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Final Report for Option 1 Contract Year

Cost and Schedule Analytical Techniques Development

Contract NAS8-40431

December 1996

SAIC
6725 Odyssey Drive
Huntsville, AL 35814-1220

Prepared for:
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Engineering Cost Office
Marshall Space Flight Center, AL 35812

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Final Report

Cost and Schedule Analytical Techniques Development
Contract NAS8-40431, Option 1 Year
December 1, 1995 Through November 30, 1996

I. INTRODUCTION

This Final Report summarizes the activities performed by Science Applications International Corporation (SAIC) under contract NAS8-40431 "Cost and Schedule Analytical Techniques Development" (CSATD) for the base contract year from December 1, 1995 through November 30, 1996. The Final Report is in compliance with Paragraph 5 of Section F of the contract.

This CSATD contract provides technical services and products to the NASA Marshall Space Flight Center's (MSFC) Engineering Cost Office (PP03) and the Program Plans and Requirements Officer (PP02). Detailed Monthly Progress Reports were submitted to MSFC in accordance with the contract's Statement of Work Section IV "Reporting and Documentation". These reports spelled out each month's specific work accomplishments, deliverables submitted, major meetings held, and other pertinent information. This Final Report will summarize these activities at a higher level.

II. MSFC TASKS

The basic CSATD contract calls out three major Statement of Work task areas that provide analytical technique developments for MSFC. Accomplishments under these areas are discussed in the following paragraphs.

II.1. REDSTAR Data Base System Maintenance & Expansion

Approximately 1,080 documents were added to REDSTAR this year, bringing REDSTAR's total holdings to over 18,160. REDSTAR's growth was mainly due to receipt of documents from the MSFC PP02 and PP03 offices, along with approximately 200 reports gathered to create a REDSTAR Mission Operations Collection. Two boxes of documents for scanning were received from NASA Headquarters. The REDSTAR data base also saw improvement with the assignment of over 1,000 keywords, and modifications to the automated cataloging and checkout system.

With the REDSTAR data base available through the Internet, several requests for REDSTAR documents were placed. With permission, requested documents were made available to the U.S. Air Force, JSC Cost Group, MSFC Propulsion Lab, Lockheed Martin, and Ball Aerospace.

Data collection contacts were made during the year to enhance the REDSTAR collection. On-line access was gained to the Wright-Patterson Cost/Schedule Data Center's database of 8,000 documents, mostly concerning aircraft. The MSFC Public Inquiries Historical Photograph Collection was searched for pertinent spacecraft pictures. Information was also requested from the following: Jack McCommons of Thiokol, Peter Goldberg of Aero Astro, Elizabeth Ambrose of CTA Space Systems, Cynthia Cele of

TRW, and Madhu Thangavelu of USC. On-line data bases such as NASA-Recon, along with other data bases now available through the Internet, are frequently queried in information retrieval efforts.

Research was conducted to locate information on the following subjects: Space Station propulsion, Bus-1, aircraft schedules, Shuttle-C schedules, various schedule milestones, payload processing, TSS-1, SEDS, PMG, SWAS, ground-based telescopes, STABLE, REX, RADCAL, Space Elevator, gun launchers, Glovebox, SAMPIE, desktop videoconferencing, robotics, HST-OTA, mid-air and water recovery of satellites, Cryostat, Mercury Iodide Crystal Growth, Organic Crystal Growth Facility, Critical Point Facility, UHF Follow-on Satellite, upper stages, risk assessment, spacecraft design criteria, outsourcing desktop systems, Mars Pathfinder, HETE weights, Proton launch vehicle, commercial use of space, Boeing-TIE contract, tourism, satellite servicing, Satellite Service Facility, STAR-48, and the NASA lease agreement for TDRSS.

II.2. Data Analysis

Data has been collected to continue the expansion of the NASCOM Data Base. For a data point to be considered for NASCOM Data Base inclusion, the data collection effort has to provide a comprehensive history of the project's cost, technical, and programmatic metrics. Further, specifics on technical cost drivers, design maturity and program efficiencies or anomalies must be understood. This year SAIC collected thirteen current "low-cost", unmanned spacecraft programs that are to be added to the NASCOM Data Base. They are: TOMS-EP, Lewis, Mars Global Surveyor, Mars Pathfinder, Lunar Prospector, Freja, Orsted, Darpasat, PoSAT, and STEP 0, 1, 2, and 3. In the area of launch vehicles, SAIC has collected data in sufficient detail to include into NASCOM Pegasus XL, Atlas II, and Delta II (Recurring cost only), Minuteman III, Peacekeeper, and Titan IV. The inclusion of these data will bring the total of NASCOM data points to 119.

Innovations during the contract year in the current NASCOM Data Base are primarily in the area of system level costs. Added to the NASCOM research and filter routines is a multi-parameter data base containing searchable descriptions of individual test programs, engineering and management approaches and requirements and descriptions and metrics of Ground Support Equipment and Tooling for each project data point. These program identifying characteristics aid the estimator in choosing analogous data points for system level estimating.

