

Appendix Q: Glossary

Analogy

A currently fielded system similar in design and/or operation to the proposed system. The cost of the proposed system is developed by taking the fielded system's data and adjusting them to account for any differences. Analogous estimates are also called comparative or extrapolated estimates.

Analysis of Alternatives (AoA)

An AoA broadly examines multiple elements of project or program alternatives including technical risk, maturity, and costs. AoAs are intended to illuminate the risk, uncertainty, and relative advantages and disadvantages of the alternatives being considered; they show the sensitivity of each alternative to possible changes in key assumptions, and they aid decision makers in judging whether any of the proposed alternatives offer sufficient operational and/or economic benefit to be worth the cost.

Announcement of Opportunity (AO)

A mechanism used to solicit proposals for unique, high-cost research investigation opportunities that typically involve flying experimental hardware provided by the bidder on one of NASA's Earth-orbiting or free-flying space flight missions. Scope selection through AOs can require development periods of many years and involve budgets of many millions of dollars for the largest programs. Selections are usually awarded through contracts, even for nonprofit organizations, although occasionally grants are also used.

Baseline

The technical performance and content, technology application, schedule milestones, and budget (including Unallocated Future Expenses [UFEs]) that are documented in the approved program and project plans.

Beta Curve

A method that can be used to spread parametrically derived cost estimates. The Beta Curve's shape can be tailored by modifying two parameters: cost fraction and peakedness.

Business Case Analysis (BCA)

A method to aid decision makers in the comparison of alternative approaches, options, or projects. A BCA considers not only all Life-Cycle Costs (LCCs) identified by a Life-Cycle Cost Estimate (LCCE), but also other quantifiable and nonquantifiable benefits for all possible alternatives.

Coefficient of Determination (R²)

In the context of statistical models, this is the proportion of variability in a dataset accounted for by the statistical model. In cost estimating, it provides a measure of how well cost estimates are likely to be predicted by the model. R² ranges from 0 (no relationship) to 1 (perfect relationship).

Compounding

The process of going from today's values, or present values (PVs), to future values (FVs).

Constant Year (CY) Dollars

An analytical technique that translates a real year (RY) dollar estimate (the year expenses were realized) to a single-year value by discounting the effects of inflation. A figure expressed in CY dollars reflects the present value of a single year. Cost models are developed by normalizing actual costs to remove the effects of inflation from historical data points. Those data points are then used to develop the model. Cost estimating results are thus informed by CY values.

Cost Analysis Data Requirement (CADRe)

A document that captures the technical, cost, and schedule scope associated with selected project key decision points (KDPs) in a consistent format and utilizes a consistent Work Breakdown Structure (WBS). CADRe ensures the consistent capture of project data for the development of future cost and schedule estimates.

Cost As an Independent Variable (CAIV)

The process of examining cost drivers by holding cost independent of other technical parameters. CAIV is founded upon two primary principles: first, system costs are constrained; and second, “trade space” is the foundation for smart decisions. Trade space is the range of alternatives available to decision makers. It is four-dimensional, comprising performance, cost, schedule, and risk impacts.

Coefficient of Variation (CV)

A normalized measure of the dispersion of a probability distribution. The absolute value of the CV is sometimes known as relative standard deviation (RSD), which is expressed as a percentage.

Correlation

A statistical technique used to determine the degree to which variables are related or associated. Correlation does not prove or disprove a cause-and-effect relationship.

Cost Benefit Analysis (CBA)

An analytic technique that compares the costs and benefits of investments, programs, or policy actions in order to determine which alternative(s) maximize net profits. Net benefits of an alternative are determined by subtracting the present value of costs from the present value of benefits. Guidance for Cost Benefit Analysis for Government programs is provided in OMB Circular A-94.

Cost Breakdown Structure (CBS)

A preliminary Work Breakdown Structure (WBS) produced by a cost estimator to facilitate the generation of a cost estimate prior to the development of a project WBS. The CBS should be consistent with the NASA standard Level 2 WBS.

Cost Driver

Input variables for a cost estimating model that will have a significant effect on the cost estimate.

Cost Estimate

The result of applying quantitative techniques to calculate and forecast development, production, operation, and disposal costs within a scheduled timeframe and defined scope for a given project.

Cost Estimating Relationship (CER)

A mathematical relationship that defines cost as a function of one or more independent parameters such as performance, operating characteristics, or physical characteristics.

