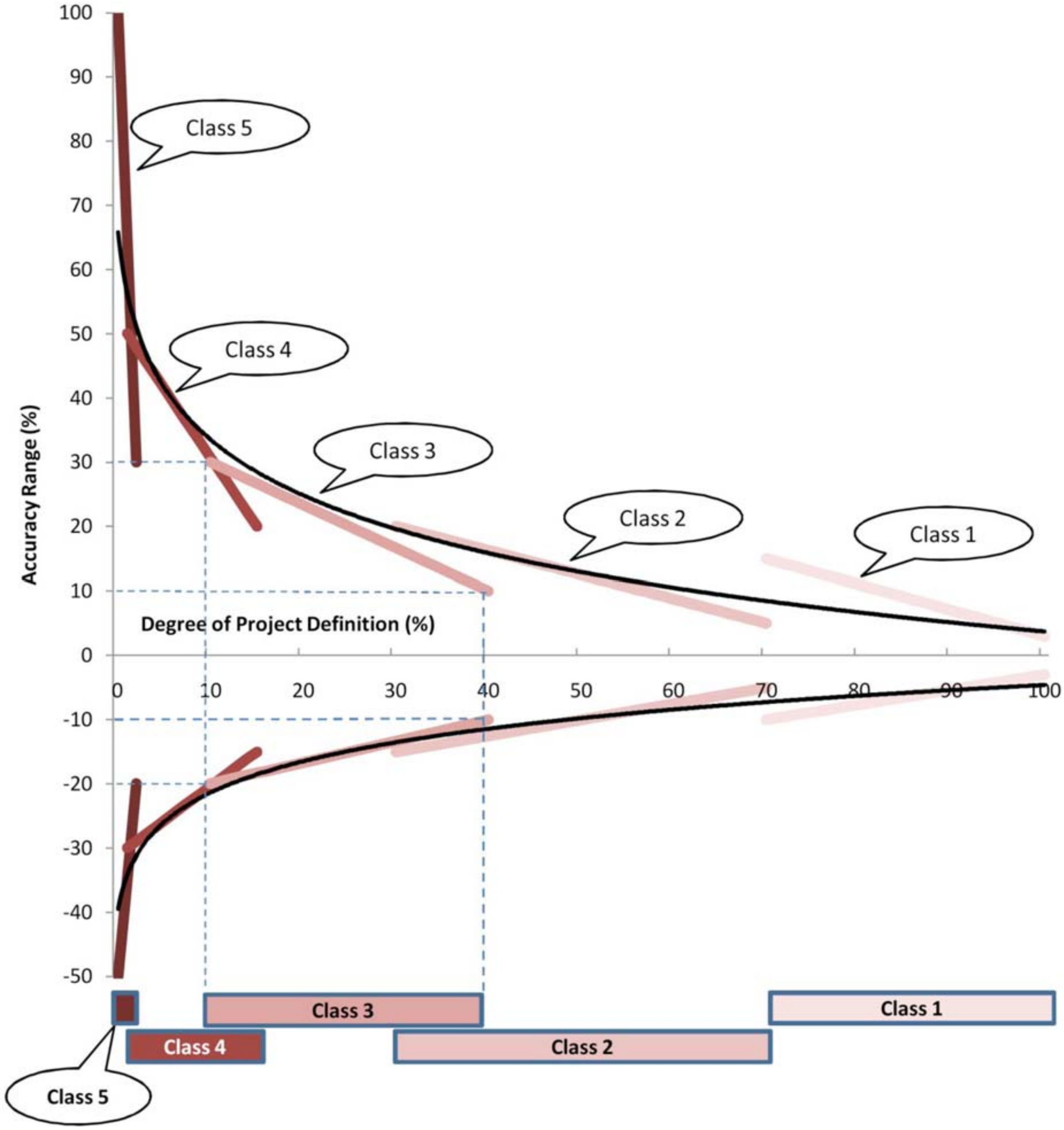


**FIG. X1.2 Example of the Variability in Accuracy Ranges for a Process Industry Estimate**