

# ATTACHMENT A

## Summary of Work Performed Under Task #2 of NAS5-32374

### Subtask a

#### Work to be Performed

Prepare an Earth Sciences Data and Information System (ESDIS) Project Management Plan (PMP) consistent with applicable NMIs, local GSFC management and documentation guidelines and existing EOS program plans. This activity will include development of a project Work Breakdown Structure (WBS) and project documentation tree for inclusion in the PMP.

#### Deliverables and Schedule

First draft:	2/1/95
Second draft:	2/15/95
Final:	3/8/95

#### Amendment #1

Final: 8/9/95

Per direction from the ATR, consider work on this subtask complete by this date if no comments on the latest PMP draft have been received by then from the ESDIS Project (Code 505)

#### Accomplishments

The 1st draft of the PMP was delivered on 2/13/95 and the 2nd draft was delivered on 2/28/95. Work on the final version was held up pending receipt of comments from the 6 ESDIS Project reviewers designated by the ESDIS Project Manager. Changes were made based on inputs from 3 of the 6 reviewers, but comments were not received from the other designated reviewers nor from the Project Manager. Delivery of the final version of the PMP by the required date was therefore not possible.

At the direction of the ATR, a 3rd draft incorporating those comments that were provided was delivered to the ESDIS Project Manager on 5/16/95. Work on the PMP was then suspended awaiting responses. When no additional comments were received by August, the ATR agreed that no further work on this subtask should be planned by GST. Amendment #1 formally established a revised completion date for

this subtask as 8/9/95, and the 3rd draft PMP delivered on 5/16/95 became the final deliverable.

Miscellaneous other activities related to the ESDIS PMP were performed at the ATR's request. These included:

- 1) Reviewing and providing comments on revised NMI 7120.4 and NHB 7120.5 "Management of Major System Programs and Projects" (these documents strongly influenced the structure and content of the ESDIS PMP),
- 2) Researching and providing information on matrix management approaches applicable to Code 505 (one such approach was reflected in the PMP), and
- 3) Attending meetings with people in or supporting the MO&DSD who desired to benefit from our work on the ESDIS PMP.

### **Subtask b**

#### **Work to be Performed**

Prepare an ESDIS Project Systems Engineering Management Plan (SEMP) consistent with the developed PMP. The SEMP will define the processes and responsibilities associated with conduct of ESDIS systems engineering functions, including those internal to the Project and those relating to external organizations.

#### **Deliverables and Schedule**

First Draft:	4/12/95
Second Draft:	5/10/95
Final	5/31/95

#### **Amendments**

None

#### **Accomplishments**

This work was scheduled to start in Mid-February. Although a query was received in January from the ESDIS Project concerning the possibility of accelerating the SEMP delivery schedule (this query was referred to the ATR), no direction was received from the ATR to do so. Consequently, work on the SEMP started as planned on 2/22/95.

An annotated outline of the SEMP was prepared and delivered to the ESDIS Project in early March. At that time, the ESDIS Systems Manager requested that a Systems

Management Plan (SMP) be written rather than an SEMP. The SEMP was restructured, an annotated outline created, and work on the first draft SMP was delivered on 4/13/95. Annotated outlines for an SEMP and a Mission Management Plan (MMP) were also delivered at that time.

No responses were received from the Project through the rest of April, and at the end of April this work was suspended. Delivery of a second draft on 5/10/95 was therefore not possible. It was agreed with the ATR and the ESDIS Project on 5/23/95 that because of the limited opportunity to interact with Project personnel on these documents it would be more effective for the Project to complete these documents internally. As requested by the project, we then delivered (on 5/26/95) hardcopies and softcopies of the revised 1st draft ESDIS SMP, the annotated outline of the ESDIS System Engineering Management Plan and the annotated outline of the ESDIS Mission Management Plan. This completed the work on this subtask.

### **Subtask c**

#### **Work to be Performed**

Evaluate ESDIS and related EOS program requirements development, management and analysis processes. This assessment is intended to identify opportunities to improve the effectiveness of these processes and program /project responsiveness to requirements. Specific topics will include (1) an assessment of the user community processes for establishing science data processing requirements, ESDIS/user interactions thereon and internal ESDIS processes for interpretation of these requirements and conversion into system specifications, and (2) the EOS/ESDIS requirements allocation process.

