

COVER

NASA Cost Estimating Handbook - 2008

Volume 5 - Knowledge Management

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Cost Estimating Knowledge Management Dimensions



1. Introduction

Knowledge Management (KM), is getting the right information to the right people at the right time, and helping people create knowledge and share and act upon information in ways that will measurably improve the performance of NASA and its partners. For NASA this means delivering the systems and services that will help our employees and partners get the information they need to make better decisions.

NASA faces a wave of retirements in the near future that could lead to a situation referred to as a “knowledge crisis” for the cost estimating community.¹ To avoid or lessen the impact that may result from a large portion of

the workforce retiring, it is important to capture, retain, and transfer skill competency and knowledge via cost estimating knowledge management dimensions. By doing so, a successful knowledge transfer can occur between the current cost estimating community and the next generation of cost estimators at NASA.

Figure 1 illustrates the six lifecycle dimensions of cost estimating knowledge management. To maintain a healthy cost estimating community at NASA, each dimension must be successfully understood, integrated, and managed. Integration across all six dimensions encompasses the complete lifecycle of cost estimating knowledge management. Each of the six dimensions outlined in Figure 1 below are discussed in detail in the subsections that follow.

¹ See Building a Better NASA Workforce: Meeting the Workforce Needs for the National Vision for Space Exploration (2007).

Cost Estimating Knowledge Management Dimensions				
Recruitment	Training and Development	Retention	Outreach	Policy
<ul style="list-style-type: none"> ▪ Entry Level ▪ Coops ▪ Fresh outs ▪ Interns ▪ Mid level ▪ Senior Level ▪ Jobs Link Page ▪ Associations w/ Universities ▪ Junior Engineer Tracks ▪ Design Competitions ▪ Senior Design Projects 	<ul style="list-style-type: none"> ▪ Cost 101 ▪ Cost Risk/Confidence Level ▪ Cost Estimating Handbook Training ▪ Degree Programs ▪ College Curriculum ▪ Career Development Guide Update ▪ Symposia ▪ Professional Societies ▪ Professional Certification ▪ Tool Specific Training ▪ PBMA ▪ Cost Section in General Training 	<ul style="list-style-type: none"> ▪ Career Path ▪ Promotion/ Advancement ▪ Awards ▪ Recognition 	<ul style="list-style-type: none"> ▪ CAD Web Site ▪ Presentations ▪ Road Show ▪ Professional Meetings ▪ CASG ▪ Cost Symposium ▪ Non-Cost Professional Societies (e.g. AIAA) ▪ Center Newsletters 	<ul style="list-style-type: none"> ▪ 7120 ▪ 7123 ▪ FAR ▪ FMR ▪ CEH
Career Path				
<ul style="list-style-type: none"> ▪ Project ▪ Program ▪ Center (Institutional) 	<ul style="list-style-type: none"> ▪ Mission Directorate ▪ PA&E CAD ▪ IPAO 	<ul style="list-style-type: none"> ▪ Cost Estimating Job Classification ▪ Rotational Assignments 		

Figure 1. Lifecycle Cost Estimating Knowledge Management Dimensions

2. Recruitment

Recruitment refers to the process of finding the right person for the right job or function and succeeding at getting the person to accept the job or function. Recruitment is more than a management or human resource function. It is a shared responsibility among all NASA cost estimators at every Center and at Headquarters. The title of the book written by Harvey Mackay, sums it up best, “Dig Your Well, Before You're Thirsty”. It is imperative that all members of the NASA cost community work to establish and maintain a network of various sources of pre-qualified cost estimators. Relationships with potential cost estimators should be fostered as early as possible. NASA cost estimators are encouraged to actively recruit others via networking. This option allows estimators to spread information by word-of-mouth regarding vacant positions or upcoming vacancies in their networks of friends and associates.