Cost of First Unit

The expected or known cost of the first unit produced or delivered in a multi-unit production. In learning curve theory, this unit is expected to be the most expensive of the production and often used as the basis for adjusted cost projections of later units.

Cost Risk

Risk due to statistical uncertainty in the cost estimating methodology, technical parameters, economic factors, rates, and schedule, as well as programmatic and technological factors.

Cumulative Distribution Function (CDF) (also known as “S-curve”)

Describes the probability that a real-valued random variable, X , with a given probability distribution will be found at a value less than or equal to x . CDFs are used to specify the distribution of multivariate random variables.

Discount Factor (also called the Discount Rate)

The factor that is used to translate values from different time periods so that they may be combined into a single number. Discount rates are used to calculate present value (PV).

Discounted Cash Flow (DCF)

Refers to a cash flow summary that has been adjusted to reflect the time value of money.

Earned Value Management/Earned Value Management System (EVM/EVMS)

A management technique and system utilized to relate resources to schedules. Work is planned, budgeted, and scheduled in time-phased increments, producing a cost and schedule measurement baseline. The EVMS enables the evaluation of the deviation and enables the forecasting of the resulting cost and schedule performance.

Estimate at Completion (EAC)

The actual cost of work completed to date plus the predicted costs and schedule for finishing the remaining work. It can also be the expected total cost of an activity, a group of activities, or the project when the defined scope of work is completed.

Estimate To Complete (ETC)

The expected cost to complete all the remaining work for a schedule activity, Work Breakdown Structure (WBS) component, or project.

Fixed Cost

The costs of an activity (manufacturing, production, assembly, operation, maintenance, etc.) that do not vary significantly with the measure of the product or service output. Though these costs will be incurred regardless of the output of the system, the starting point scope of fixed costs is often determined by factors that can be controlled, such as design, capacity planning, and infrastructure scope and business process steps.

Functional Breakdown Structure (FBS)

A structural alternative to a Work Breakdown Structure (WBS) that can be used for estimating cost. The FBS is organized by functions that must be performed to produce a product, whereas a WBS is broken down by the end products themselves. The activities-based structure is not tied to any particular architecture because it is a listing of the needed functions, not the elements, of the architecture.

Future Value (FV)

A financial term that establishes the value of an asset or set of cash flows at a future point, assuming certain interest rates. FV does not include corrections for inflation. FV is used to calculate the time value of money.

Grassroots Estimate

The estimate generated by computing the value of labor and materials for each Work Breakdown Structure (WBS) line item. It is also referred to as “bottom-up” or engineering buildup estimating.

Ground Rules and Assumptions (GR&A)

A description of features that bound the cost estimates for a specified technical and programmatic scope. These allow the estimator to clearly communicate the content of the estimate to customers and stakeholders.

Homoscedasticity

A statistical assumption that the variance of error is constant across the data (a necessary assumption in the use of Ordinary Least Squares [OLS] regression techniques).

Inflation

The rise in the general level of prices of goods and services over time. Increases in inflation represent an erosion of the purchasing power of money. The inflation rate is an annualized percentage change in a price index over time.

Interest

A fee charged for the use of money or capital paid by a borrower to a lender as a form of compensation for the use of the assets.

Internal Rate of Return (IRR)

A metric used in capital budgeting to measure and compare the profitability of alternate investments. It is also known as an effective interest rate or a discounted cash flow rate of return. The IRR is the annualized effective compounded rate of return that makes the net present value (NPV) of all cash flows from a particular investment equal to zero.

Joint Cost and Schedule Confidence Level (JCL)

A cost and schedule condition in which there is the probability that a given project or program's cost will be equal to or less than the targeted cost and the schedule will be equal to or less than the targeted schedule for completion for a specified confidence level.

Learning Curve

The assumption that the more times tasks are performed, the less time will be required for each of the successive iterations, hence reducing the cost estimate. Learning curves can be calculated through several different equations. How a learning curve applies to the space sector is questionable where fewer items, rather than multiple items in a mass-production environment, are fabricated.

Lease-versus-Buy Decision

A specialized type of trade study that enables a decision to minimize Life-Cycle Cost (LCC) outlays by comparing the cash flows associated with each alternative and assessing the best value. This specialized Business Case Analysis (BCA) is typically applied to information technology (IT) and facilities.

