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ISSUES IN NASA PROGRAM AND PROJECT MANAGEMENT

Special Report: 1997 Conference

"Project Management Now and in the New Millennium"

NASA Project Management Shared Experiences Program

NASA SP-6101 (13)

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NASA Project Management Shared Experiences Program

edited by

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National Aeronautics and Space Administration
Office of Management Systems and Facilities
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Issues in NASA Program and Project Management

Special Edition: "Project Management Now and in the New Millennium"

NASA Project Management Shared Experiences Program

Virginia Beach, Virginia

March 25-28, 1997

National Aeronautics and Space Administration **Autumn 1997**

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SP-6101(13) *Issues in NASA Program and Project Management* is thirteenth in a series from NASA's Program/Project Management Initiative. This edition is collected and edited by Dr. Edward J. Hoffman and Dr. William M. Lawbaugh. Statements and opinions are those of the authors and do not represent official policy of NASA or the U.S. Government. Useful and enlightening material is welcome, and diversity of ideas is encouraged.

Inquiries should be directed to Dr. Edward J. Hoffman, Program Manager, Office of Training and Development, Code FT, NASA Headquarters, Washington, DC 20546-0001.

NOTE: In Issues 12, Spring 1997, Figure 1 should be Figure 3 and Figure 3 should be Figure 1 in the article titled The "OnePager": Methodology & Application, Experiences and Lessons Learned, by Tony E. Schoenfelder and James Wilcox. We apologize for the error.

The Project Management Shared Experiences Program

Virginia Beach, Virginia
March 25-28, 1997

New Directions

Dr. Edward J. Hoffman

Welcome to "Project Management Now and in the New Millennium," the fourth offering of this program of shared experiences. With each program the level of interest seems to expand in terms of both participation and interest in delivering sessions. The line-up for this program represents the most impressive array of speakers we have ever had for a Project Management Shared Experiences Program.

In virtually every area of our organization, as well as the world, we see the unmistakable signs of massive change. The issue is no longer whether to change, or even when we will change, but how we will direct the change into a bold new century.

From the beginning, the Project Management Shared Experiences Program was set up to be a forum for the NASA community to share information, hopes and concerns about NASA project management. Through this forum, effective networks can be formed to help NASA embrace the future. In recent years this network has been expanded to include colleagues from industry, universities and international partners. This expansion reflects the growing globalization of project management, as well as NASA's commitment to be a leading player in this area.

This year's program emphasized many of the critical trends that are transforming a new organizational reality. As we begin the year 1997, I am very pleased that the NASA Program/Project Management Initiative, established in 1987, continues to step up to the challenges inherent in this decade. For example, NASA can offer to the people in the project management community a world-class, industry-benchmarked, professional development process. The Project Management Development Process (PMDP) is a voluntary process of development, supported at each NASA installation, a program that continues to grow and receive international recognition.

This shared experiences program was diverse, relevant and packed with possibilities. Breakout sessions were conducted by experts who, in most cases, are leading practitioners in their disciplines. All of these sessions reflected key issues of change impacting project management.

Another new direction was the offering of a "skills workshop" day. The intent here was to offer several four-hour sessions during which a program participant could attend two. These sessions offered more direct, hands-on skills in a small concentration of time.

Of course, as in the past, we were fortunate to offer plenary sessions with people who are resetting the benchmarks of project management. I am very impressed with the speakers and panelists who were assembled. They represent a cross section of the best of NASA, industry, government and universities. Furthermore, many of our speakers are seminal thinkers and leaders in their fields, and expect they challenged our assumptions and stimulated our thinking.

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Critical Core Issues for the Future of the Agency

General John R. Dailey

General John R. Dailey, USMC (retired) has been Acting Deputy Administrator of NASA since March 1993 and also serves as Associate Deputy Administrator. In his 36 years in the Marine Corps he clocked 6,000 hours of flight time, including 450 fixed wing missions during two tours in Vietnam. Prior to his arrival at NASA, he was Assistant Commandant of the Corps.

General Dailey focused on three general areas in his hour and a half with delegates to the Project Management Shared Experiences Program: NASA's strategic plan, project management and communications.

He began by urging everyone to study and work the newly approved *NASA Strategic Plan*, the Agency's blueprint to year 2020. He spoke directly to NASA's 36% cut in budget, from $122 billion to $82 billion over five years, and a staffing decrease to approximately 18,000 civil servants by October 1999. Why change things? "We can't afford to do it the old way," he noted. Directives are in place, the process is being developed, but resistance is Agencywide. His job is to push the change process and drive the deadline. The NASA culture is strong, creative and collaborative, he acknowledged. He and others noted that Office of Management and Budget proclaims NASA as a model of reinvention in government.

"Project management is the absolute heart of NASA," he said. One major shift is from operations to R&D. The recent NPG 7120.4/5 Directive and forthcoming Handbook must become "bibles for our programs," especially with more lead Center and cross-Center projects. "Your projects are measurable," he said, and "technical competence is first, last and always."

In terms of communication, General Dailey said: "Communication is our biggest problem in the Agency," internally and externally. While each government Agency is forbidden by law to advertise or promote its successes, NASA could learn from politicians and public affairs specialists. Technical briefs, for example, must be "consumable," written at eighth grade level.

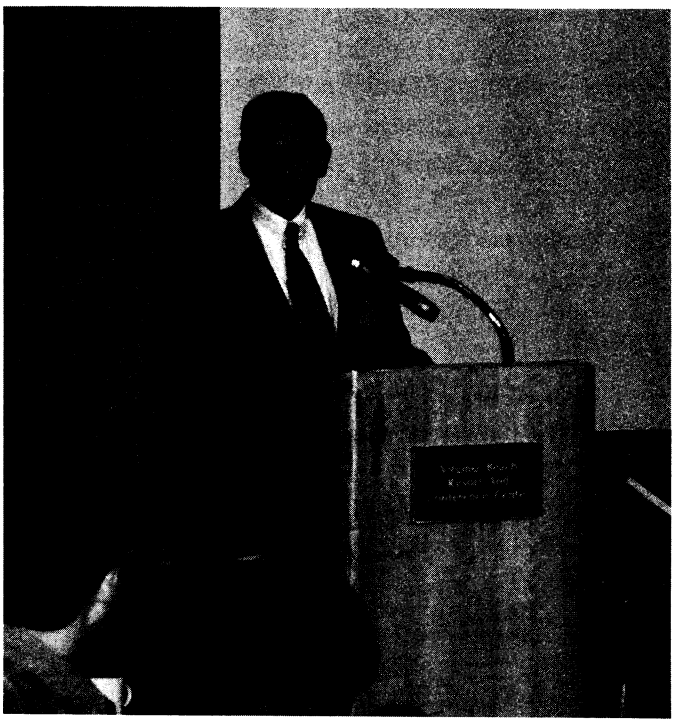

Figure 1. Gen. Dailey speaks to the NASA shared experiences program participants

In summary, General Dailey said: "We decided we would design an Agency that worked as a team of Centers, each providing its unique capabilities to this total, which enables us to maintain our position of excellence in doing the hard things nobody else can do, providing the technology that enables American industry to develop its products and maintain its supremacy in the industrialized world."

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National Space Policy Strategic Management

Alan Ladwig and Gary Steinberg

Alan M. Ladwig is Associate Administrator for Policy and Plans overseeing strategic plans and policies, as well as the History Office. He had served on the Administrator's task force that produced *Leadership and America's Future in Space.* Gary A. Steinberg is Director of Strategic Management in the Office of Policy and Plans, coordinating the development of *NASA's Strategic Plan*, the *Strategic Management Systems Handbook* and the Agencywide metrics system. He chairs the NASA Strategic Management Working Group.

Alan Ladwig opened the discussion of strategic plans by noting a September 1996 switch from President Bush's primary space goal to "strengthen and maintain the national security of the United States" to a national space policy that would "enhance knowledge of the Earth, the solar system and the universe through human and robotic exploration."

The top policy goal for Aeronautics research and technology is to "maintain the superiority of U.S. aircraft and engines." The Clinton Administration modified the SEI missions to the Moon and Mars, increased the emphasis on joint ventures, especially with the Russians, and altered the International Space Station to save it after a congressional effort to kill it lost by just one vote.