#### **Deliverables and Schedule**

First Report (briefing): 4/5/95  
Second Report (briefing): 5/10/95  
Final Report (briefing): 6/14/95  
Report Update (briefing): 12/20/95

#### **Amendment #1**

Merge the findings and recommendations of Subtasks c and d into a briefing for Dr. Dale Harris and others. Coordinate this work with a Code 504 person designated by the ATR. This will be the final report for these subtasks

Final Report (briefing): 7/27/95  
Delete Report Update

## **Accomplishments**

An initial analysis of the requirements management process was completed and presented to the ATR in January. An assessment of how MODIS science data processing requirements are developed was also completed. Uncertainties concerning these requirements, and assumptions being used to arrive at computational resource needs, were analyzed and discussed with various GSFC personnel. Results of these analyses were presented to the ATR on 2/28/95. Several discussions were held with ESDIS Project personnel to understand in greater depth how they handle science requirements and establish L1-L2 traceability. All of this information was analyzed and the First Report briefing was presented to the ATR on 4/3/95.

Recommendations to improve requirements management were then developed. Meetings were held with the ATR to further discuss requirements management issues and strategies, and how to present the analyses and recommendations to the ESDIS Project. The synergistic relationship between the recommendations being developed under this subtask and those being developed under Subtask d (cost estimating and modeling) became evident, and the ATR concurred in our recommendation to combine the final phases of the work under these subtasks into a single briefing for the ESDIS Project. It was understood that this approach would be reflected in an amendment to Task #2. This agreement removed the requirement for the Second Report briefing on 5/10/95 and for the Report Update on 12/20/95, and changed the Final Report date to 7/27/95.

Work on the integrated Subtask c/d briefing began in June with a target date of 7/25/95 for presentation to the ESDIS Project. Several dry-runs to the ATR and Code 504 personnel were conducted between mid-June and mid-July. Recommended changes were made to the briefing between dry-runs. The briefing to the ESDIS Project (Code 505) scheduled for 7/25/95 was canceled (that day) due to work conflicts in Code 505, and was presented on 8/8/95.

In discussions that followed the briefing, direction was given to prepare a more detailed plan and cost estimate for developing and demonstrating an integrated process and cost model for a suitable subset of EOSDIS requirements and capabilities. This work would be continued under Subtask f. Presentation of the 8/8/95 briefing therefore constituted completion of the work under Subtask c.

## **Subtask d**

### **Work to be Performed**

Evaluate overall ESDIS cost estimation processes and construct recommendations for improvements and extensions thereto. This assessment will include system planning, development and operations for the life-cycle, and is intended to identify

approaches to maximize reliability of estimation in management decision-making. The recommendations from this evaluation should include prospective cost-modeling tools available within the Center or elsewhere and a proposed ESDIS implementation of an appropriate suite of capabilities.

### **Deliverables and Schedule**

First Report (briefing): 4/12/95  
Second Report (briefing): 5/31/95  
Final Report (briefing): 6/28/95  
Report Update (briefing): 12/20/95

### **Amendment #1**

Merge the findings and recommendations of Subtasks c and d into a briefing for Dr. Dale Harris and others. Coordinate this work with a Code 504 person designated by the ATR. This will be the final report for these subtasks.

Final Report (briefing): 7/27/95  
Delete Report Update

### **Accomplishments**

As planned, work began on this subtask in late March. Meetings were held with the ECS cost estimator (Chris Daly) to understand ECS cost estimating methodology and with the Resources Analysis Office (Code 152) on their methods, and literature was researched on cost estimating approaches. The First Report (briefing) was prepared and presented to the ATR on 4/17/95.