Level of Effort (LOE)

A support activity that must be done to support other efforts. It typically involves work that must be periodically repeated. The duration is generally from the start to the finish of the effort being supported. An LOE task should never be on a project's critical path.

Life-Cycle Cost (LCC)

The total cost for all phases of a project or system, including design, development, verification, production, operations, maintenance, and disposal. NASA has included a detailed definition of project LCC in NPD 7120.5E. For more information, visit <http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7120&s=5E>.

Linear Regression

A statistical approach to modeling the relationship between a dependent variable and one or more explanatory variables. This is employed in the development and use of parametric cost estimating tools.

Make-versus-Buy Decision

An analysis that supports make-or-buy decisions, including both financial and strategic considerations, such as whether the element is critical to the success of the project, whether it fits into the desired future core competencies of the organization, or whether the item is so specialized that there are few or no other suppliers.

Margin

An allowance that is carried in budgets (now referred to as Unallocated Future Expenses [UFEs]), as well as in schedule and technical performance parameters, to provide for uncertainties and risks. Margins are typically established as a baseline in formulation and consumed as the project progresses through its life cycle.

Model

A representation of a system broken into its component factors, or parts, so as to mimic or behave as the actual system would, were such parts or factors to be varied and intermixed. A model is used to gain knowledge about a system without actually executing the system.

Monte Carlo Simulation

A class of computational algorithms relying on repeated random sampling to compute results. This simulation method is most suited to uses where there are many coupled degrees of freedom and significant uncertainty in inputs.

Multivariate Regression

A mathematical modeling technique that relates two or more independent variables to a dependent variable through a predetermined equation that minimizes the sum of the squared error.

Multicollinearity

A statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this state, the coefficient estimates may change erratically in response to small changes in the model or the data, thus potentially rendering calculations of individual predictors invalid.

NASA Research Announcement (NRA)

A mechanism used to announce research opportunities in support of NASA's programs. Respondents prepare proposals based on their ideas, unlike proposal responses to a specific Statement of Work (SOW) issued as a part of a Request for Proposal (RFP) process. NRA proposals may result in awards of grants, contracts, or cooperative agreements.

Net Present Value (NPV)

The sum of the present values (a time-series of incoming and outgoing cash flows) minus the present value of the initial investment.

Nominal Discount Rate

The term for a real discount rate that has been adjusted to reflect anticipated inflation rates.

Nonlinear Regression

A statistical technique of modeling a nonlinear functional relationship in which observational data are modeled by a function that is a nonlinear combination of the model parameters and dependent on one or more independent variables.

Normalize/Normalization

Analysis to adjust data to a common predetermined basis. Cost data are frequently normalized to remove the effects of inflation, for example.

Ordinary Least Squares (OLS)

A statistical technique for estimating the unknown parameters in a linear regression model that minimizes the sum of squared distances between observed responses in a dataset and the responses predicted by the linear approximation. Where there is no multicollinearity and errors are homoscedastic and have a normal distribution, OLS is the maximum likelihood estimator.

Organizational Breakdown Structure (OBS)

A method of organizing costs or plans by the organizational units that perform the work. The OBS is frequently the basis for tracking fiscal performance where the Work Breakdown Structure (WBS) is used to organize the end items or work.

Parametric Cost Estimate

An estimate generated by methods utilizing statistical relationships between historical costs and other project variables such as a system's physical or performance characteristics.

Payback Period

The time required for the cumulative value of savings to equal the cumulative value of the investment. Achievement of payback is sometimes referred to as the "break-even point."

Present Value (PV)

The value on a given date (present) of a payment or series of payments made at other times. Future cash flows are discounted to reflect the time value of money or investment risk. PV calculations are used to provide a means to compare the cash flows of various alternatives.

Probabilistic Cost or Schedule Estimate

An estimate that incorporates risks, uncertainties, and Monte Carlo simulations to provide a cumulative distribution function (S-curve) of the probability of a variable with a given probability distribution being less than or equal to a value.

Probability Density Function (PDF)

A function that describes the relative likelihood for a random variable to have a given value. The probability for the random variable to fall within a particular region is given by the integral of the variable's density over the region. It is not negative, and its integral over the entire space is equal to one.

Real Discount Rate

The adjustment of a discount rate to eliminate the effects of expected inflation. It is used to discount CY dollars, real benefits, or costs.