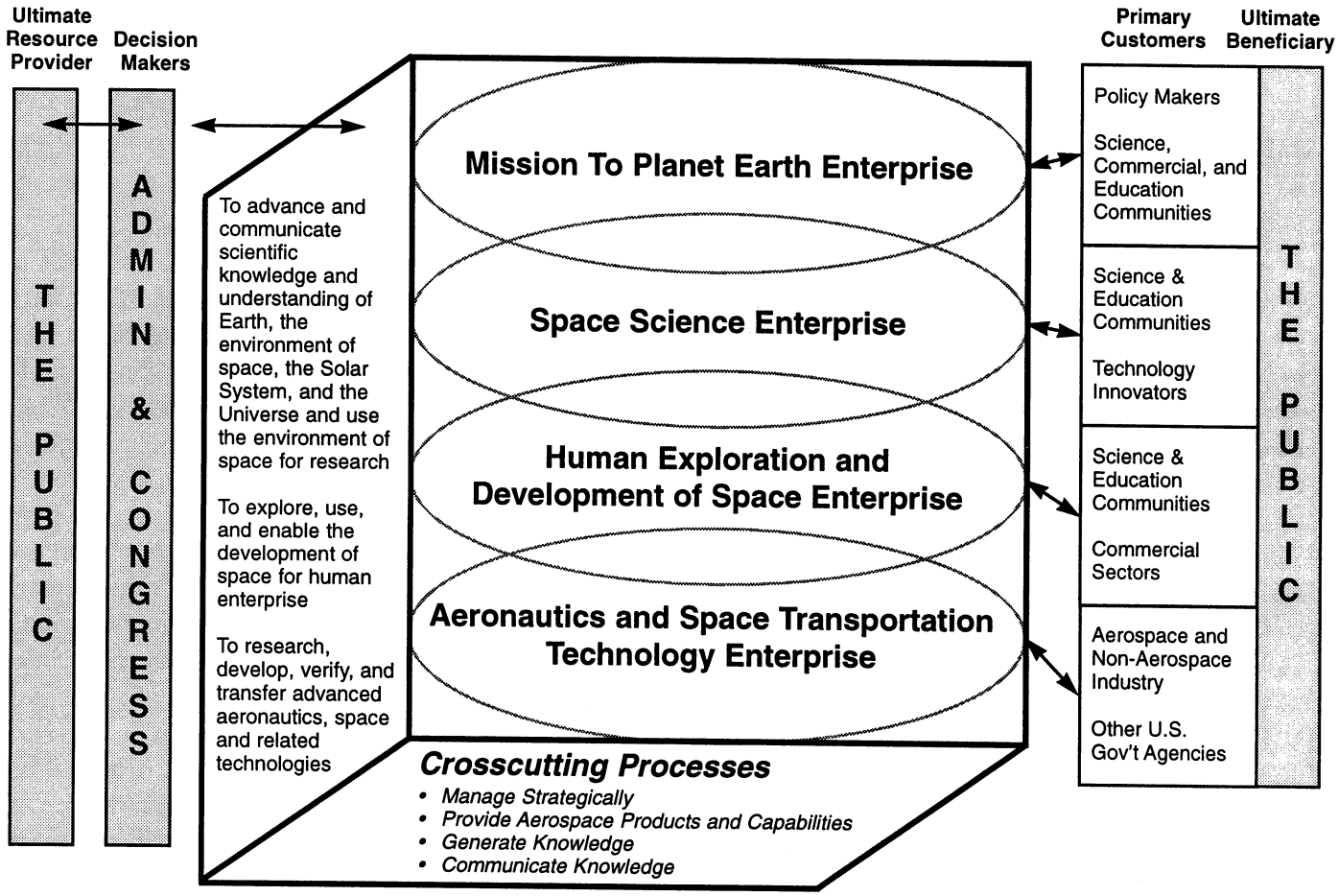

Figure 2. Strategic Framework for NASA

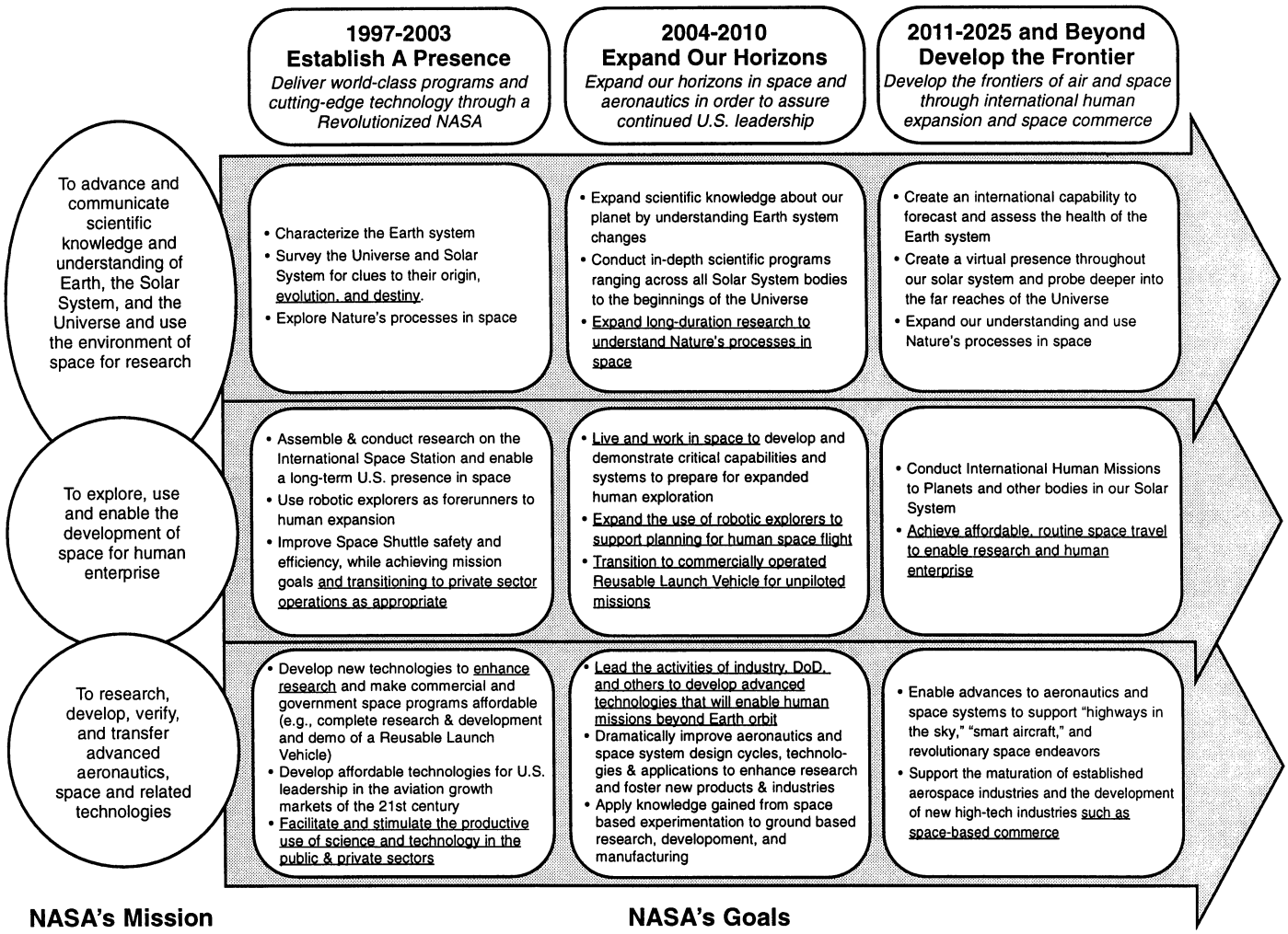

Figure 3. NASA's Strategic Roadmap to the Future

The effort now is to align national space policy with the Agency strategic plan, with Enterprise and functional/staff implementation plans, with Center and Center of Excellence plans and eventually with program plans and Program Commitment Agreements (PCAs) with individual performance plans.

He described the "strategic framework for a single NASA" (Figure 2) based upon the four customer-focused Strategic Enterprises, crosscut or executed by functional and staff offices at Headquarters and Centers. He also described where the Agency is currently headed in terms of missions and goals from 1997 to 2025 and beyond (Figure 3).

Gary Steinberg asked: "Where do you fit in the *NASA Strategic Plan*?" stressing the importance of linking individual performance plans to PCAs, program or project plans which in turn should align with Center and Agency plans. He noted the need to "streamline, reduce redundancy and focus on Agency priorities." Thus, instead of redundant Center capabilities we have Centers of Excellence. Instead of Headquarters program offices we have lead Centers. Instead of multiple decision paths we have councils and boards on program management and capital investment. Instead of fragmented individual functions and approaches, we now have integrated crosscutting processes.

Stressing the need to "clarify roles and responsibilities," Steinberg explained the role of the new Capital Investment Council (CIC) in balancing resources among the four Strategic Enterprises for facilities,

human resources, technology, information systems, environmental management and other designated long-term investments.

Copies of the blue NASA Strategic Plan (dated February 1996) and the red NASA Strategic Management Handbook (dated October 1996) were distributed to participants.

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ISO 9000 and NASA

Carl Schneider

The International Organization for Standardization (ISO) was created in 1946 to help postwar Europe achieve harmonized product specifications. In 1987, the initial first five series standards were released in the U.S. through the American National Standards Institute and the American Society for Quality Control; in 1994 the standards were released in a second edition. Today, ISO 9000 is a world wide standard adopted by more than 100 countries.

The NASA Administrator has directed the Agency to become ISO 9000 certified by a third-party registrar by September 1999. While NASA is a leader in science and technology development, the Administrator also wants the space Agency to become a leader in quality and the lead federal Agency for quality management.

ISO 9000 consists of a flexible minimum set of requirements. It is not a project-oriented specification, nor a guarantee of high quality hardware. It is not another "layering of requirements," explained Carl Schneider of Code Q. Rather, it is an international conformance standard adopted by most industrialized nations that can be contractually imposed on contractors to assure consistent product quality.

Quality has always been part of NASA culture. In the 1970s, NASA's quality process was defined in NHB-5300.4 (1B) dated 1969 to detect defects and make corrections. The shift from "inspect in quality" to "design in quality" came in the 1980s with more emphasis on process control than product. A balance was achieved in the 1990s with a further shift from motivational programs such as TQM, quality circles and zero defects to output/outcome, the "what" instead of the "how to." ISO 9000, which ensures consistency, not quality, thus fits perfectly in a system that requires you to "Say what you do . . . Do what you say . . . Prove it."

The ISO standard pertaining to the most comprehensive Quality Management Systems (ISO 9001) addresses 20 elements covering contract review, design control, product identification and traceability, inspection and test status, corrective and preventative action, internal quality audits, training, statistical techniques and more. Certification in this area has the potential to save suppliers and customers considerable cost since it minimizes duplicative customer audits of suppliers. In a global economy, it promotes international competition due to its internationally accepted certification process. Finally, ISO 9001 independently assures compliance of contractor QMS as it relieves customers of many supplier audits.