Recruitment can also take place at conferences if cost estimators take time to meet and get to know potential candidates. Finally, cost estimators can make a difference by taking time to gather business cards from and develop relationships with potential employees from their own social networks, as well as professional societies, academic connections, etc. The following list identifies a variety of options that contribute to a healthy recruitment strategy:

Entry level: Develop a proactive approach to hire the following:

- Cooperative students (co-ops)
- Fresh-outs; recent graduates with pertinent skills from academic institutions
- Interns.

Journey level: Develop a proactive approach to hire journey-level cost estimators. Sources to consider are:

- Laterals within NASA
 - Within the cost estimating career field
 - From other career fields
- Laterals from outside of NASA
 - From Department of Defense (DoD)
 - From industry
 - From other Government Agencies
- Other:
 - DoD and Military Services:
 - ▶ Graduates from the Air Force Institute of Technology (AFIT)
 - Obtain list of AFIT graduates
 - Follow-up to see if graduates have interest in working for NASA after Air Force commitments are up
 - ▶ Graduates from Navy Operations Research Center
 - Obtain list of graduates
 - Follow-up to see if graduates have interest in working for NASA after Navy commitments are up
 - ▶ Interface with other cost estimators from DoD and Military Services to determine if the employee has any interest in working for NASA
 - Interface with other cost estimators, both government and contractors, through professional societies such as the International Society of Parametric Analysts (ISPA), the Society of Cost Estimating and Analysis (SCEA), the Consortium on Space Technology Estimating Research (CoSTER), etc., to determine if the colleague has any interest in working for NASA
 - Target specialized talent outside of NASA
 - ▶ Support contractors
 - ▶ Commercial/industrial entities that perform cost estimation.

Senior Level: Develop a proactive approach to hire senior level cost estimators. Sources to consider are:

- Laterals within NASA
 - Within the cost estimating career field
 - From other career fields
- Laterals from outside of NASA
 - From DoD
 - From industry
 - From other Government Agencies
- Interface with other cost estimators, both government and contractors, through professional societies such as ISPA, SCEA, CoSTER, etc., determine if the colleague has any interest in working for NASA
- Target specialized talent outside of NASA.

Job Link Page: Create a job page for cost estimators to view vacancies and learn about future employment needs within NASA. Headquarters and Centers are represented and information is kept up to date by the respective focal point.

Association with Universities: Foster and improve associations with relevant universities by attending job fairs, providing literature about career opportunities, etc.

Sponsor Special Events: Special events are a great way to showcase exciting aspects of careers and to draw interest to them. There are several different special events to consider in the cost estimating career field at various career stages as well, such as:

- Junior Engineer Tracks: currently sponsored as part of the Institute of Electrical and Electronics Engineers (IEEE) Aerospace Conference, but could also be done as part of the NASA Cost Symposium
- Design competitions
- Senior design projects.

3. Training and Development

[Training and development](#) is another dimension of the cost estimating knowledge management lifecycle. Training and development opportunities are offered at NASA in order to help employees gain the necessary knowledge and skill to fulfill NASA's mission through formal education, training, and on the job developmental experiences. Cost estimators should be given frequent opportunities to learn and grow in their careers, knowledge, and skills as well as understand how their jobs/performance affects organizations. Without the opportunity to try new opportunities, sit on challenging committees as part of professional organizations, or attend conferences or seminars, cost estimators can stagnate. A career-oriented, valued estimator must experience growth opportunities, therefore, training and development is a shared responsibility among employees, managers, and the organization. The following list identifies a variety of options that contribute to a healthy training and development strategy:

- **Cost Estimating 101:** Develop a Cost Estimating 101 Course and put it on the Program Analysis and Evaluation (PA&E) Cost Analysis web page, the Cost Analysis Steering Group (CASG) website, and in SATERN. The course could also be given at the NASA Cost Symposium if attendance warrants it.
- **Develop and conduct a cost risk/confidence level training course:** Develop a Cost Risk/Confidence Level training course and put it on the PA&E Cost Analysis web page, the CASG website, and in SATERN. The course could also be given at the NASA Cost Symposium if attendance warrants it.
- **Develop and conduct a CEH training course:** Develop a Cost Estimating Handbook training course and put it on the PA&E Cost Analysis web page, the CASG website, and in SATERN. The course could also be given at the NASA Cost Symposium if attendance warrants it.
- **Degree program:** Conduct research to see if there are any degree programs currently offered by colleges or universities in cost estimating; if not; discuss whether it makes sense to hold

discussions with colleges or universities to create one. Build strong ties with these institutions to aide them in referring high quality graduates to NASA.