Work then continued on the analysis of cost estimating and modeling techniques used by the Project. Analyses were also made of modeling techniques used by others that might improve current practices in the Project. Collection of information continued on NASA (e.g., JPL, Space Station, MO&DSD) and non-NASA (mostly DoD) cost estimation and modeling methods. Additional meetings were held with the Ecom and EDOS Projects to obtain an understanding of their respective cost estimating and modeling methods. Demonstration of a very effective technique was provided by the Ecom Project. The Second Report (briefing) was prepared and presented to the ATR on 6/1/95.

Recommendations to improve cost estimating and modeling techniques were then developed. Meetings were held with the ATR to further discuss cost estimating and modeling issues and strategies, and how to present the analyses and recommendations to the ESDIS Project. The synergistic relationship between the recommendations being developed under this subtask and those being developed under Subtask c (requirements management) became evident, and the ATR concurred in our recommendation to combine the final phases of the work under

these subtasks into a single briefing for the ESDIS Project. It was understood that this approach would be reflected in an amendment to Task #2. This agreement removed the requirement for the Report Update on 12/20/95, and changed the Final Report date to 7/27/95.

Work on the integrated Subtask c/d briefing began in June with a target date of 7/25/95 for presentation to the ESDIS Project. Several dry-runs to the ATR and Code 504 personnel were conducted between mid-June and mid-July. Recommended changes were made to the briefing between dry-runs. The briefing to the ESDIS Project (Code 505) scheduled for 7/25/95 was canceled (that day) due to work conflicts in Code 505, and was presented on 8/8/95.

In discussions that followed the briefing, direction was given to prepare a more detailed plan and cost estimate for developing and demonstrating an integrated process and cost model for a suitable subset of EOSDIS requirements and capabilities. This work would be continued under Subtask f. Presentation of the 8/8/95 briefing therefore constituted completion of the work under Subtask d.

## **Subtask e**

### **Work to be Performed**

Evaluate present ESDIS schedules and scheduling tools and provide overall recommendations with respect to identified issues of schedule accomplishment. As indicated on the basis of conclusions, provide guidance for the development of resource-loaded critical path networks and develop approaches to maximize the utility of schedule networks in management decision-making.

### **Deliverables and Schedule**

First Report (briefing): 4/12/95  
Second Report (briefing): 5/31/95  
Final Report (briefing): 6/28/95  
Report Update (briefing): 12/20/95

### **Amendment #1**

Change this subtask to read "Define and justify project management schedule information needs. "

First Report (briefing): 7/12/95  
Delete Second Report  
Final Report (briefing): 8/9/95  
Delete Report Update

## Accomplishments

As planned, work began on this subtask in late March. Meetings were held with the ESDIS DPM/R (George Barth) and the ESDIS Scheduling Manager (Keith Oppenhauser) to understand current ESDIS scheduling methodology and implementation. The extent to which such schedules were based on resource-loaded activities was analyzed. Alternative techniques for developing and managing resource-loaded critical path schedules were also briefly analyzed.

It was determined relatively quickly (in early May) that:

- 1) The current ESDIS scheduling system ("Prestige" software on a PC-based LAN) was being used nearly to the full extent of its software and hardware capabilities;
- 2) Even though there are now better ways to implement the ESDIS scheduling function to improve ESDIS schedule management products, it would be a major impact to the Project to make the software and hardware changes that would be needed;
- 3) The ESDIS scheduling data base had recently been established as a shared database with the EOS Project, and any change to the ESDIS system would have a significant impact in this area; and
- 4) Progress was being made, albeit somewhat manually, to establish more effective relationships between the schedule and the resources required and available to accomplish that schedule.

With the consent of the ATR, work on this subtask was suspended in mid-May.

In June, it was agreed with the ATR to re-define this subtask according to the language planned for Amendment #1. It was also agreed that this work should be the lowest priority of all work on Task #2 and should not resume until Amendment #1 was approved and work on other subtasks had been mostly completed. However, no more work was done on this subtask because Amendment #1 was not received until 12/8/95 and the furlough beginning 12/16/95 did not permit adequate opportunity for Government direction before the close-out of Task #2 on 12/31/95.