ISO 9000 is driven by customers' deliverables and key process. It yields a structured and documented management system consisting of a quality policy manual, consistent procedure across departments, intra-departmental work instructions and data control. It aligns NASA to commercial best practices in quality management by ensuring consistent approaches and systems within and between centers.

NMI 1270.3, "*NASA Quality Management Systems Policy (ISO 9000)*," dated December 6, 1995, applies to NASA Centers and suppliers. The Administrator's guidance of November 1996 requires Marshall, Johnson and Stennis Centers to achieve third party certification by April 1988 and all other locations by September 1999. Currently, the White Sands Test Facility is the only site that is ISO 9000 certified.

NASA is the first federal Agency to make a commitment to ISO 9000 certification, although the Department of Defense abolished MIL-Q-9858 in September 1996 and issued a policy directive to remove impediments of imposing ISO 9000 in contracts. Also, the Federal Aviation Administration is

promoting AS 9000, a derivative of the ISO 9000. In a November 13, 1996 letter to NASA officials and directors, the Administrator said: "We must also be leaders in the world of quality" as demonstrated through ISO 9001 certification. "I am also expecting that all our suppliers will step up to the challenge."

Carl Schneider ended his breakout session with a quotation from a quality guru: "You don't have to do this," said W. Edwards Deming, "survival is not compulsory."

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New Acquisition Initiatives

Kenneth A. Sateriale

NASA has been at the forefront of the acquisition reform movement. Many of these reforms will have a profound effect on how the Agency does business in the near future.

Ken Sateriale of the Contract Management Division in the Office of Procurement describes five key acquisition reforms: Performance-Based Contracting, Single Process Initiative, Consolidated Contracting Initiative, Commercial Item Acquisition and Streamlined Source Selection. A brief description of each follows.

Performance-Based Contracting consists of four elements: the statement of work (SOW) or specification, the appropriate contract type, incentives for results (not best efforts) and two types of surveillance, insight or oversight.

Writing the SOW involves performance standards such as power, speed, weight, size, capacity, accuracy or repeatability that specify the minimum acceptable level of performance. The SOW can specify input (resources applied), output (product or activity) or outcome (ultimate objective). Requirements should specify function (the need), performance, essential physical characteristics and detail or design. If requirements are under-specified, the result could be poor performance and expensive changes in work requirements; over-specified requirements can hamper the flexibility needed to meet performance standards. Incentives can be offered when performance is above the minimum level if it is a significant value to the government, worth the additional cost and clearly within the control of the contractor. Figure 4 shows when to use insight surveillance (a process of gathering a minimum set of product or process data that provides adequate visibility) or the more intrusive on-site oversight surveillance such as inspection with implicit or explicit review and approval authority.

Single Process Initiative attempts to reduce contractor operating costs by transforming multiple government-unique management and manufacturing systems into common, facility-wide processes. Using a "block change" modification approach, SPI unifies requirements existing on a facility-wide basis rather than on a contract-by-contract basis

The Department of Defense adopted SPI in December 1995 and NASA followed suit on May 17, 1996. For each project, the manager will review each proposed block change for approval. A Block Change Management Team has been set up at NASA Headquarters.

NASA's Consolidated Contracting Initiative is a process that emphasizes developing, using and sharing contract resources, whenever practicable, to meet Agency objectives. The approach calls for participants to capture and list CCI-like contracts, look for reasonable conversions (up to the Centers), post planned awards to develop new CCI contracts and list them on the CCI homepage, such as leasing arrangements for photocopy machines. Users then check the Bulletin Boards for existing or planned contracts before initiating, purchasing or developing sealed bids or RFPs.

Planned changes to CCI include a scrub of other Agency contract lists to eliminate "bad" contracts, electronic enhancements and additional CCI contracts from contractors.

Commercial Item Acquisition is defined as any item "of a type" used for nongovernmental purposes that has been sold, leased, licensed or offered to the general public. It would include such items off the shelf requiring customary or minor modifications as well as services "of a type" sold competitively based on catalog or market prices. Commercial items do not include construction nor "true" R&D.

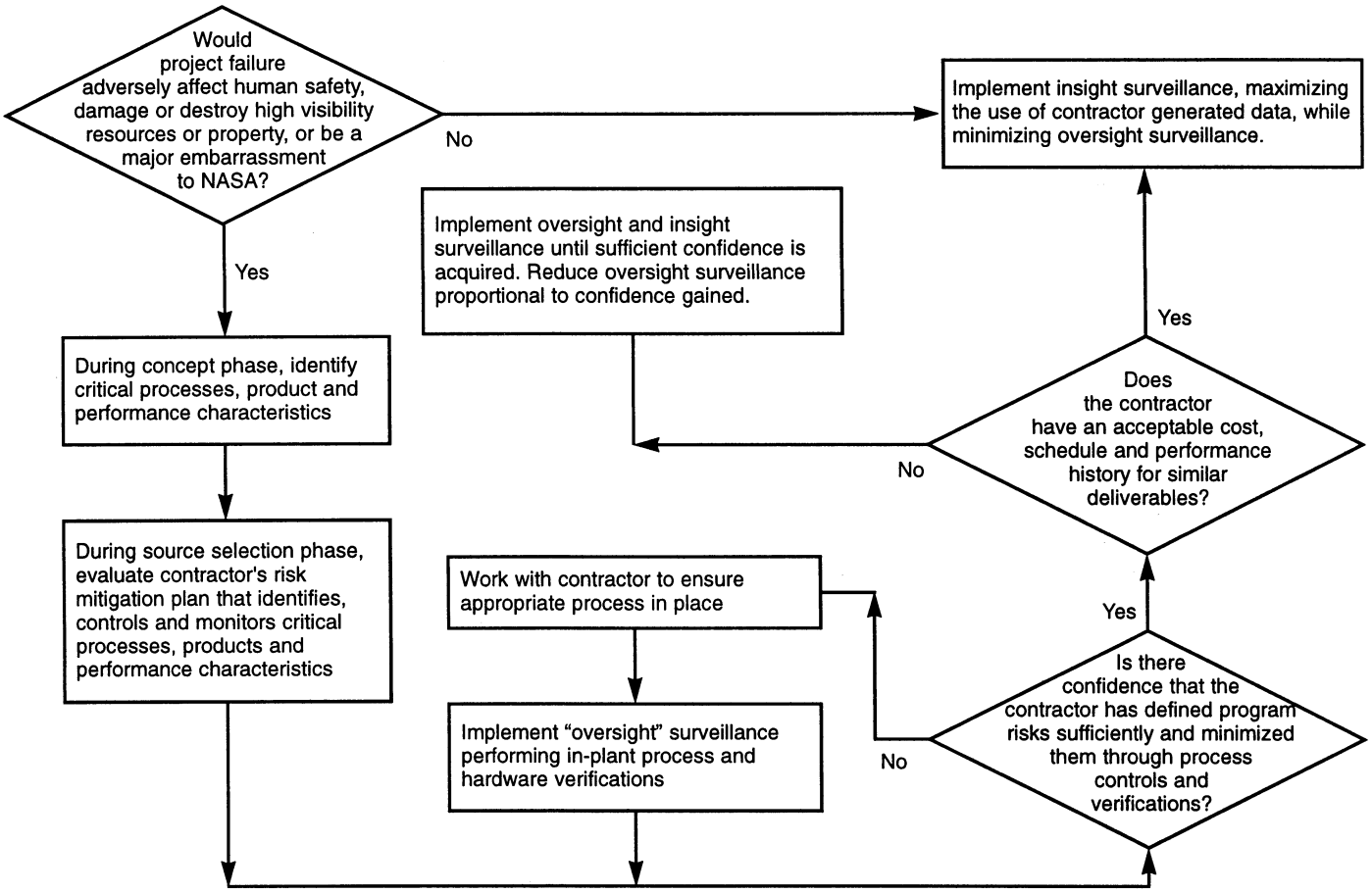

Figure 4. Developing Surveillance Strategy

Market research should determine if NASA's need can be met by a commercial item, one modified, or an item used exclusively for government purposes. If one commercial item or source is found, procurement proceeds in accordance with FAR Part 12, but if none is found, the requirement should be reviewed to see if it can be restated to permit a commercial item. Only Firm Fixed Price (FFP) or FP (EPA) contract types apply to this process.

Streamlined Source Selection procedures became effective in October 1996 (PN 89-88). They establish basic requirements for all procurements over the mid-range threshold (usually $1 million) and additional requirements of the Source Evaluation Board threshold ($50 million).

Standard evaluation factors include mission suitability, cost/price, and relevant experience and past performance. The last factor is adjectivally scored (Figure 5), but firms without relevant experience or past performance can be asked in the RFP to submit a list of references or forward a questionnaire to prior customers.

The goals of this and the other new acquisition initiatives are to meet user needs faster, reduce user time spent on acquisition-related tasks, shorten acquisition-related tasks, shorten acquisition lead time, minimize contract duplication, save resources and improve cooperation with other government agencies. Since these initiatives are processes and not new contract types, they are compatible with most contracts and with other initiatives, depending on the amount needed or requested.

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Adjective	Definition
Excellent 91-100	A comprehensive & thorough proposal of exceptional merit. One or more major strengths. No weaknesses or only minor weaknesses.
Very Good 71-90	Demonstrates overall competence. One or more major strengths and strengths outbalance any weaknesses.
Good 51-70	Reasonably sound response. There may be strengths or weaknesses, or both. As a whole, weaknesses, not off-set by strengths, do not significantly detract from the offeror's response.
Fair 31-50	One or more weaknesses. Weaknesses outbalance strengths. Major weaknesses can probably be improved or minimized.
Poor 0-30	One or more major weaknesses which are expected to be difficult to improve or minimize.