Regression Analysis

An analysis that explains how the value of a dependent variable changes when any one of the independent variables is changed while the other independent variables are held constant. Linear regression and Ordinary Least Squares (OLS) regression are parametric in that the regression function is defined in terms of a finite number of parameters that are estimated from the data.

Request for Proposal (RFP)

A contractual document that provides a formal invitation to submit a proposal for a scope of work with the intent of forming a contract.

Return on Investment (ROI)

The ratio of money gained or lost on an investment relative to the money invested, which is normally expressed as a percentage. The ratio is sometimes referred to as a Rate of Return (ROR).

Risk

The chance of uncertainty or loss. Where there are potentially favorable and unfavorable events, risk is the probability that an unfavorable event will occur.

Rough Order of Magnitude (ROM)

An estimate based on an approximation without benefit of details or detailed analysis.

Schedule Assessment

Schedule assessment is the process of determining schedule validity and performance at a given point in time. A thorough schedule assessment using many of the techniques described in the following paragraphs should always be performed prior to establishing the IMS baseline and is essential in ensuring a quality JCL analysis. Periodic assessment is also necessary to gain assurance that the schedule continues to generate valid data and to support the project's objectives throughout the project life cycle. A reliable schedule assessment checklist is an important aid that can benefit a project team or outside review team in determining schedule validity.

Schedule Estimating Relationship (SER)

A mathematical relationship that defines schedule as a function of one or more parameters or factors, which may include technical parameters as well as parameters for cost. The development and use of SERs within NASA is substantially less mature than the use of CERs.

Sensitivity Analysis

An analytical technique used to measure the uncertainty in the output of a model relative to different sources of uncertainty in model inputs. Varying the input parameters and evaluating the changes in the outputs enables an analyst to evaluate the relationship between the inputs and outputs (testing the model) and the effects of those variations on the conclusions derived from the model.

Simulation

The imitation of a real-world process or system over time. The initial step requires the development of a mathematical model that represents key characteristics or behaviors of the system or process over time.

Software Cost Estimating

An effort that requires identical processes as the estimation of hardware, but utilizes different measures and tools.

Then Year (TY) Dollars

The values associated with costs or estimates in the year that they are planned or occur (also called RY dollars). These costs include any projected or experienced inflation, as opposed to CY dollars, which provide total costs from a cash flow in a single-year base (deflated or inflated).

Time-Phased Cost

Costs that have been allocated to a schedule or time period.

Time Value of Money

The value of money, including a given amount of interest earned over a given amount of time. This core concept in financial analysis enables the calculation of present value and its derivatives.

Total Cost of Ownership (TCO)

The total cost of an investment over a life cycle, including development, operations, maintenance, upgrades, and decommissioning.

Trade Study

The techniques utilized to compare alternatives as part of the decision to select the preferred alternative(s). These studies may range from formal Analyses of Alternatives (AoA) to informal quantitative analyses.

Technology Readiness Level (TRL)

A common scale that describes the maturity of a technology, which is utilized as an input in planning development efforts. Many cost and schedule estimation models utilize TRL as an input parameter.

Unallocated Future Expense (UFE)

Funding that is provided to accommodate the realization of risk and uncertainty associated with a cost or schedule estimate. These funds may ultimately be distributed to mitigate the risk, to make the product work, or to accommodate cost or schedule growth, but, because not all risks or uncertainties will be realized, initial allocation of funds to particular WBS elements would be premature. UFE is established by exercising probabilistic techniques.

Uncertainty

The indefiniteness about the outcome of a situation. There is uncertainty about both favorable and unfavorable events. The uncertainty must be understood in order to assess risk.

Value Engineering

A systematic effort to improve the value of goods or services utilizing an examination of the function. Value can be increased by either improving the function or reducing cost while preserving basic functions.

Variable Cost

Costs that change in proportion to the activity of the effort. The concept is useful in forecasting the impact of performance when planned baselines are not achieved.

Work Breakdown Structure (WBS)

A means of organizing all project or program components into a product-oriented structure that can be used to establish work packages for project cost and schedule baselines.

Wrap Rate

In NASA cost estimating language, major relatively fixed-cost components such as project management, systems engineering, and safety and mission assurance are referred to as wraps. The components of the wrap rate will vary from model to model. In many parametric cost models, the cost of these elements is calculated as a function of the cost of the hardware and software.