## **Subtask f**

### **Work to be Performed**

Evaluate ESDIS Project, Directorate and EOS Program practices and activities in the following areas and make appropriate recommendations to the MO&DSD and the ESDIS Project. In these areas specific follow-up research, recommendations and/or reports may be required:

- (1) Risk assessment, risk mitigation strategies and approaches, and use of risk information in management decision-making
- (2) Prototyping, technology assessments and insertion
- (3) System integration and validation
- (4) System, science and operations concept development, including system evolvability

### **Deliverables and Schedule**

Status briefing on the 1st Monday of each month starting 4/24/95.

Final report (briefing) on 12/20/95.

Other briefings and/or reports as required

### **Amendment #1**

Add item (5) as follows:

- (5) Assess the feasibility of an improved MTPE system management process which would be supported by a computer-based model which encompasses top-level cost modeling and associated major cost drivers (e.g., critical requirements, costly functions and capabilities, price vs. performance relationships, and price vs. time relationships. Develop a prototype process model using a selected subset of MTPE cost-related drivers that are sufficient to demonstrate the feasibility (or lack of feasibility) of the approach.

Item (5) is to be complete by 12/20/95.

### **Accomplishments**

The original 4 areas of work under this subtask were predicated on the development of arrangements within GSFC by which the MO&DSD would actively support various EOSDIS systems engineering initiatives of the GSFC MTPE Office (Code 170). Work was planned to start on this subtask in the March timeframe after these arrangements had been made.

No such arrangements were successfully established between these two organizations. Nevertheless, in April we were asked for and provided 6 System Team issues pages for Mr. Paul Caruso/Code 170 and later, also at Code 170's request, provided analysis of these issues and identified associated team responsibilities.

In late June, discussions with the ATR resulted in new direction on this subtask that would be included in a pending task modification (Amendment #1). These discussions acknowledged that support to Code 170 according to the original subtask language would not occur. The significant reduction in overall Task #2 effort resulting from this change prompted a complete re-plan of Task #2 and the generation of a significantly revised CTR (a reduction of approximately \$123K through 12/31/95 Task #2 completion).

In accordance with these changes, work was initiated on assessing the feasibility of an improved MTPE system management process that would be supported by a computer-based model encompassing top-level cost modeling and associated major cost drivers. This was directed toward the objective of developing a prototype process model using a selected subset of MTPE cost-related drivers that would be sufficient to demonstrate the feasibility of the approach. Such a model would have system engineering applications both in the ESDIS Project and in the GSFC MTPE Office.

Additional direction in this area was received at the 8/8/95 briefing of Subtask c and d results to the ESDIS Project. Further, the ATR delegated technical management responsibilities for this work to the MO&DSD Systems Engineering Office (Code 504) and directed that henceforth we should work with and through them on this subtask.

Based on this direction and discussions with Code 504, we initially:

- 1) Drafted and delivered a more detailed SOW for GST tasks associated with modifying and applying the Veda International CASEMM process/cost modeling tool.
- 2) Developed and delivered plans, schedules, and resource estimates to manage and accomplish this work.
- 3) Initiated the approval cycle for procurement of a computer system to host the CASEMM tool, including preparing and submitting a request for approval to the CO.
- 4) Met with Veda, Inc. and developed an approach for working this task together, including an integrated SOW (GST Organizational Conflict of Interest [OCI] issues were recognized).

- 5) Jointly (GST and Veda) met with Code 504 on 8/24/95 and presented the draft SOWs and the results of the joint planning activities (schedules, estimated costs, proposed products).
- 6) Demonstrated the current version of the CASEMM tool to Code 504 personnel, together with discussions of how the tool would be extended and enhanced for use by the ESDIS project.

Code 504 advised on 8/31/95 that we should initiate the GST portion of this joint work within the scope of this subtask (as amended), and that acquisition of Veda's services to modify the CASEMM tool would proceed. It was understood that additional funding from the ESDIS Project would be needed for continuation of GST's work beyond 12/31/95 (probably via the impending MO&DSD/GST task order contract) as well as to fund Veda for CASEMM modifications (probably via an existing Veda subcontract under the NMOS contract).