Figure 5. Adjective and Point Equivalents

Full Cost Initiative

Joseph R. Struhar

The purpose of this initiative is to develop and carry out full cost accounting, budgeting and management practices in NASA in order to support cost-effective mission performance through timely, reliable financial information and practices. Full cost management is expected to:

- Motivate project managers to operate efficiently
- Report information consistently, internally and externally
- Justify NASA's budget on a program or project basis
- Support analysis and decision making for management and reimbursement purposes.

In an environment of constrained budgets and increased expectations for oversight and accountability, Joe Struhar, Langley's Chief Financial Officer, notes, full cost practices support compliance with several recent legislative and administrative mandates, such as the 1990 Chief Financial Officers (CFO) Act requiring cost information and reporting, and the 1993 Government Performance & Results Act (GPRA) requiring performance and resources measures (cost metrics). The National Performance Review (NPR) of 1993 also supports full cost accounting

In a nutshell, all costs, including civil service labor, are accounted for and reported in full cost. This includes direct costs, such as contractor-supplied hardware, salaries, benefits and travel; service costs, such as computing, engineering and fabrication; and "general and administrative" costs from the Center, Headquarters and the Enterprise. There are no "free" resources.

This is a new way of doing business for government, although highly competitive corporations have been doing it for years.

THOUSANDS Category	ACTUALS $	FULL COST $
Direct		
Salaries, Overtime, Benefit		10,235
Travel		180
Purchases, Contracts, Grants & Stock	82,837	83,922
Project Support	16,902	N/A
Service Cost Pools		
Fabrication	1,090	735
Engineering	742	289
Facility Operations & Test Support	1,497	2,315
Computer Services		11,536
Instrument Pool/Cal Lab		75
R&D Utilities (Major Research Facilities)		3,343
Imaging Technology		56
General R&D Facility Maint. & Utilities		1,005
General and Administrative		7,972
TOTAL	***103,068***	***121,663***

Figure 6. Lewis Research Center Full Cost Prototype—FY95 Activity
Project: High Speed Research (UPN 537)

Categories	Labor	Benefits	Travel	Pur. & Stock	Other		TOTAL
					ROS	FS41	
Direct Costs							
Service Pools	87,349	16,850	3,430	531,210			638,839
Fabrication	2,430	470	39	3,524			6,463
Engineering	5,555	1,078	70	3,132			9,835
Fac. Ops/Test Sup.	4,510	873	34	10,534			15,951
Computer Services	6,711	1,296	91	25,586			33,684
Inst. Pool/Cal. Lab	101	19	2	2,335			2,457
R&D Utility (Maj. Res. Fac.)				6,897			6,897
Imaging Technology	262	51	3	1,592			1,908
General R&D Fac. Main/Util.	4,437	860	53	24,919			30,269
G&A Costs	21,936	4,361	565	6,456	34,851	11,493	79,662
TOTAL	$133,291	$25,858	$4,287	$616,185	$34,851	$11,493	$825,965

Figure 7. Lewis Research Center Summary by Categories & Elements of Cost FY95 Activity (000)

The Full Cost Initiative was adopted by the NASA Administrator in 1995. In 1996, the NASA Performance Plan included various cost metrics, and full cost accounting and reporting for federal agencies is required by new Federal Accounting Standards. That same year, NASA completed prototype testing on the concept at Headquarters, Goddard, Lewis and Marshall. An Agencywide testing phase runs through 1998, the implementation phase in FY 1999 and by FY 2000: all of NASA will manage, budget and account in a full cost mode.

The key to full cost management is the project manager who maintains full cost visibility. This is consistent with business practice and the NPR's employee empowerment concept. Project managers will be able to control or influence more resources, and budget full costs through projects. Struhar says, "Active project manager input will produce the most useful tool" for managing projects, and with a strengthened project tie to budget requests, the NASA budget should become more credible and defendable.

The downside of full cost accounting is complexity, requiring more staff expertise. It is not easy to determine service cost pool amounts much less the general and administrative costs of a project. The project manager has little control of those "overhead" costs. There is also potential risk to the technical base, the so-called "lightening rod" effect, due to full cost budgeting.

Nevertheless, the full cost concept continues to evolve. The 1996 prototype efforts at Headquarters and three Centers indicate that NASA incurred about $5.8 billion in direct costs and about $600 million each in service costs and G&A costs for a total of $7.0 billion.

Before the full cost concept becomes operative in FY 2000, NASA plans a full year implementation phase to test the system and train the staff.

Full costing ties all costs to projects, the heart of NASA, supporting full disclosure and accountability for the very first time.

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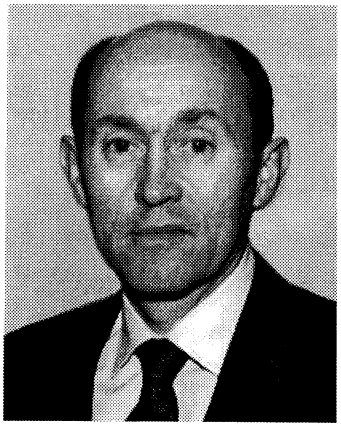
PM Career Development

Owen C. Gadeken



"In this era of constant change," says Owen Gadeken, "you must make the commitment to continuous improvement and development of your job-related skills. You should not only take advantage of opportunities offered by NASA, but should actively seek outside and even nontraditional professional development opportunities."

The goal of his presentation on strategies and resources for project management career development was for each participant to take "personal ownership" of one's career development and "commit to acquire the skills you need for the future."

He began with a study of "changing times," noting there has been more change in the global economy in the past two or three years than in the previous 25 years. Government continues to reinvent itself with new paradigms such as new ways of doing business. Instead of a linear career path from the bottom to top, in one organization, many are seeking "portable careers" based upon developing skill requirements and following fast-breaking career opportunities.

The project management career, Gadeken says, is a balance of expertise: technical, managerial and, for the best PMs, leadership. Today there are two parts to the PM job: tasks (what the job consists of) and competencies (what it takes to do the job in an outstanding way). "A systematic approach to development should concentrate on both," he notes. "The more complex the job, the more important the competencies."

In a nationwide survey of 27 core competencies, project managers favored people skills over technical knowledge. Functional managers ranked "technical expertise" first, but PMs ranked it 21st. First on the list for PMs was "a sense of ownership/mission" that functional ranked 17. The other wide discrepancy was "political awareness" which PMs ranked 4, and functional managers ranked 21.

In addressing PM competencies, Gadeken suggests critical incident interviews (with a focus on competencies demonstrated on previous jobs), on-the-job feedback, 360-degree feedback instruments, and training and development exercises such as case studies and computer simulations. Career resources include libraries, training institutes (such as the Albert Einstein Institute on Cape Cod), one's own Agency training opportunities, academia, consultants and vendors, and especially professional associations. He noted that the top ten percent of leaders read a book a month while the top one percent read a book a week.

Gadeken mentioned three professional associations for project managers. The Project Management Institute (PMI) offers certification, publications, conferences and networking. The International Project Management Association (IPMA) is a network of 26 national associations with a world congress set for June 1998 in Ljubjana, Slovenia. Project World usually offers a June conference in Washington, D.C., and a December conference in Santa Clara, California. PMI's Project Management Body of Knowledge (PMBOK) covers nine knowledge areas: time, cost, quality, scope, human resources, procurement, communication, risk and, most recently added, integration.

However, most new learning for career development takes place on the job. According to a Center for Creative Leadership study of 191 executives (616

Competencies	RANK ORDER OF IMPORTANCE Program Managers (N = 128)	Other Acq. Professionals (N = 225)
Sense of Ownership/Mission	1	17
Long-Term Perspective	2	6
Managerial Orientation	3	2
Political Awareness	4	21
Optimizing	5	5
Results Orientation	6	8
Systematic Thinking	7	3
Innovativeness/Initiative	8	11
Focus on Excellence	9	9
Action Orientation	10	10
Relationship Development	10	14
Coaches Others	12	12
Proactive Information Gathering	13	15
Strategic Influence	14	23
Creativitiy	15	3
Self Control	15	13
Interpersonal Assessment	17	18
Collaborative Influence	18	16
Critical Inquiry	18	24
Positive expectations	20	24
Technical Expertise	21	1
Interpersonal Sensitivity	22	22
Attention to Detail	22	7
Assertiveness	24	20
Efficiency Orientation	25	18
Directive Influence	26	26
Competitiveness	27	27

Figure 8. Survey Validation of PM Competencies

events and 1,547 lessons), nearly half of the lessons learned came from Challenging Assignments (48%), especially in the fix-it phase. Three other areas were split just about evenly (17-18% each). Significant others such as mentors or role models was one category. Hardships was another, especially business failures or mistakes, missed job opportunities, subordinate performance problems and career change. The third area for optimal career development, according to this one survey, included Other Events such as training, early work experience and purely personal experiences.

Dr. Gadeken concluded that leadership skills, not management, are the key to a competitive edge in the challenging project management workplace of the future.

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PM Project Database

Bernard Dixon and Gene Guerny

The GSFC Resource Encyclopedia was recently developed by the Resource Analysis Office in order to capture the history of people, projects and science at NASA's Goddard Space Flight Center. Bernard Dixon and Gene Guerny showed PMSEP delegates the structure and organization of the new encyclopedia and unveiled a new PPMI Lessons Learned CD-ROM, first in a series.

Under "GSFC Projects" the Resource Encyclopedia takes you through each Goddard project, past and present, with a list of instruments, charts and reports. Most projects contain an overview and four summaries: resource, technical, schedule and cumulative schedule which includes milestones by percentage of months, staff and cost.