An area where data research and analysis has been conducted through out this contract year is NASCOM's Complexity Generator. The Complexity Generator, the cornerstone of NAFCOM 1997, represents a methodology whereby hardware performance, program nuances (positive or negative), design maturity levels, and management and engineering efficiencies/inefficiencies are identified, documented, and understood for all NASCOM data. The concerted quantitative impact that these metrics have on cost is then statistically derived for all subsystem hardware. This resultant multi-variant equation is then the primary estimating tool to be employed by NAFCOM 1997. TO date, all program metrics have been identified and documented. Initial metric quantification values have been projected and verified to some degree. Final effort in the coming contract performance period for the analysis portion of the complexity Generator will entail the statistical derivation of equations and verification of their application as a viable estimating tool.

II.3. Development of Cost Estimating Techniques

The most significant effort completed this contract year in the area of cost estimating techniques has been the release of the NASA Cost Model (NASCOM) Version 5.0. NASCOM is a comprehensive data base and cost model that is used to parametrically estimate the cost of future aerospace hardware. In 5 years NASCOM has evolved from a simple three volume hardcopy data base into a fully automated, multi-dimensional, complete estimating tool.

The NASCOM Cost Model operates in the Microsoft Windows environment and has many capabilities that allow the user to develop a thorough and quick estimate. Enhanced features include: (1) an on-line data base with NASA and Air Force-provided group, subsystem, component, and unit level cost data for 100 manned spacecraft, unmanned earth orbiting and planetary spacecraft, and launch vehicles and engines; (2) the capability to build a WBS with up to ten levels using specific analogies, data base averages, user defined equations, and roll-ups; (3) the capability to search and filter the data base on over 115 cost, technical, and programmatic parameters; (4) the capability to define test hardware, learning curves, complexity factors, and quantities for each cost estimating relationship; (5) an on-line documentation and help system that includes a WBS Dictionary and Spacecraft Resumes for each program in the data base; (6) a cost sheet module which allows the viewing of the entire Project Phase C/D Cost Sheet for any NASCOM historical project.

The NASCOM Cost Model Version 5,0 was released in the fall of 1996 with many new features. This version of the model introduced the capability of estimating multiple systems using a restructured WBS, shown in Figure 1. The model now has the capability for estimating hardware and system integration cost for up to five spacecraft or vehicle systems. For example, the model can now calculate the cost of the booster, the external tank, and the orbiter in one estimate. The user is allowed to set different production quantities for each system.