In September and early October, GST:

- 1) Finalized and delivered plans including, tasks, critical path schedules, labor resource estimates, and costs.
- 2) Met several times with Veda to discuss plans and resource estimates.
- 3) Conducted another demonstration of CASEMM for Code 504.
- 4) Analyzed alternative approaches when the GST computer purchase was denied by the CO due to a contract clause prohibiting a contractor from purchasing "facilities" with government funds.
- 5) Initiated research and data collection for information needed in further developing the CASEMM tool and applying it to the ESDIS Project needs.
- 6) Conducted weekly coordination meetings with Code 504.
- 7) Prepared and presented a briefing on the CASEMM tool development plans to the ESDIS Project, and participated in a demonstration of the tool to the ESDIS Project.

However, because of NASA furloughs, uncertainty about the FY96 MTPE budget, involvement of ESDIS Project managers with responses to external reviews, and growing potential for significant re-direction of the ESDIS program, focused direction (and FY '96 funding) for this modeling work by GST and Veda never occurred. By late October, because of this lack of direction and with the concurrence of the ATR, GST scaled back its work and focused primarily on collecting data and researching various tools and methods that could be used to support the modeling effort.

Meetings with ESDIS managers to follow-up the CASEMM demonstration could not be arranged. However, on 11/13/95 (via e-mail) the ESDIS Deputy Project Manager (DPM) advised "We are inclined to initiate a short term effort with you to use CASEMM to model the federation alternatives at some level". With this "encouragement", we continued collection of data and other research for use in the CASEMM tool development for ESDIS Project or Code 504 applications. We also reviewed descriptions of a system engineering tool called SLATE, attended a demonstration of the tool, and discussed SLATE applications and operations with the tool vendor. We understand that SLATE may be used by the ESDIS Project to complement the capabilities of CASEMM.

On 12/11/95 the ESDIS DPM indicated the possibility of a meeting after 12/20/95 to discuss this further. However, by 12/15/95 the ATR had decided not to extend this task and by 12/16/95 NASA was again on furlough. On 12/20/95, GST stopped all work on this subtask and initiated preparation of the Task #2 Final Report. A summary of the research work done on process/cost modeling is contained in Attachment B to the Final Report.

### **Subtask g**

#### **Work to be Performed (per Task Amendment #2)**

Research the technical and system engineering aspects of the Business Process Reengineering (BPR) methodology as it would apply to the MO&DSD and its mission support data systems. Advise on how technical and systems engineering matters (such as data system architecture and data service/data product quality considerations) could be dealt with in an MO&DSD BPR exercise.

*(This is the draft of Amendment #2 as discussed with the ATR on 11/9/95. Because of the NASA furlough in effect since December 16, 1995, GST has not formally received Amendment #2. As discussed with and directed by the Contracting Officer in November, this amendment was intended to provide wording for the draft Subtask g previously provided by the ATR. Since the probable wording of this amendment had been discussed among GST, the ATR and the CO, and since the work according to the expected wording of Subtask g has been completed, this report includes Amendment #2.*

#### **Deliverables and Schedule**

Include findings in ATR's weekly meeting starting 7/12/95  
Complete all work by 9/8/95.

## Accomplishments

All the work performed by GST related to Subtask g was accomplished from June through August 1995.

All work accomplished was in preparation for performing system engineering work under Subtask g and was primarily to develop a better understanding of MO&DSD data system engineering issues associated with Business Process Reengineering (BPR). BPR is a structured methodology for "re-inventing" the business and technical processes, services and products of an organization. This first phase of the task was primarily for the purpose of clarifying everyone's understanding of BPR methodology from a technical perspective (e.g., how is MO&DSD data system architecture and performance affected) and would also serve to develop a more definitive agreement with the ATR on the deliverables required of GST under this subtask. We believe this work was within the scope of the contract and of the task because it was in preparation for performing systems engineering work regarding future MO&DSD data systems. The purpose of such work would have been to technically define data system architectures and designs.