"Organization" displays the GSFC organizational chart by code, and each code lists staff and mission. Individual information is extracted from the "People" window: name, address and perhaps a photo and short work history.

"Science" presents a list of instrument families, orbital mechanics, the President's Quality Award application and the GSFC Strategic Plan. Each instrument contains a technical description. "Data and Information" contains a top level description of facility manpower, funds, projects, people and organizations. More detailed data is presented under each category. "Timeline" presents a graphic representation of projects imposed on top of a timeline defined by decade. Projects can be sorted alphabetically or chronologically, and selection of a project pulls up all the information behind the "GSFC Projects" window.

"MAP" is a graphical representation of GSFC buildings and a locator for codes, projects and civil servants. The "Gallery" window is populated with pictures, still and motion, on GSFC projects, people, science, the future of the organization and Lessons Learned CD-ROMs.

The "Instruments" window displays the Resource Analysis Office parametric and raw data with the type of instrument measurement with costs, weight and statistical information. "RAO Products" starts with a list of material developed by the Resource Analysis Office such as parametric cost estimating models and a presentation of selected materials.

"Tour" provides an audio explanation of each window and a description of the data available in each window. The audio tour can be turned on and off. "Configuration" allows an individual to configure the computer to access various material along a CD-ROM path or a hard drive path.

The first in a series of interactive CD-ROMs on lessons learned was unveiled at the Project Management Shared Experiences Program in Virginia Beach. The first disk features the Compton Gamma Ray Observatory, the heaviest (17 tons) astrophysical payload flown, launched April 5, 1991. Subsequent PPMI CD-ROMs will cover COBE, UARS, IUE, GOES (849), ICE/ISEE, Orbital Mechanics, Hubble Space Telescope, Next Generation Telescope, Jerry Madden's 101 Lessons Learned in Project Management and Dr. Noel Hinners' presentation to PMSEP.

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NASA Fast Track Studies

Gregory Stover

During the Advanced Project Management 23 course at the Wallops Island Management Education Center from April 28 to May 8, 1996, a core group provided input for the revised NPD 7120.4 that replaces NMI 7120.4, and the NASA Program/Project Management Guide, concerning Fast Track Projects. (These are defined as small projects under $150 million and completed within three years.)

Eleven members of PPMI APM-23 interviewed 14 experts and conducted four data gathering efforts. Sixteen other interviews were conducted and a final report, NASA APM-23 Special Study Group *Fast Track Study*, dated November 1996, has been published by the NASA Program/Project Management Initiative.

Greg Stover of LARC noted that the project life cycle template (guidelines) for large projects is currently too big to apply to small projects. Furthermore, current project guidelines do not fit with the "faster, better, cheaper" Agency direction. A more flexible structure that allows for innovative approaches in project management is needed for Fast Track projects.

Key points from the interviews clustered around three issues: Planning, Teamwork and Management. These were the common threads in the execution of Fast Track Projects.

"Planning is the key to successful management of a Fast Track Project, which is constrained by cost and

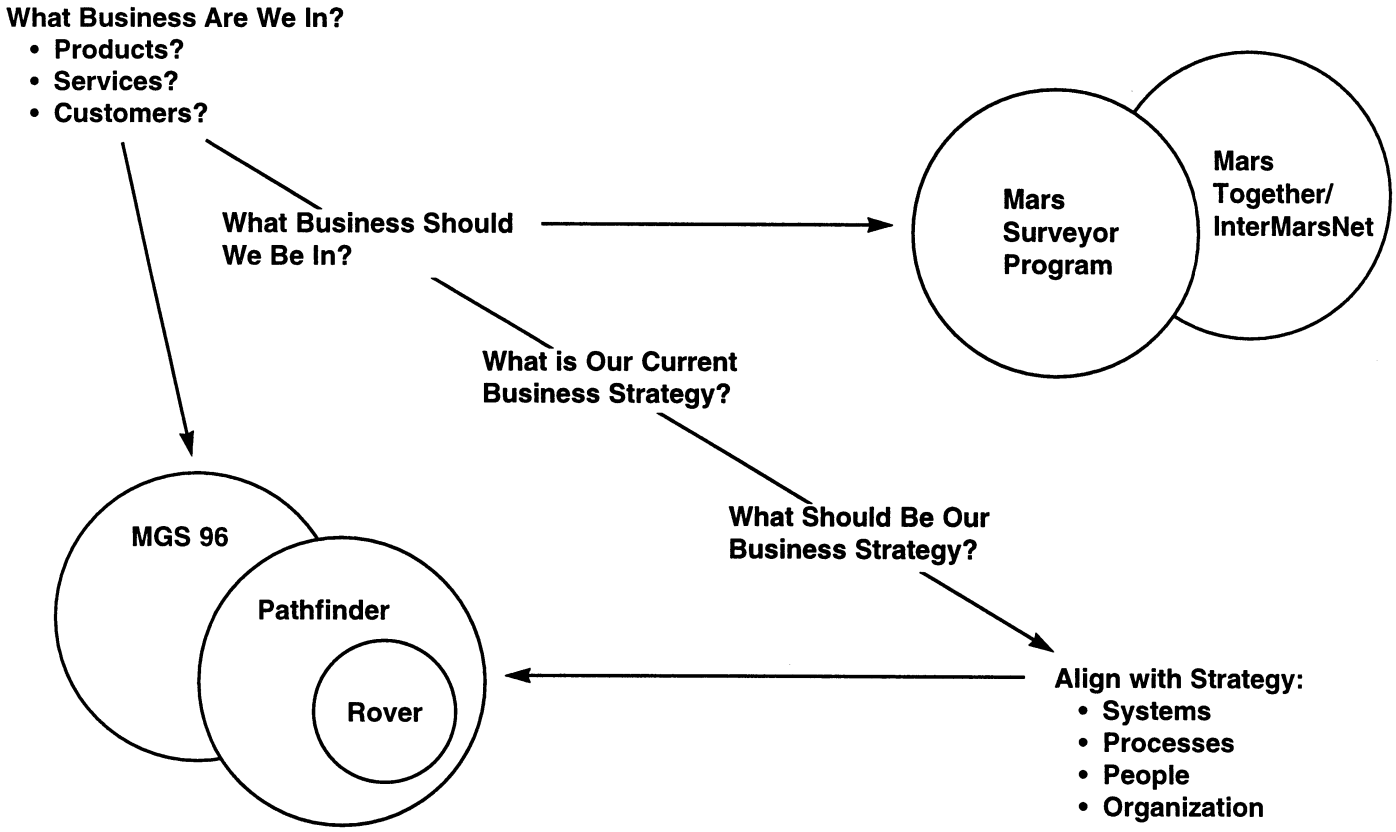

Figure 9. Mars Exploration Program Strategic "Business" Planning Process

contact as well as a compilation of lessons learned on previous Fast Track projects. The NASA APM-23 *Fast Track Study* is a start in that direction.

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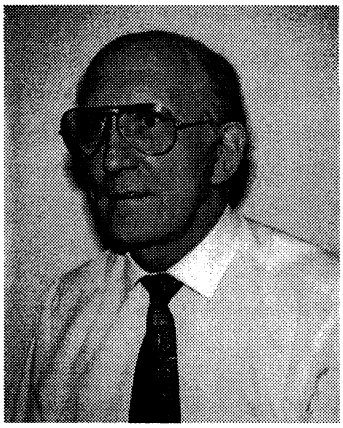
Fast Track Projects

Ray Piper



Over the years, fast track projects have been the result of early project delays due to late funding or problems on the front end. In order to rescue the project from impending disaster, the project manager would apply crisis management and produce havoc for a while. The project would either suffer disaster or be yanked back onto schedule somehow.

There is a better way, says Ray Piper of Union Carbide. He showed PMSEP participants some of the proven, successful techniques to organize and manage a fast track project. "In the highly competitive environment in which we all work, these techniques can be applied to projects such that they can be started later or completed earlier than current practice," he said. "This is not a panacea for troubled projects but a tool which can be applied in the strategic planning stage of projects which need to be compressed due to the derailment of project cost."

Piper begins by asking: "What is the 'Optimum Project Schedule'?" The answer: the ideal schedule or project cycle time for which the project can be installed at the lowest Total Installed Cost (TIC). "Any deviation from the Optimum Schedule adds to the Total Installed Cost of a project," he notes. See Figure 11, Cost of Compressing a Schedule.

"Fastrack Projects" at Union Carbide may start later because more time is needed to define and reduce scope, or to allow for developing technology. More time may be needed to study alternative locations, or because of cyclic market requirements and product priorities. Cash flows that are postponed can allow earlier funding of some commercial products.

Fastrack Projects need to finish early for a variety of reasons. Usually the company wants to be first for market advantage, such as a new product or if the product has a high return or investment (ROI). At times the project faces a regulatory deadline, an environmental issue, product interruption or a plant shutdown. Spending earlier rather than later can improve the net present value and reduce project cycle time.