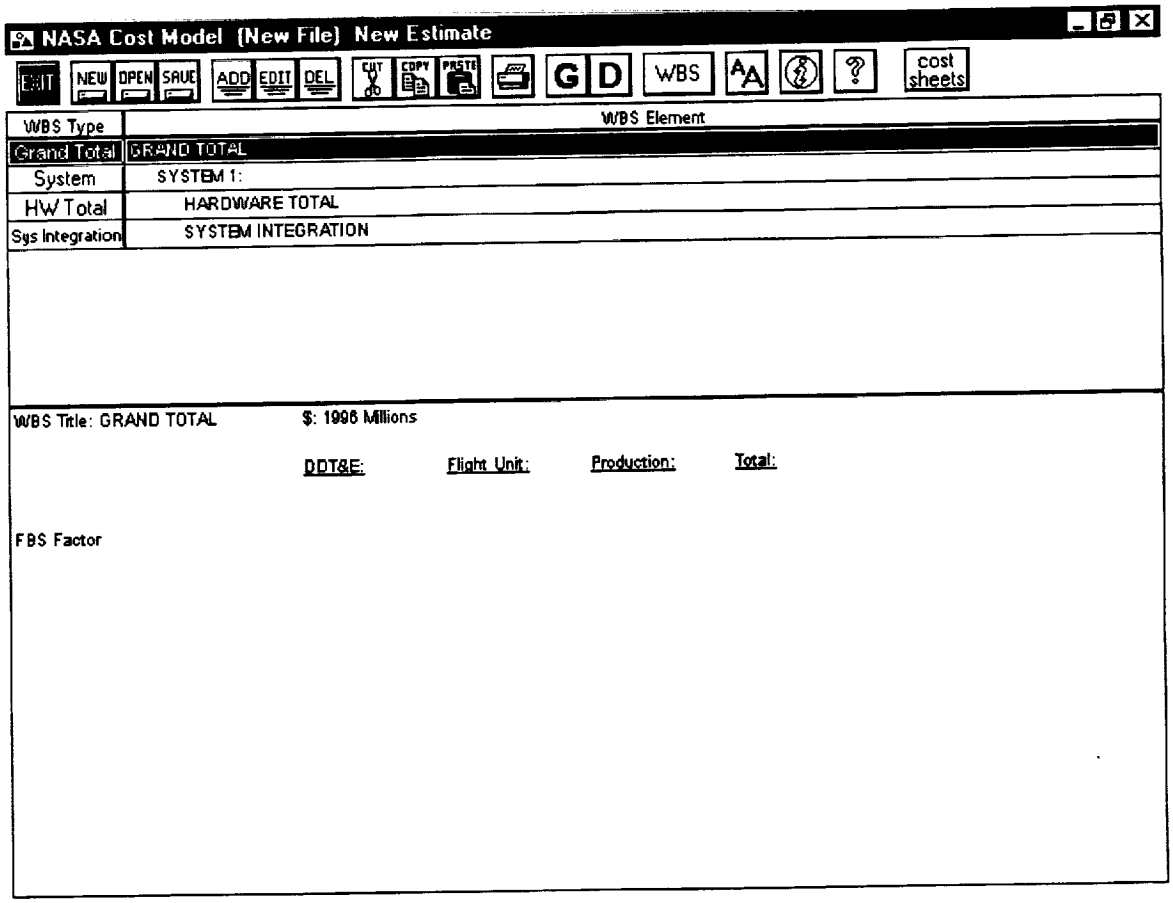


Figure 1 Restructured WBS Accommodating Multiple Systems

Instead of using standard percentages and a "roll-up" methodology to calculate system integration costs, NASCOM now allows the user to select analogous data points for system integration calculation. The user has the option of permitting the model to use built-in equations for calculating system integration, or entering a user defined equation. Filters can be used to locate system integration data points which reflect new ways of doing business. Examples of these filters are displayed in Figures 2 and 3.