Because of the possibility of a future MO&DSD solicitation in this area and the possibility that GST would want to participate in responding to such a solicitation, the potential for Organizational Conflict of Interest on this subtask was envisioned from the outset. The ATR and GST took what are believed to be appropriate precautions. For example, it was understood that GST would not have or be required to have access to proprietary or source selection information that might be applicable to a solicitation for BPR services. Also, GST would not be asked to provide task specifications or statements of work that would be incorporated into such a solicitation.

GST's understandings of the technical aspects of the BPR process were orally imparted to the ATR through late July. At this time it became evident that the business, management and technical aspects of this process were so interrelated that it was unlikely that technical work could successfully be performed separately under this subtask. From that point on, GST efforts on this subtask were phased out. MO&DSD then began exploration of full BPR support from other contractors currently available to NASA. As of the writing of this Final Report, however, GST is not aware of any decisions by the MO&DSD to acquire such support.

The work that GST performed under this subtask was as follows:

- 1) Developed planning information for the revision of the Task 2 CTR on this contract to reflect the addition of Subtask g.
- 2) Became familiar with the technique of Business Process Reengineering (BPR) and identified how technical and systems engineering matters (such as data system architecture and service quality impacts) are dealt with in BPR.

This included discussions with a company that is expert in BPR and is currently working for NASA (KPMG Peat Marwick) and an organization at GSFC (NSSDC) also attempting to deal with BPR/technical interactions.

3) Met with the ATR several times -- usually as part of overall task coordination meetings with the ATR and sometimes with other MO&DSD managers present -- to discuss and orally impart our understandings of the technical component of the BPR process. GST described our understanding of how systems engineering and other technical issues which that impact MO&DSD data systems (including MTPE) might be dealt with during a BPR exercise. Such work would have included performing analyses and engineering in areas such as space data information management and distribution, data storage system architecture, advanced information system architecture, high speed digital communications, data system interfaces, data system operations, and distributed resource management and control. The purpose of such work would have been to technically define data system architectures and designs consistent with the business and management alternatives being considered by others in the BPR process.

## ATTACHMENT B

### Summary of Work Performed Under Subtask f, Item (5)

This report provides information in three areas:

- 1) Research, including university, government, and private,
- 2) Internet web site locations that led us to some promising areas of development, and
- 3) Software tools and models that are currently available or are under development.

This is a limited selection of data from a vast amount of data that exists. Had more resources been available to continue this task, more data could have been presented. It is hoped, however, that what is being provided will be of value to future work in the arena of cost estimation and modeling.

### **Research**

#### **University Research on Cost Estimation**

University of Iowa - College of Business Administration

*How are Costs Estimated?* Lecture notes for Introduction to Management Accounting. Good theoretical description of cost estimation elements and processes.

Genopersistation (Dean-1993)

A recursive concept to facilitate the analysis and synthesis of systems. To genopersist an object means to bring forth, sustain, and retire that object. It is an action upon an object and has both mathematical and systemic meaning. It is the functional equivalent of the life-cycle.

Hierarchical Storage Management for Relational Databases

A concept that has the potential to optimize the cost and performance of data storage and access by automatically managing the placement of data on different storage media. Paper describes a prototype that integrates a DBMS with a storage management system, allowing simple, cost effective access to large volumes of data stored in a tape archive.

#### **Government Research**

Langley Research Center (Dean)

Design FOR Cost - Designing FOR cost is the conscious use of engineering process technology to reduce life-cycle cost. Design TO cost is the iterative redesign of a project until the content of the project meets a given budget.

Designing for cost seeks to increase system performance while reducing cost. Design to cost usually reduces performance until the budget is met. Designing for cost is an engineering driven process. Design to cost is a management driven process. Designing for cost seeks to design the product only once and to minimize the life-cycle cost by designing in high quality. Design to cost is iterative by nature and incurs redesign and rework cost.

Parametric Cost Analysis - Parametric estimating relies on simulation models that are systems of statistically and logically supported mathematical equations. The impacts of a product's physical, performance, and programmatic characteristics on cost and schedule are defined by these equations. Parametric cost analysis is the set of processes by which appropriate characteristics of systems are mapped to appropriate ranges of cost. Given these mappings, one can then estimate cost, estimate the variability of cost, or design for cost with respect to the given system characteristics. Parametric cost analysis provides an excellent tool for estimating cost and cost uncertainty (using probabilistic methods to simulate), and can be used to design for cost with Taguchi methods, response surface methodology, or multidisciplinary optimization. Optimizing for cost illuminates a previously undiscovered form of cost driver. This research indicates that more appropriate drivers come from the system to bring forth, sustain, and retire the system to be estimated (genopersistation).