- **College curriculum:** Conduct research to see what courses exist that would be applicable for cost estimators. If no courses are available, discuss whether it makes sense to hold discussions with colleges or universities to see if they could create courses that would be beneficial. Build strong ties with these institutions to aide them in referring high quality graduates to NASA.
- **Career Development Guide (CDG) Update:** Update and expand on career development information contained in the 2004 Cost Estimating Handbook; Add a career path section to the Cost Estimating Handbook.
- **Symposia:** Continue to hold annual cost symposiums for NASA cost estimators and the extended cost community. Cost estimators should attend other conferences or symposiums that can further individual development or that may provide training. Continue to hold CASG meetings as necessary to keep the NASA cost community informed and intact as a community.
- **Professional Societies:** Cost estimators should join one of the cost estimating societies referred to in the Guide to stay current in the latest cost estimating trends and methods.
- **Professional Certification:** Pursue certification as a cost estimator. See information on this topic in the Guide.
- **Tool Specific Training:** Determine your training needs using an IDP (see the IDP example found in Section 10 of the Career Development Volume); take refreshers as needed.
- **Process Based Mission Assurance Secure Work Groups (PBMA) Cost Analysis Steering Group (CASG):** This website provides top-level information applicable to cost estimators across NASA. It also provides a multi-dimensional, collaborative functionality to support the CASG community at large. Log-on to the PBMA CASG website to stay current on the NASA cost community.
- **Cost Section in General Training:** Insert cost training content into the general training given by NASA and its Centers.
- **Research and Publications:** Conduct research, present papers at cost related symposiums and conferences, and submit results to appropriate avenues to get published.

4. Retention

Employee retention is another dimension of the cost estimating knowledge management lifecycle. Employees must not only be recruited and hired; they must also be retained. In the past, government employees would often spend their entire careers in the government. Today there is a high demand in the public and private sectors for qualified employees in general. It is extremely difficult to find cost estimators, so once cost estimators are hired and trained by NASA,

it is important to retain them. Retaining great staff is a key component for the success of the NASA cost estimating career field.

Talented cost estimators who continue to develop skills and increase their value to the cost community are our most important resource; therefore, it is important to develop a strong retention strategy that will entice people to stay. Creating an environment where cost estimators can thrive will help this happen. Retention issues are a shared responsibility among managers and the organization.

The following list identifies a variety of options that contribute to a healthy retention strategy:

- **Career Path:** Add information regarding career paths for cost estimators to the Cost Estimating Handbook.
- **Promotion/Advancement:** Managers are encouraged to ensure employees are using the IDP in this Guide to help guide cost estimators careers. Managers should be active in ensuring cost estimators are properly trained so promotions are not delayed due to lack of preparation. Mentors and coaches can also assist in guiding employees and increasing their job commitment and satisfaction.
- **Awards & Recognition:** Awards and recognition are key elements that motivate personnel and contribute to pride in one's work. Good news should be shared by creating an area on the PBMA CASG website to post relevant information regarding awards cost estimators have received. When the situation warrants, good news should be sent to Inside NASA, Center newspapers, Center journals, etc.

The list for recruitment opportunities and venues also points to ongoing community activities that can keep the job experience fresh and interesting.