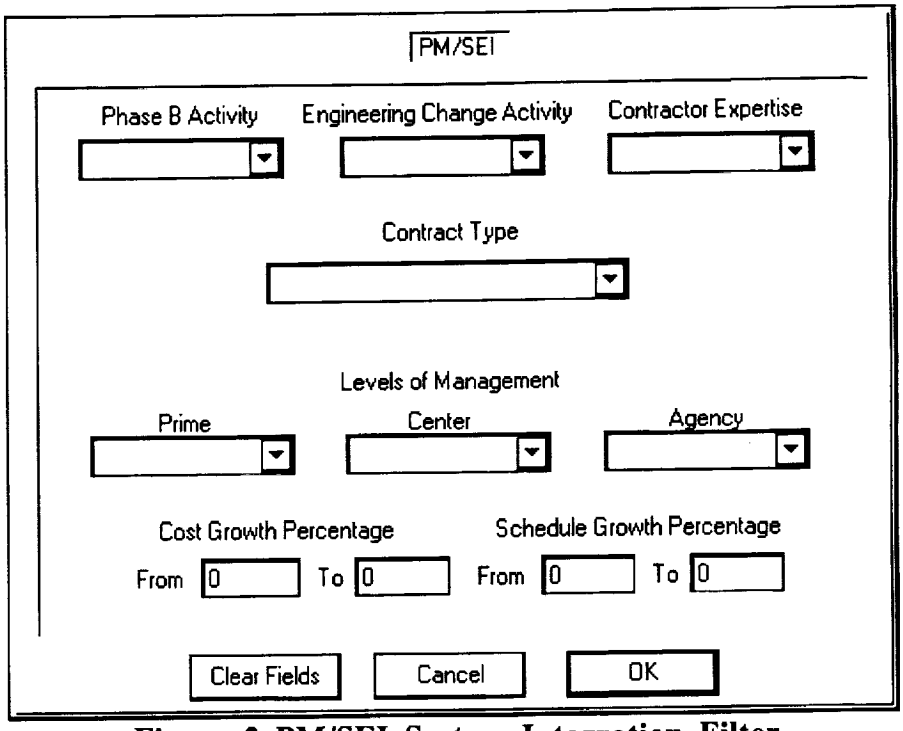


Figure 2 PM/SEI System Integration Filter

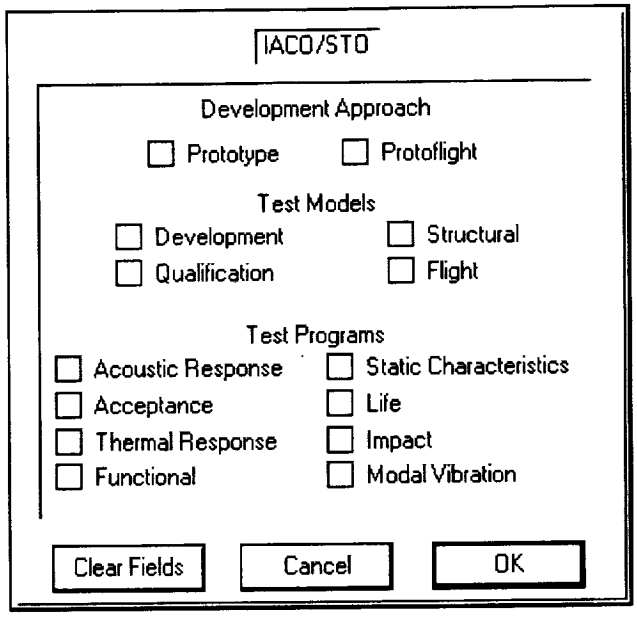
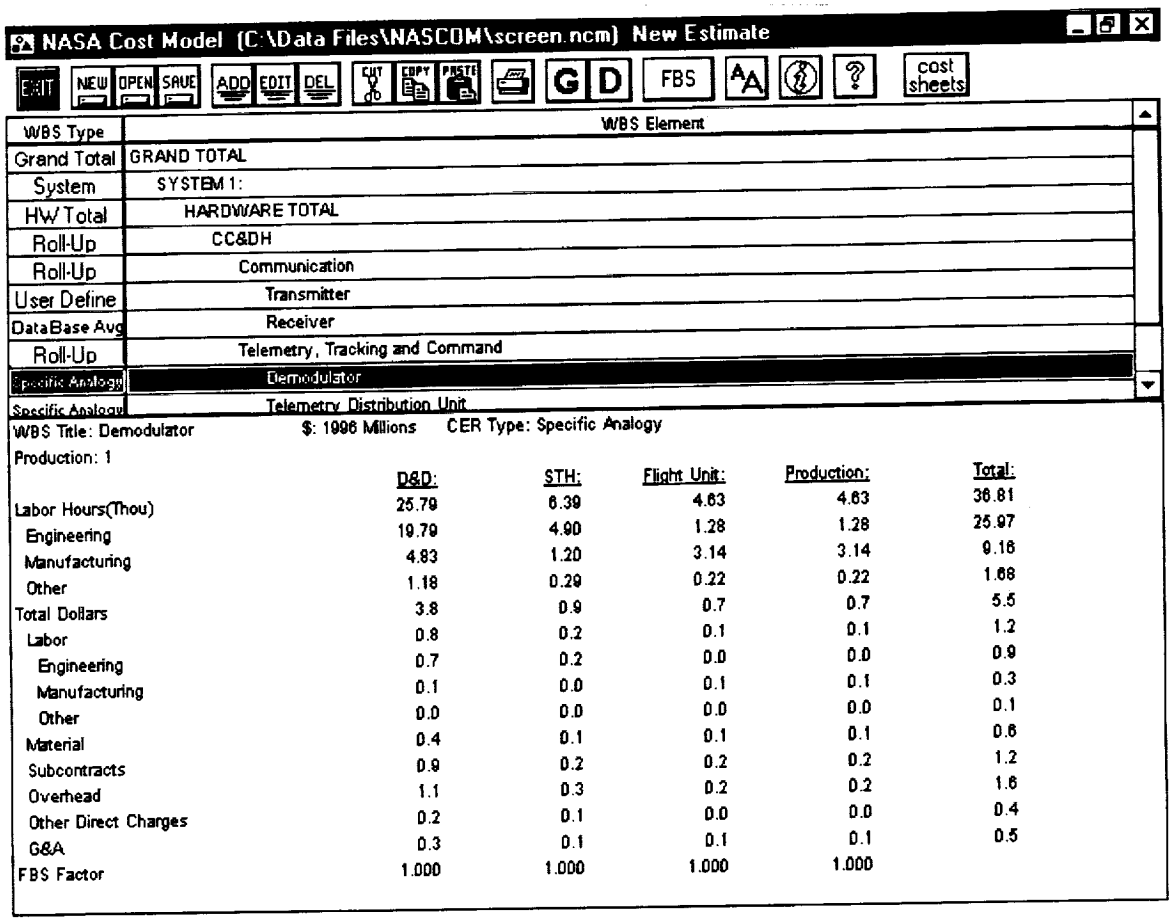


Figure 3 IACO/STO System Integration Filter

NASCOM Version 5.0 also includes a functional breakdown structure estimating capability. Using default rates, average percents-of-total, and user defined functional rates, the model can now take an element's NASCOM generated or user defined cost and break it down into its functional parts. The model will calculate cost and hours for labor, and cost for material, overhead, subcontracts, other direct charges, and general and administrative (G&A) expenses for each element in the WBS as shown in Figure 4.



	D&D:	STH:	Flight Unit:	Production:	Total:
Labor Hours(Thou)	25.79	6.39	4.63	4.63	36.81
Engineering	19.79	4.90	1.28	1.28	25.97
Manufacturing	4.83	1.20	3.14	3.14	9.16
Other	1.18	0.29	0.22	0.22	1.68
Total Dollars	3.8	0.9	0.7	0.7	5.5
Labor	0.8	0.2	0.1	0.1	1.2
Engineering	0.7	0.2	0.0	0.0	0.9
Manufacturing	0.1	0.0	0.1	0.1	0.3
Other	0.0	0.0	0.0	0.0	0.1
Material	0.4	0.1	0.1	0.1	0.6
Subcontracts	0.9	0.2	0.2	0.2	1.2
Overhead	1.1	0.3	0.2	0.2	1.6
Other Direct Charges	0.2	0.1	0.0	0.0	0.4
G&A	0.3	0.1	0.1	0.1	0.5
FBS Factor	1.000	1.000	1.000	1.000	

Figure 4 Functional Cost Breakout

In addition, the model now provides the option of adjusting cost using labor rates, an overhead rate, and a G&A rate. The model displays FBS factors for each element which is a multiplier indicating the amount that an element's cost changed due to a change in a labor rate, overhead rate, or G&A rate. The FBS factor can be seen in Figure 4 above.