Parametric Cost Deployment - Parametric cost analysis is a mathematical approach to estimating cost. Parametric cost analysis uses non-cost parameters to estimate the cost to bring forth, sustain, and retire a product. Basic concept is to match value with cost. Cost deployment is a means of designing for cost.

Concurrent Engineering - Also known as simultaneous engineering is designing for all of the attributes of a product. It's use tends to reduce cycle time and to reduce cost when appropriately applied.

Goddard Space Flight Center

IMAACS Project - Integrated Monitoring, Analysis, and Control System attempts to combine COTS software and hardware with existing legacy tools. Successful demonstration shows that these products can be combined and work together with real mission data.

COGS - Part of Code 501 Planning, Analysis, and Coordinating Environment (PACE) Process which includes Renaissance capabilities, ASSET, & NCASEMM

Johnson Space Center - Parametric Cost Estimating Reference manual

Cost Estimating Guidelines

Cost Estimating Associations (listing)

NASA Cost Model (NASCOM)

Jet Propulsion Laboratory

Mission Operations Staffing Spreadsheet (J. Caraway)

DoD - Dept. of Army

Cost Analysis Manual

Economics Analysis Manual

National Media Lab

Life Cycle Costs - (L. Ptasienski from LaRC) Excellent work on life-cycle costs but limited to advanced electronic storage systems.

### **Commercial Development**

Cost Management Model (CMM) - ECON, Inc. Developed in 1988 using Fortran 77, this large, expensive, and constraining model seems to be outdated by more current developments.

## **Internet Addresses**

Below are listed a sampling of some of the more interesting WWW sites that we explored during the performance of this task. There are many more sites that could have been listed and some of the more obvious sites, such as GSFC, JPL, JSC, etc., were not included. No ranking or special value is intended in this listing.

<u>Name</u>	<u>URL</u>
INCOSE	<a href="http://usw.interact.net:80/NCOSE/">http://usw.interact.net:80/NCOSE/</a>
The International Society of Parametric Analysts	<a href="http://mijuno.larc.nasa.gov/dfc/societies/Ispa.html">http://mijuno.larc.nasa.gov/dfc/societies/Ispa.html</a>
Cost Technology Home Page	<a href="http://mijuno.larc.nasa.gov/dfc/ctec.html">http://mijuno.larc.nasa.gov/dfc/ctec.html</a>
TD Technologies (SLATE)	<a href="http://www.slate.tdtech.com/">http://www.slate.tdtech.com/</a>
Advanced Simulation and S/W Eng Tech	<a href="http://pike.cecer.army.mil/">http://pike.cecer.army.mil/</a>
Mid-Atlantic Technology Applications Center	<a href="http://oracle.mtac.pitt.edu/WWW/MTAC.html">http://oracle.mtac.pitt.edu/WWW/MTAC.html</a>
The National Technology Transfer Center (NTTC)	<a href="http://iridium.nttc.edu/nttc.html">http://iridium.nttc.edu/nttc.html</a>
Center for Networked Info Discovery & Retrieval	<a href="http://www.cnidr.org/welcome.html">http://www.cnidr.org/welcome.html</a>
National Media Lab	<a href="http://www.nml.org/#top">http://www.nml.org/#top</a>
Data Storage Systems Center	<a href="http://www.ece.cmu.edu/afs/ece/www/httpd_doc/research/dssc.html">http://www.ece.cmu.edu/afs/ece/www/httpd_doc/research/dssc.html</a>
Institute for Systems Research (ISR)	<a href="http://www.isr.umd.edu/">http://www.isr.umd.edu/</a>
Applied Economics Lab, Portland State Univ	<a href="http://eclab.ch.pdx.edu/">http://eclab.ch.pdx.edu/</a>
Center for Discrete Mathematics and Theoretical Computer Science	<a href="http://dimacs.rutgers.edu/">http://dimacs.rutgers.edu/</a>

## Tools Available

Below is a sampling of some of better software tools that are available or under development at the current time. Included along with this listing is a short description and evaluation of each tool.