Optimum Project Schedule and Fastrack Projects call for different options. In contracting, the optimum schedule commonly calls for fixed price, reimbursable with incentive and target price with incentive (for engineering), but Fastracks options include reimbursable with incentive (for engineering and construction), target price with incentive for both, and a unit rate contract for construction. In engineering, the Optimum Schedule may start with "frozen" scope packages, but Fastracks may start at less than 100% scope package, issue piecemeal drawings, increase the work schedule and double-shift the engineering. For equipment purchases, the Optimum Schedule calls for in-house or vendor design based on cost effectiveness, but Fastracks require in-house or vendor design based on schedule, often a single source for critical items, in-shop vendor drawing

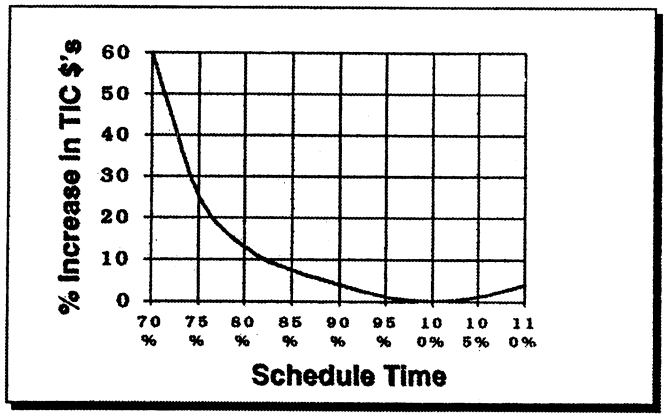


Figure 11. Cost of Compressing a Schedule

reviews, stock equipment and double-shift stock work. Materials purchases on an optimum schedule may call for master price agreements (no bids) or an integrated supplier concept, but Fastracks use standardized and in stock materials, pay for shop time and vendor engineering overtime, use early material requisitions and unchecked drawings, use multiple fabricators and site fabrication, reduce purchase order time and either eliminate or reduce authorization for POs. Finally, in construction, on optimum schedule may start with 50% detailed engineering complete, spot overtime and a density factor of 1.0. Fastrack options include a start with less than 30% detailed engineering complete, scheduled overtime and double shifts, and a density factor above 1.0.

The key to success of Fastracks is customer-driven project scheduling. The owner clearly specifies critical elements and is willing to pay for the fast tracking. With management commitment and full support for shared risk, the project manager assembles a dedicated task force in a single location and standardizes designs to the greatest extent possible. Money must be available and no funding delays. Without studies to define "a better way," Fastracks require a single alternative with risks. Keep in mind that the work process will vary with the amount of risk an owner is willing to take, and with the investment premium the owner is willing to pay. Techniques frequently used to compress schedules have been effective for both Union Carbide and others, but there is no rigorous proof of the definition of "optimum project schedule." The project team, steering committee and project owners continue to evaluate benefits carefully.

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The Earned Value Concept

Wayne F. Abba

Earned Value is not a new concept, yet it is a significant part of the federal acquisition reform initiatives being implemented throughout government. Once viewed by many as a mere financial reporting requirement, Earned Value has come into its own as the only reliable tool for integrating cost, schedule and technical performance management on complex programs.

Wayne Abba, a senior program analyst in the Office of the Undersecretary of Defense for Acquisition and Technology, defines Earned Value as a management tool that relates resource planning to schedule and technical performance requirements. All work on a project is planned, budgeted and scheduled in time-phased "planned value" increments, constituting a baseline for performance measurement. As work is performed, it is "earned" as it was planned, in dollars or other quantifiable units such as hours of work. The earned value should match the planned value. Any difference between the two is called a "schedule" or "accomplishment" variance. Thus, Earned Value is an objective measurement of completed work compared to planned and actual values for the same work.

The Earned Value concept emerged in the 1960s but did not have the computer hardware and software support to make it work effectively. Today it is endorsed by the Department of Defense and the Project Management Institute, and it is among the "best practices" of Boeing, Lockheed, Motorola and Delco. The ANSI considers it an industry "standard."

Earned Value starts with the control account: plan, budget, schedule and corrective action. The Budgeted Cost for Work Scheduled (BCWS) is compared to the Budgeted Cost for Work Performed (BCWP) and the Actual Cost of Work Performed (ACWP.) Any difference between BCWP and BCWS provides a schedule variance, and any difference between BCWP and ACWP provides a cost variance. From those two figures you can project the cost performance and estimate-at-completion.

Another way of picturing this is with questions. What's the plan? (Budget or Target Cost) What should be done by now? (BCWS) What is done so far? (BCWP) What did it cost to do it? (ACWP) What is the schedule variance? (BCWP minus BCWS) What is the cost variance? (BCWP minus ACWP) What is the Cost Performance Index (CPI)? (BCWP divided by ACWP) What is the estimate at completion? Estimates at cost of completion can be calculated or evaluated using the performance indices.

Abba says that although the "Earned Value Management Systems" (EVMS) replaced the previous cost/schedule control criteria at DOD in December 1996, Earned Value is not a "system." Rather, it is a comprehensive planning process that

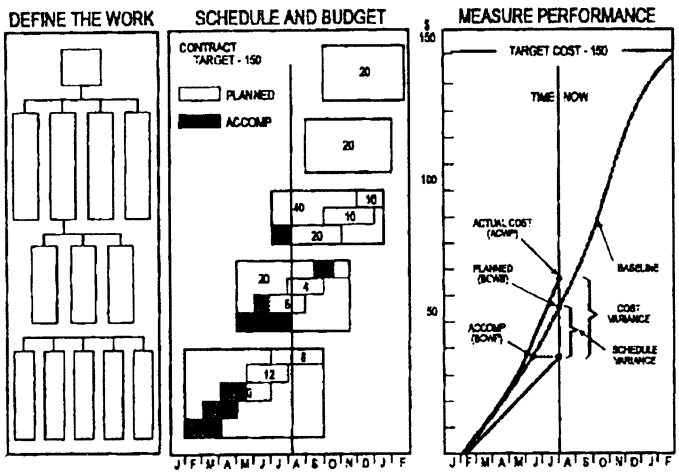

Figure 12. The Earned Value Concept Summary

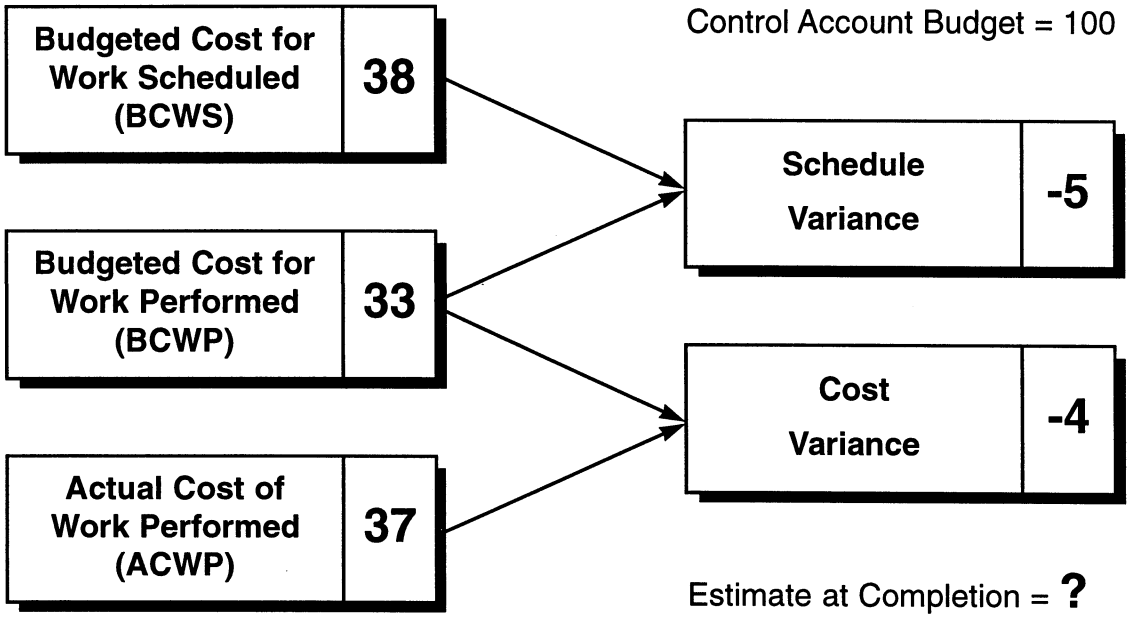

Figure 13. What did it cost to do it?
Actual Cost of Work Performed

covers the entire SOW, schedules activities and allocates resources. It is not a reporting system, contract administration, cost analysis or accounting system but rather blends with the contractor's own management system. Soon after contract award, program managers are now expected to perform an Integrated Baseline Review to assure that the contract performance measurement baselines capture the entire technical scope of work consistent with schedule requirements, and that adequate resources have been assigned. Such a review, supported by Earned Value experts, should improve the cost, schedule and technical performance management and reduce the number of reviews.

In 1995, the United States signed a Memorandum of Understanding with Canada and Australia to advocate "improved project management in both government and industry, based on effective risk assessment and integrated management of cost, schedule and technical performance objective, using earned value as the integrating tool." Since then, the United Kingdom, Sweden and New Zealand have expressed similar interest.

For more information on Earned Value, point your Web browser to < www.acq.osd.mil/pm >.

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Value-Added Metrics

Gilbert L. Roth

The terms "metric" and "metrics" have been used, abused and misused for many years in project management. Over the past three years, Gil Roth has conducted in-house workshops on metrics at Headquarters and NASA Centers. Currently the National Security Industrial Association and the Aerospace Industries Association are preparing a document to show how suppliers use a set of critical metrics to measure, control and improve their products and services in terms of adding value to performance, cost and schedule.

A metric is a quantitative measurement of an activity, results and/or reaction. Under activity, a meeting schedule is a typical example: Did we do what we planned to do when we planned to do it? Under results, after we met schedule, did we deliver a good product? Test and inspection should measure those results. Under reaction, attempts are made to recover to schedule status or improve receiving inspection results: What, if anything, should we do, based on activity and/or results?