Another major enhancement that was added to NASCOM in Version 5.0 was the PRICE Model complexity factors feature. Approximately 550 subsystem level manufacturing complexity factors, as well as the corresponding engineering complexity and new structure percentage values were calibrated and added to the NASCOM data base. When a hardware CER is created in NASCOM, the model calculates average, standard deviation, minimum, and maximum values for manufacturing complexity, engineering complexity, and new structure percentage, as shown in Figure 5. These inputs can be used in the PRICE Model to generate NASCOM comparable backup cost estimates for similar subsystems.

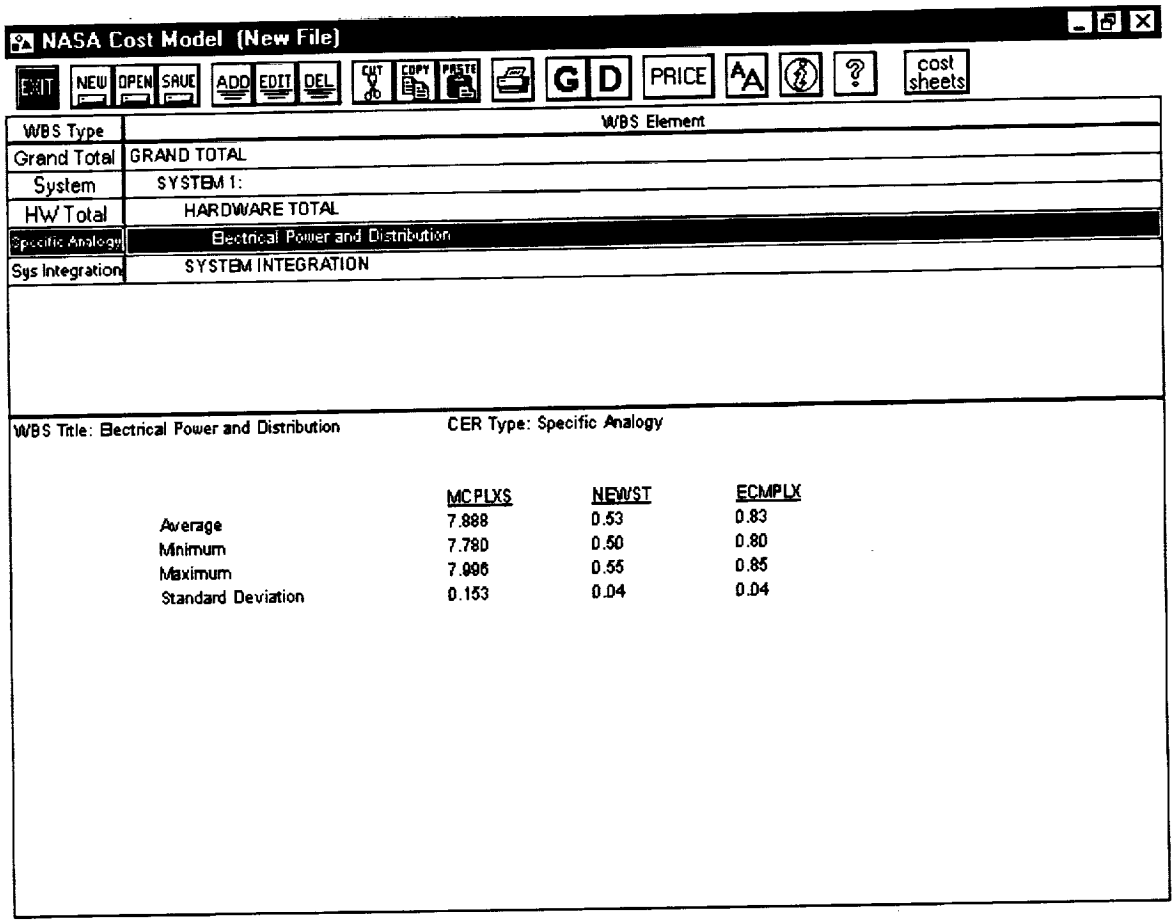


Figure 5 PRICE Model Complexity and New Structure Percentage Values

Other new or enhanced existing features include: (1) an improved cost sheet module which now provides both the contractor-reported WBS and the standard WBS; (2) simplified color coding of the element type identification tabs which makes totals easily distinguishable; (3) an improved calculator; (4) an avionics breakout; (5) increased data base with inclusion of Air Force-provided data for eight Earth-orbiting missions; (6) improved project data resumes; (7) six new tool bar commands for changing the font size, cutting, copying, and pasting WBS elements, setting defaults inputs, and changing the information viewed on the status display; (8) expanded print options, and (9) the capability to operate NASCOM in Windows 95 or Windows 3.1.