ACASEMM (Air Force) / NCASEMM (NASA - front end only) - Veda, Inc.

CASEMM (Computer-Aided Systems Engineering and Management Model) is a PC-based analysis tool that provides an integrated environment to model cost and operational effectiveness of complex process-like tasks. CASEMM is an open architecture, object-oriented, knowledge-based fully integrated model that is specifically tailored for rapid process definition, simulation, costing, and evaluation. With this tool, the dynamic relationship between system requirements, performance, and costs can rapidly be assessed and contains a unique capability for data analysis.

ANATOOL

Uses Structured Systems Analysis (SSA) for modeling information systems to provide a method for project managers and systems analysts to accurately and clearly describe complex data flows. Tool assists and yet requires conformity to SSA requirements while automating many of the tedious processes necessary for creating SSA documents.

ASSET (Advanced Simulation & Software Engineering Technology) U.S. Army  
Research incomplete; not much data found.

ClearCase (S/W)

Research incomplete; not much data found.

COGS (Cost Analysis Module of ASSET)

Under development by GSFC, Code 501.

Data System Performance Modeling

Code 520 models designed to ensure that optimal data systems are developed which have known behavioral characteristics and which predict the performance of emerging Code 500 data systems. They are used to study the effect, and mitigate the risk of system engineering decisions. Different approaches are utilized together with the models to simulate data system performance.

DEFT

CASE system for designing relational databases. Large, very complicated to learn and use, and expensive.

Digraph

Used on NASA's Space Station Project (and others) for failure analysis.

### DSDS+ (Data System Dynamic Simulator)

Discrete-event based simulator to simulate complex, high-data-rate, end-to-end data systems. Models data traffic of a system to determine size of data links, speeds of components, sizes of buffers in the components, etc. Features hierarchical modeling plus a graphical interface that utilizes elements such as data generators, CPUs, switches, orbit calculators, and schedulers, linked together to form the model.

### RDD-100

Used extensively by the government and NASA for generating and tracking requirements.

### RGS (Requirements Generation System)

Utilizes an interactive processing environment to automate many of the activities associated with the development, editing, review, and approval of requirements, and the creation of requirements documents. RGS data base facilitates communication of information about all levels of mission requirements and whose hierarchical structure ensures requirements traceability.

### SA/BPR: System Architect/Business Process Reengineering

An affordable, PC-based, powerful, and user friendly tool for creating business models using the IDEF methods (IDEF0/Function Modeling and IDEF3/Process Modeling and Object State Modeling).

### Satellite Tool Kit (Analytical Graphics)

Powerful, interactive, graphical analysis software tools to provide engineers the ability to access, manage, display and manipulate satellite data for mission planning, modeling and analysis. New version released for the high-end PC world.

### SLATE (System Level Automation Tool for Engineers)

A dynamic, multi-user, integrated information system for organizing and managing the product life cycle. It is a client-server system using an object-oriented database and can be used to capture original requirements, manage and analyze the design, and implement a design model for the entire product life cycle.

### SYNERGE (Systems Engineering Environment)

Code 522 prototype of a multi-user tool for designing, creating, browsing, editing and analyzing complex sets of system engineering information. Simple, low-cost, desktop-based single point of access to project requirements, interface definitions, schedules, and other information using information system technology to also facilitate training, assure information consistency and completeness within and between projects. Operational prototype completed in 1993.

TOPIC - Research incomplete; not much data found.

While some of the above tools are excellent for their specific application, none of them have the capability of generating top-level cost estimations using parametric cost estimation relationships (CERs) with the exception of Veda's ACASEMM. However, it is specifically designed for use with the Air Force's systems, processes, and CERs and would have to be integrated with the NASA version of CASEMM and modified to include the back-end (ground systems) and NASA appropriate CERs.