Roth's next question: How do we measure value added? Mainly through effectiveness and efficiency. If work does the right things on time (effectiveness) with the right resources (efficiency) in the right way (quality), the organization will experience high or increasing productivity and the product or process will experience added value in performance, cost and schedule. Key questions for effectiveness include knowing your customers and their requirements: How do I measure and improve my performance against these requirements? Key considerations for efficiency include focusing on processes and finding ways to make better use of our resources by reducing or eliminating duplication, delay, unneeded complexity and unnecessary work.

A "good" metric adds value to the process or activity but it is also easy to comprehend by peers. It stands by itself and does not require clarification. The numerics can be easily substantiated, the table or chart fits the story being told, and the headings state a clearly understood numeric. (See Figure 14, Basic Tools.) It presents sufficient information to allow a timely and reasonably well-founded decision by providing a clear picture of strengths and weaknesses, an early warning for rate of approach (ROA) and some indication when corrective decisions can be made.

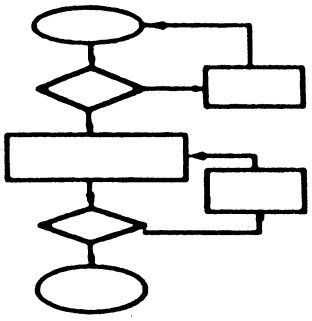
A "bad" metric requires excessive manipulation of input data (including mathematical solutions) and makes it difficult to obtain data or information in a timely manner. So, why measure in the first place? "Measurement enables us to evaluate our progress objectively, with facts, rather that subjectively," Roth says. "We recognize that it is sometimes difficult to avoid 'subjectivity' in measurement. The goal is to drive toward specific quality elements that can be quantified and expressed numerically."

Metrics also establish a baseline and enable us to determine progress or slippage towards goals. They should be able to tell us if we are satisfying customer requirements and if processes are working or not.

In sum, measurement is established for customer requirement and use of resources. Selected metrics should contribute to cost containment but there are some don'ts to consider:

- Don't have too many.
- Don't make them more complicated than they need to be.
- Don't lose sight of the goal.

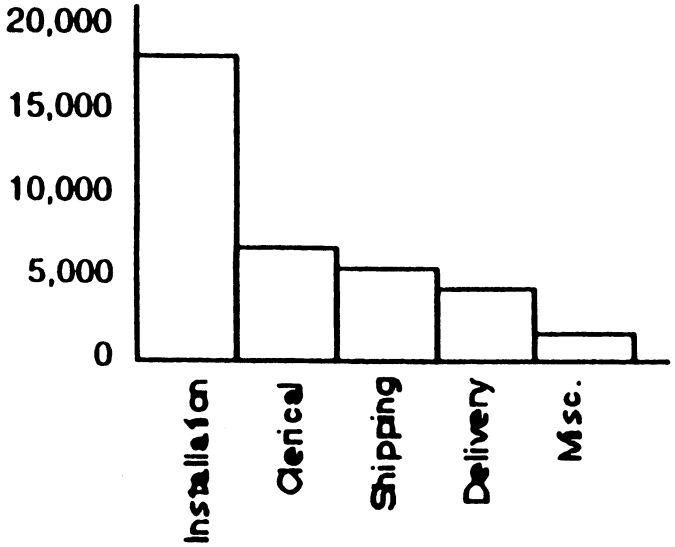
Metrics become increasingly significant in NASA's changing environment from a growing budget to a



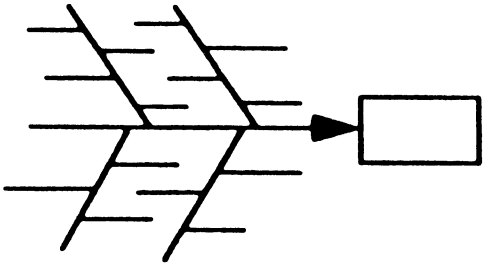
Process Flow Charting

Defect	May				Total
	6	7	8	9	
Wrong Size	III	II	IIII	III	12
Wrong Shape	IIII	IIII	III	III	14
Wrong Color	II	IIII	IIII	II	12
Total	9	10	11	8	38

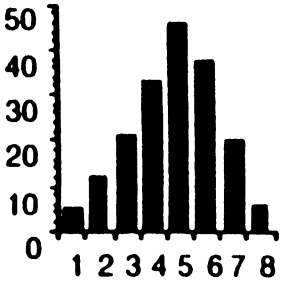
Check Sheet



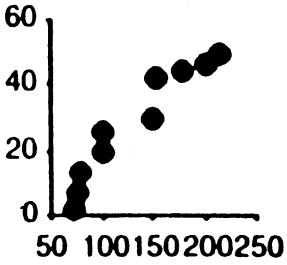
Pareto Diagram



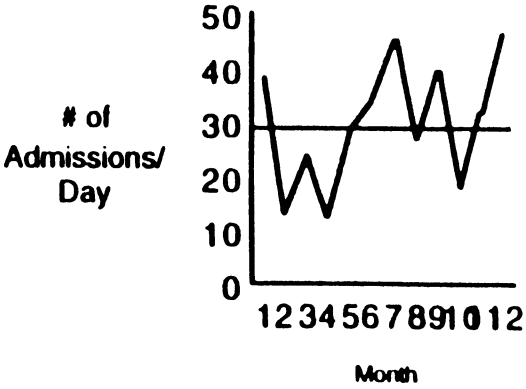
Cause and Effect Diagram



Histogram



Scatter Diagram



Run Chart

Figure 14. Basic Tools

fixed one, large programs to smaller projects, proven to new technology, politically to economic driven and from low risk to an acceptance of more risk.

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Global Work

Mary O'Hara-Devereaux

The Institute for the Future is a spinoff from the Rand Corporation of about 30 years ago, and Mary O'Hara-Devereaux is co-author of *Global Work: Bridging Distance, Culture & Time* (Jossey-Bass, 1994). She spoke on the "shifts, shadows and guideposts" to 10 years out, and their implications for project management in the next millennium. She organized her presentation under six topics.

1. Global Context. Over the next few years we expect to see the rise of the third-world economies, especially in Asia. Thus, expect more multinational firms, joint ventures and alliances. International agreements will be more common on projects.

2. Organizational Shifts. In contrast to oldline American organizations, today's company is only half focused on core business; 38% of company functions are contracted out and another 12% are working in space, not in place. Is the new fishnet organization flexible or fragmented?

3. Transformation of Work: Expect to work more, not less, than 40 hours per week in this highly charged competitive economy. Unions or brokers will bundle workers who are loyal to jobs, not employers.

4. Cultural Challenge. Instead of command and control, expect more teamwork, more diversity

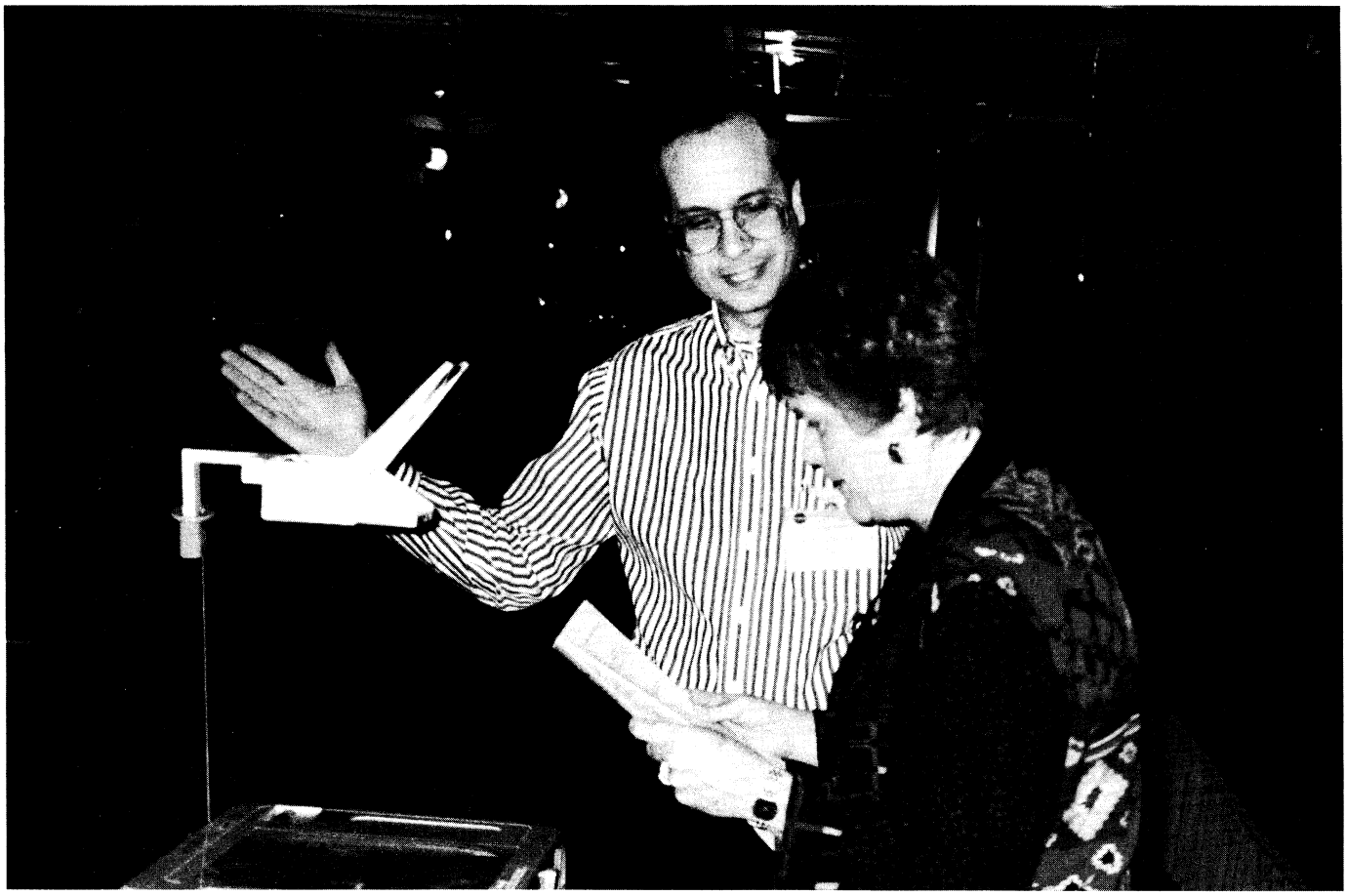

Figure 15. Dr. Edward J. Hoffman and Mary O'Hara-Devereaux at the PMSEP

in the workplace, more "process facilitation" and more emphasis on information management in a cross-cultural environment.