II.4. Schedule Development and Analysis

In September we delivered Version 2.4 of the Schedule Template Evaluation Model (STEM) to PP02. This delivery of STEM contains detailed gantt bar chart schedules for the following templates: Nuclear Vehicles, Cooperative Agreements, Experimental Vehicles, Unmanned Lander, Rovers, and Upper Stages. These additions also include the schedule source and a print capability for each schedule. We have also updated the Glossary. Currently, there are 42 templates in 16 categories representing 128 missions and experiments. After the delivery, we continued to work on the STEM enhancements. Another revision is planned for 1997.

In early 1996 we continued the task of going through the REDSTAR documents to locate schedules. We were able to locate a number of schedules that have been added to the Schedules collection.

We worked with PP02 in obtaining Project/Program Plans from project offices and labs. So far we have added 8 documents to REDSTAR. We also searched the PP02 file cabinets and were able to add several planning schedules as well as engine schedules to REDSTAR as a result.

In 1996 we were asked to research low cost program schedules. This effort was meant to determine if there is a verified correlation between the low cost programs and business as usual programs in terms of cost and schedule. We delivered this report and the research data in September.

We met a number of ad hoc requests for schedules and schedule data this past year. They were on:

Hard X-ray Telescope,
Production schedules for large telescope
Space Station Schedules
Tethered Satellite System (TSS-1)
Small Expendable Satellite Deployer System (SEDS)
Plasma Motor Generator (PMG)
Plot of Automated Rendezvous & Capture program
Upper Stage schedule data on specific configurations designated by MSFC
MECM and SACOM equations for compression and extension penalties
Schedule data on Shuttle C, HLLV, SEI, GRO, HEAO, and HST

We were tasked to assist with the 1996 NASCOM revision by updating the schedule data for 101 programs in the programmatic section. We completed this task in February. We also began some of the groundwork needed to begin the next NASCOM revision. This will contain the schedule integration portion of the model.

III. ADDITIONAL TASKING

In addition to the mainline tasks accomplished for the Program Development directorate of MSFC, several in-scope tasks were performed under the contract for other NASA elements. Those tasks that were funded by the NASA Headquarters Comptroller Office were (1) the second phase of an effort to develop comprehensive NASA Space Operations Cost Models, (2) the transfer of additional hardcopy REDSTAR Data Base documentation to CD-ROM format and distribution to NASA centers, and (3) the calibration of the PRICE Systems Cost Model for NASA users.

A task to provide cost estimating and modeling capability at the Ames Research Center, funded jointly by that center and the NASA Comptroller, was continued this contract year. A Lewis Research Center (LeRC) task to develop an Operations and Maintenance Cost Estimating Model for Space Station Microgravity Facilities was completed this contract year. A MSFC funded task provided cost modeling enhancement for the MSFC Microgravity Project Office. Finally, a task funded by the Air Force Cost Analysis Agency was performed to add Air Force unique requirement to NASCOM and convert it to a joint NASA and Air Force cost model.

These additional tasks provide synergistic elements to each other as well as to the basic MSFC effort. Additionally, they often draw upon the data contained in the

REDSTAR and NASCOM data bases, utilize the NASCOM Cost Model, and tailor the cost modeling methodologies developed under the basic contract to their needs so that uniform, compatible, and cost effective products are obtained by all NASA customers. The specific work performed in each of these tasks during this contract year is described in the following paragraphs.

III.1. ARC Cost Analysis

SAIC was tasked to develop cost tools, methodologies, and a cost analysis/estimating capability at the Ames Research Center. To satisfy these requirements, a full-time analyst was assigned to Ames and he was supported by other analysts in Huntsville as required.

One assigned task was to continue the development of the Automation Life Cycle Cost Model (ALCM). SAIC prepared a paper, "Development of a PRocess-Based Cost Model", outlining the vision and plan for the further development of the ALCM. This paper was peresented at both the SCEA National Conference in Orlando, Florida and at the NASA Cost Symposium in Washington, D.C. SAIC was also tasked to design an Internet Home Page for Ames that discusses the cost work activities at that center.

SAIC worked with wind tunnel test engineers to provide a Wind Tunnel Test Model to supply engineers with cost distributions for a test's total cost, cost per run, and cost per data point. Also provided was a risk analysis for the Wind Tunnel Test Model outputs. Information on how to use the software estimating packages SASET and REVIC was provided to Ames engineers attempting to develop a software estimate for the Advanced Animal Habitat Centrifuge (AAHC) project.

SAIC developed an independent cost estimate for the Airplane for Mars Exploration (AME). The spacecraft, airplane, and scientific instrument protions of the AME were estimated.

SAIC continued to identify generic processes for use in a process-based model. The REDSTAR library and other sources were researched to locate detailed schedules to identify subsystem specific process. Useful process data in schedules for AXAF, OMV, and Space Station was located. Discussions with several key personnel at MSFC were held to explain our plans for a process-based model and to solicit their inputs/suggests for our data colleciton efforts. Several technical papers and articles relating to design process were located and analyzed. By utilizing the detailed schedules and input form project engineers, SAIC was able to determine which processes are generic, where they occur in the timeline of a project, and how the processes interact with one another. Once this definition phase is completed, the process data base will be incorporated into NASCOm. This work will continue through the next contract year.