5. Outreach

Outreach is the fourth dimension of the cost estimating knowledge management lifecycle. Outreach refers to activities or events that are designed to reach out to other cost estimators. It is an attempt to keep the extended cost estimating community up-to-date on the most recent policy(ies), initiative(s) or other issues facing cost estimators. Outreach is a shared responsibility among employees, managers, and the organization. The following list identifies a variety of options that contribute to a healthy outreach strategy:

- **PBMA CASG Website:** Continue to operate the CASG website and utilize it to conduct outreach to the extended NASA cost community. CASG can serve as a powerful tool to communicate and advertise all that is of interest to the cost estimating community across NASA.
- **Presentations and Road Shows:** Develop and conduct presentations as a form of outreach, as needed, to NASA Centers. Deliver presentations in a timely fashion once a request is made. Conduct road shows as a form of outreach to NASA Centers, as needed. For example, if new a policy is established that affects cost estimating, a road show may be required to

discuss the new policy, its impact on cost estimators, and to listen to feedback from Centers on the new policy.

- **Professional Meetings:** Numerous cost estimating related professional organizations exist, as listed in this handbook. Outreach is achieved by participating in professional organizations, through attending meetings, and/or presenting research at professional meetings.
- **CASG/Executive Cost Analysis Steering Group (ECASG) Meetings:** Outreach can be accomplished by continuing to hold CASG/ECASG meetings to keep the NASA cost community informed and intact as a community. Historically, CASG has met three times a year and this has been extremely effective in strengthening the NASA cost community.
- **Cost Symposium:** Symposiums are an excellent opportunity for outreach. Specifically, the NASA Cost Symposium, serves as an excellent outreach event, allowing cost estimators from all Centers including the extended cost community supporting NASA, to come together to focus on cost estimating and related topics. Other related symposiums are also an excellent avenue for outreach. Attending and speaking at other conferences allows NASA outreach to occur.
- **Research and Publications:** Conduct research, present papers at cost related symposiums and conferences, and submit results to appropriate avenues to get published.
- **Non-Cost Professional Societies:** Outreach can be conducted by participating in other professional societies not directly related to cost estimating and attending their conferences. For example, the Institute of Electrical and Electronics Engineers (IEEE), is the world's leading professional association for the advancement of technology. IEEE sponsors conferences that would be appropriate for cost estimators and also provide a good outreach opportunity.
- **Center Newsletters:** Outreach can also be achieved by publishing cost estimating related events in Center newsletters. The more information we can provide to people about cost estimating, the better!

6. Policy

Policy is the fifth dimension of the cost estimating knowledge management lifecycle. A policy is a deliberate plan of action to guide decisions and achieve rational outcomes. Cost estimating policy refers to the process of making important decisions regarding cost estimating. Policy issues primarily reside at the headquarters level with the Office of Program Analysis and Evaluation (PA&E), in both the Cost Analysis Division and in the Independent Program Assessment Office (IPAO); however, Center feedback can be used to shape policy. The following list identifies a variety of options that contribute to cost estimating and represent policy that makes up one of the dimensions of the cost estimating knowledge management.

6.1 Federal Acquisition Regulation (FAR)

The FAR is the primary regulation for use by all Federal Executive agencies in their acquisition of supplies and services with appropriated funds. It became effective on April 1, 1984, and is issued within applicable laws under the joint authorities of the Administrator of General Services, the Secretary of Defense, and the Administrator for the NASA, under the broad policy guidelines of the Administrator, Office of Federal Procurement Policy, and Office of Management and Budget.

The FAR precludes agency acquisition regulations that unnecessarily repeat, paraphrase, or otherwise restate the FAR, limits agency acquisition regulations to those necessary to implement FAR policies and procedures within an agency, and provides for coordination, simplicity, and uniformity in the Federal acquisition process. It also provides for agency and public participation in developing the FAR and agency acquisition regulation.

6.2 NASA Policy Directive (NPD) 1000.0, Strategic Management and Governance Handbook

The Strategic Management and Governance Handbook (NPD 1000.0) has two primary aims: (1) to set forth the principles by which NASA will strategically manage the Agency and describe the means for doing so; and (2) to identify the specific requirements that drive NASA's strategic planning process, leading to products such as the Strategic Plan and the Annual Performance and Accountability Report.