III.2. LeRC Microgravity Oprations Cost Model

The Operations and Maintenance Model developed by SAIC for the Lewis Research Center (LeRC) was delivered in August 1996. This automated tool was designed to estimate the cost Operations and Maintenance of Space Station facilities. The model is Windows compatible, user friendly, and spreadsheet-based. The model receives inputs at the Orbit Replacement Unit (ORU) level, calculates the maintenance cost at the ORU level, and sums total ORU cost using a generic Operations and Maintenance work breakdown structure (WBS). The model supports the estimating of multiple facility components at a time with a possible mission profile of 20 years.

III.3. CD-ROM Scanning Effort

REDSTAR on CD-ROM, consisting of 2,500 scanned REDSTAR documents, was delivered to NASA HQ, LaRC, LeRC, JSC, JPL, GSFC, KSC, MSFC, NASA Office of Attorney General, and the Air Force Cost Analysis Agency.

SAIC was tasked to complete a second set of CD's containing approximately 2,500 additional REDSTAR documents. Ten sets of the CD-ROMs will be distributed to various users throughout NASA. The second scanning effort began in May, and the Canofile 510 System, which was selected for the first scanning effort, continues to operate flawlessly.

Approximately 1,800 documents (totaling over 176,000 pages) were scanned during this contract year. The documents chosen for scanning came from the REDSTAR Mission Operations Collection and Space Station Collection, along with various studies, financial reports, NASA press kits, project plans, GAO reports, project management reports, cost models, and early NASA Budget Estimates. IAR's and NAR's sent from NASA Headquarters were also included. Completion of this second phase of scanning is expected in February, 1997.

III.4. PRICE System Calibration

SAIC was tasked with completing the process of calibrating elements of the PRICE System H Cost Model to the NASA environment and documenting the results in a PRICE Calibration Handbook. This exercise calibrated to the subsystem level all NASA and Air Force missions currently in the NASA Cost Model (NASCOM). As a result, NASA complexity tables have been constructed showing calibrated complexities specified by mission. These complexities can be utilized for generating estimates of new NASA programs. In this contract year, SAIC has completed the calibration of 95 missions and generated approximately 550 complexity factors. A summary of this data was compiled into the PRICE Calibration Handbook which was distributed to nearly 40 PRICE users in the NASA community. The complexity factors were also added to the NASCOM Cost Model data base. Using the average complexity factors and complexity factors for analogous missions, both of which NASCOM provides, users can now generate comparable estimates for similar hardware using NASCOM and PRICE-H.

In this contract year, SAIC has assisted MSFC with a variety of exercises. In one exercise, new technology factors were incorporated into the PRICE Model to generate a new launch vehicle estimate and show the cost reductions associated with using new technology. SAIC assisted in generating several new estimates utilizing the calibrated complexities. Also, SAIC generated numerous charts for presentations on the PRICE calibration effort.

SAIC also maintained contact with PRICE Systems to ensure current and correct usage of the model. Two PRICE tools, MCPLXS Generator and Satellite Subsystem MCPLXS/E Knowledge Base, were analyzed for applicability to our efforts.

III.5. Space Operations Cost Study

The NASA Space Operations Cost Study has made significant progress over the past year in many areas. Earlier project plans envisioned a sequential advancement for the model development. This approach assumed that a standard WBS would be established first, then data would be collected from various mission types and NASA centers, followed by an intensive data analysis effort that would support development of a space operations cost estimation methodology and model. Because of this task's complexity and broad

scope, many of these efforts are interrelated, which would require numerous iterations if a sequential approach is used. To ensure that a credible model would be developed within the study's planned schedule, a concurrent engineering approach was adopted where WBS development, data collection, and model design proceed in parallel with substantial interactions among the individuals working each of these issues.

The NASA study team, with SAIC as a key participant, is now organized into 4 separate, but interrelated, subcommittees. These are 1) WBS Development and Evolution, 2) Data Collection, 3) Cost Model Development, and 4) Activity-Based Costing and Other Advanced Cost Estimation Methodologies. The core study team members were then assigned to a subcommittee where they could focus their efforts on specific aspects of model development and generate requirements for the other subcommittees. This interaction was on a weekly basis through telecons and several working meetings at various NASA centers. In addition to supporting the overall study effort, SAIC has primary responsibilities on two of the subcommittees - 2) Data Collection and 3) Cost Model Development.

The WBS Development and Evolution subcommittee has been tasked to work closely with each NASA Center to develop a WBS that can capture the work performed at each location and identify how the WBS might evolve to capture innovative low cost operations support approaches being applied to new, very low cost missions. The current baseline WBS includes the 13 functions originally developed by JPL for Discovery Program missions. This WBS appears to be applicable to both planetary and earth orbiting mission types and is still under evaluation for payloads, launch vehicles, and manned mission types. Additionally, this subcommittee has collected inputs to support identification of activities that could be included under each of the 13 WBS functions and advanced WBS organizations under consideration for future missions currently in the conceptual design phase.

The Data Collection subcommittee has been tasked to collect cost, technical, and programmatic data for a set of missions and mission types that represent the past, current, and future mission operations approaches and map collected data into the WBS developed by the WBS Development and Evolution subcommittee. SAIC has turned in this type of data for several planetary missions and a GSFC contractor is preparing an input for several GSFC earth orbiting missions. Many contacts have been made in the space operations community by SAIC that will serve as sources for ongoing data collection efforts.

The Cost Model Development subcommittee has been tasked to develop a cost estimation methodology to correlate cost drivers associated with each mission type to each WBS function/activity that can be applied in the early stages of a mission concept formulation and evolve as the mission evolves to incorporate more detailed technical and programmatic information/data as it becomes available. SAIC is the lead on this team and in this contract year began the initial scoping of a Rapid Prototype version that will serve as a basis for future discussions and evolve as the team gains understanding of the key issues.

The Activity-Based Costing and Other Advanced Cost Estimation Methodologies subcommittee is performing a similar task to the Cost Model Development subcommittee but is focusing on activity-based costing methods and other advanced mathematical techniques. Results of both model development efforts will be merged at some point to generate a single cost estimation tool with broad capabilities.

One substantial feature of this study effort is the user-focused approach that has been adopted. SAIC has developed a User Needs Assessment survey to collect requirements for the cost model from various operations communities including inputs

from experts in cost, technical issues, and management. It is the study's intention to keep the various user communities involved in the cost model development effort by presenting them with prototype model versions to use and comment on. The recommendations from the users and the study team will be used to revise the prototype model versions which will eventually evolve into the final version of the operations cost model.

Currently, many potential user communities have been contacted and included in the User Needs Assessment. This group includes contacts at most of the NASA centers and the Space Operations Mission Office (SOMO) located at JSC. This user community has periodic interaction with the study team to resolve specific issues and can attend the Operations Cost Model Steering Committee meetings held approximately 4 times a year at different NASA centers. At the Steering Committee meetings, user communities can be informed of the study's progress and make suggestions/recommendations to direct future activities. Over the past year, the size of the user community participating with this study has grown substantially and includes representation from SOMO. The study team is continually making contacts with space operations community and looks forward to benefiting from their experience and insights.

Future directions will focus on modifications/enhancements to the recently completed Rapid Prototype Model. Subcommittee inputs will be quickly incorporated into prototype model versions which will be sent to the operations user communities for comment. In the coming year, several model iterations will be completed, each an enhanced version of the preceding one, incorporating the specific needs and recommendations from potential operation cost model users enabling the final version to be applicable to a broad group of space operations experts and operations cost analysts.

III.6. Microgravity Project Office Task

SAIC was tasked to enhanced and improve the Microgravity Experiment Cost Model (MECM) during the contract year. The primary task was the collection, normalization, and analysis of additional data to improve the cost estimating relationships and cost complexity relationships in the model. New data sources included MSFC and JPL microgravity experiments, as well as selected subsystem data from newly acquired Air Force and NASA spacecraft. As new data was added the CERs, new regression analyses were performed for new performance and weight-based CERs.

An updated version of the model, MECM 4.0, will result from these enhancement efforts. The MECM 4.0 delivery will include an updated Users Manual and a new Master Data Set with data point description.

III.7. Air Force Cost Analysis Agency (AFCAA) Task

Technical and cost data swaps and discussions between NASA/SAIC and the AFCAA occurred on a frequent basis from mid-1994 through early 1996. The AFCAA also received earlier versions of NASCOM and actual training on the model in that time period. This contract year, however, marked the first time that the AFCAA has actually provided a funded task to make NASCOM more useful to Air Force cost analysts.

During this contract year, SAIC re-normalized the entire NASCOM Data Base using Air Force inflation indices and developed a table of factors that automatically adjust cost estimates from NASA indices. This feature allows the cost model to provide estimates based on historical project data to be displayed in either Air Force or NASA today's, or future year, dollars. SAIC expanded the selection of learning curve selections to include more aggressive learning assumptions that may be appropriate with large quantity Air Force

hardware buys. SAIC also developed the capability to estimate the continuation of a production run and to calculate production rate effects to satisfy large quantity Air Force buys.

SAIC developed an approach to provide correlation between System Test Hardware (STH) and unit production costs through the application of appropriate learning curve effects to satisfy Air Force methodology requirements. Another sub-task accomplished by SAIC was to incorporate into the cost model a functional breakout of cost estimates which breaks the costs that were estimated on a hardware WBS basis to functional elements of labor, overhead, material, and subcontracts. Labor is also displayed in terms of hours at the engineering, manufacturing and other level. Default and input values for rates and factors may be through-put to accommodate Air Force approved forward pricing rates.

Results of these sub-tasks are incorporated into the initial release of NAFCOM (NASA/Air Force Cost Model). This combined model is intended as a joint Air Force/NASA cost model designed to accommodate the unique requirements of each agency. Documentation of the Air Force sub-tasks is included in the SAIC deliverable NAFCOM User's Guide and the installable model disks.