NPD 1000.0 presents an overview of core strategic management requirements and is intended to give a basic understanding of how NASA is managed and what internal and external requirements drive this management strategy. It is composed of six chapters, each of which includes a brief written explanation of its subject, a visual graphic of the identified process, and a table of organizational roles and responsibilities. Related policy documents are cited for further description.

6.3 NPD 7120.4, Program/Project Management

This NPD describes the management system by which NASA formulates, approves, implements, and evaluates all programs and projects established for safe development and operation of aeronautical and space ground and flight systems and technologies. This management system is intended to be flexible, adaptable, and tailorable to the many types of programs and projects that NASA manages. A more extensive description of the management system requirements is provided in the NASA Procedural Requirements (NPR) 7120.5, Space Flight Program and Project Management Requirements.

6.4 NPR 7123.1, NASA Systems Engineering Processes and Requirements

Systems engineering at NASA requires the application of a systematic, disciplined engineering approach that is quantifiable, recursive, iterative, and repeatable for the development, operation, maintenance, and disposal of systems integrated into a whole throughout the life cycle of a project or program. The emphasis of systems engineering is on safely achieving stakeholder functional, physical, and operational performance requirements in the intended use environments over the system's planned life within cost and schedule constraints.

The purpose of this NPR is to clearly articulate and establish the requirements on the implementing organization for performing, supporting, and evaluating systems engineering. Systems engineering is a logical systems approach performed by multidisciplinary teams to engineer and integrate NASA's systems to ensure NASA products meet customers' needs. Implementation of this systems approach will enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost. This systems approach is applied to all elements of a system and all hierarchical levels of a system over the complete project life cycle.

This NPR establishes a core set of common Agency-level technical processes and requirements needed to define, develop, realize, and integrate the quality of the system products created and acquired by or for NASA. The processes described in this document build upon and apply best practices and lessons learned from NASA, other governmental agencies, and industry to clearly delineate a successful model to complete comprehensive technical work, reduce program and technical risk, and improve mission success. The set of common processes in this NPR may be supplemented and tailored to achieve specific project requirements.

6.5 NPR 9501.2, NASA Contractor Financial Management Reporting

NPD 9501.1, NASA Contractor Financial Management Reporting System provides instructions to contractors and NASA managers for the Contractor Financial Management Reporting System and stresses the necessity for accurate and timely reporting to enable NASA to fulfill its program control, budgeting, functional management, and cost accounting responsibilities.

This NPR also provides basic requirements and instructions to assist in the preparation of the Contractor Financial Management Reports (NASA Form 533 reports). NASA Form 533 (NF 533) reports provide data necessary for:

- a. Projecting costs and hours to ensure that dollar and labor resources realistically support project and program schedules.
- b. Evaluating contractors' actual cost and fee data in relation to negotiated contract value, estimated costs, and budget forecast data.
- c. Planning, monitoring, and controlling project and program resources.
- d. Accruing cost in NASA's accounting system resulting in liabilities reflected on the financial statements and providing program and functional management information. Cost is a financial measurement of resources used in accomplishing a specified purpose, such as performing a service, carrying out an activity, acquiring an asset, or completing a unit of work or project.

NASA is required by law to use accrual accounting, which requires cost to be reported in the period in which benefits are received, without regard to time of payment. To facilitate this process, NASA requires its contractors to report accrued costs on NF 533 reports on cost type, price re-determination, and fixed-price incentive contracts.

6.6 NASA Cost Estimating Handbook

The NASA Cost Estimating Handbook (CEH), which serves as a reference for Agency cost estimators, was designed to bring the NASA cost estimating community together in a common vision as it begins to receive greater attention within NASA and beyond; this vision includes helping the Agency make critical decisions for mission success while maximizing the benefits from scarce resources. As part of this vision, the NASA cost estimating community has a responsibility to build consistency and credibility in NASA cost estimates.

7. Career Path/Career Development

Career path is another dimension of the cost estimating knowledge management life cycle. Refer to Section 6 of the Career Development Volume for more detailed information on cost estimating career paths.