5. Teams and Technology Challenges. Managing people in global teams will involve a process that begins with orientation and trust building to goal/role selection and commitment to high performance and renewal.

6. Guiding Principles. The new project manager will have to learn how to communicate more effectively, use cultural guides, build trust, beware the absence of context, redesign the work processes, manage with milestones, be creative with technology, be fluent with cross-cultures and create "third way" strategies (blend, cobble).

In her book, O'Hara-Devereaux describes four new competencies of the global manager. First and foremost is a multicultural perspective, transcending the barriers of language and behavior. Technical competence will still be important, but teams will have to be managed with "groupware," software for groups in a computer-mediated society.

A third core competency for tomorrow's project manager will be process facilitation, easing the sometimes painful but always complex processes by which teams and organizations set out to do their work. Finally, team leadership skills will become increasingly important to accomplish time driven, task-oriented, cross-functional jobs. Top-down companies and isolated individuals working on common goals cannot handle these jobs as well as a real project team.

O'Hara-Devereaux ended with an observation that the happiest people she has encountered recently in the course of her research have been "RIFed." The saddest were those who were left behind in a downsized organization.

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InsideOut Coaching

George Knight

George Knight served as a human resources director for Hercules Aerospace Company and was a research assistant to Steven R. Covey, an internal training consultant to Franklin Quest Corporation and project manager for the American Quality Foundation's "Stuff Americans Are Made Of" quality and innovation initiative.

InsideOut is one response to staff reductions, increased competition, work redesign, changing skill requirements, the loss of familiar ways of doing things, loss of power or authority, and "never enough time." Coaching is needed to eliminate fear due to low trust, low morale, uncertainty, resistance to change, a sense of powerlessness and an unhealthy focus on self rather than the work at hand. Sports is a good analogy for this syndrome because it simplifies the complex—no excuses.

When pressure mounts, we have three responses: fight, flight or what Knight calls "hyperperformance." The first two put blame on others, but the third response is fun (exhilarating, actually), fast (quick) and focused. Most of us can recall a hyperperformance experience in sports, school, business or family. Wouldn't it be great if we could operate in this mode more often?

Czikszentmihali calls it "flow," that marvelous state of mind between anxiety and depression, worry and boredom, a state of peak performance. InsideOut Coaching "takes valued people from where they are to where they want to go" by getting them to G.R.O.W.

G.R.O.W. Stands for Goal, Reality, Options and Way. The coach encourages the project member to focus on a S.M.A.R.T. (Specific, Measurable, Agreed to, Reality-based and Time-phased) goal. If the goal is complex, the coach will "chunk" it down into manageable and achievable objectives.

Reality sets in when the team member tries to explain why earlier attempts failed and what the obstacles were. Is the goal still realistic? Smart?

If so, you can explore your Options. There are usually more than you realize at first. A good coach can help you brainstorm them. Finally, coach and player select an Option and develop a plan of action within a realistic time frame. In other words, the Way forward should also be S.M.A.R.T.

Then it's a matter of practice. Like any good coach, the InsideOut coach tries to get the personal best from the player for breakthrough hyperperformance.

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Team-Based Problem Solving

Tom Logsdon

"Beyond Brainstorming: Enhancing Your Productivity by Learning to Formulate Simple, Creative Solutions" is the expanded version of Tom Logsdon's presentation to the PMSEP. An aerospace engineer retired from Rockwell, Logsdon has just finished his 28th book, *Understanding Orbital Mechanics*, for John Wiley & Sons.

Logsdon offered two ways of solving a problem, sprinkled with examples from his own experience and those of innovative organizations. His theory is that teams can learn to be more creative through shared workshop experiences.

Break the problem apart and put it back together again. "Simple, well-formulated problems lead to practical, creative solutions," Logsdon says. He suggests ordinary language, and pointed questions. For example, "Our company was once a fun place to work. But with the recent cutbacks, the morale has plummeted. How can we make Widgets International a fun place to work again?" He suggests a brain-

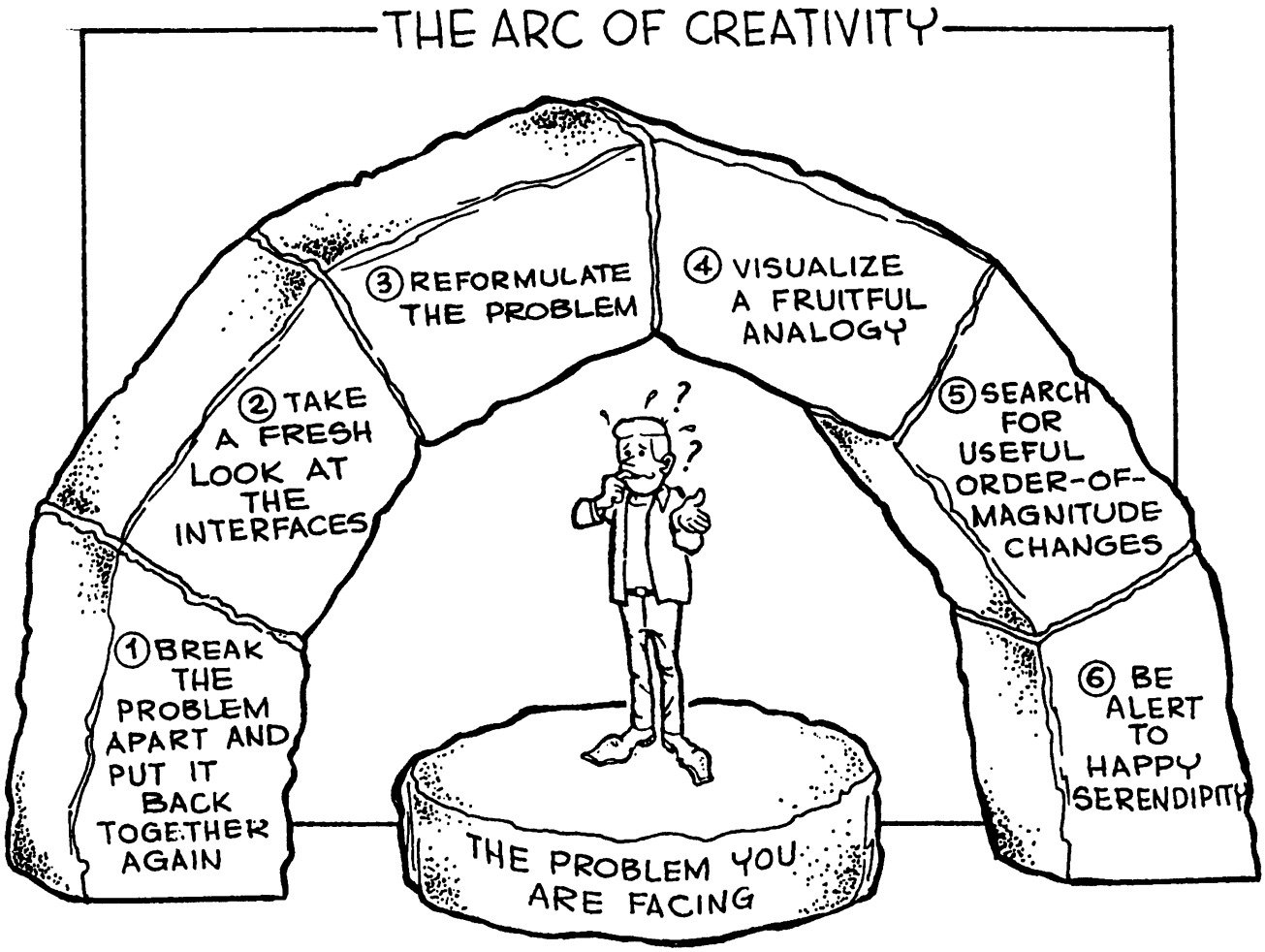

Figure 16. The Arc of Creativity

storming technique known as "Mind Mapping" with balloon diagrams, where one idea leads to another and clusters are formed around major components of the problem. Leave room at the bottom of the page to list solutions or action items that occur to you as you expand your mind mapping.

Take a fresh look at the interfaces. An interface emerges when two dissimilar things come together. They often appear in the mind mapping balloons. Logsdon suggests using the bottom of the page again for making notes on how you might solve the problem by moving, modifying or deleting one or more of the interfaces in the balloon diagram, or employing an interface for a useful purpose. For example, Gillette moved the interface between blade and handle of the old straight razor and came up with the safety razor with disposable blades. Bic came along later and deleted the interface, rejoining blade and handle once again, making the whole thing disposable. The Denver Boot modified the interface between scofflaw and police by eliminating the impound lot. And Henry Ford used an interface for a useful purpose by specifying the exact size of boards used in crates by suppliers. He even asked them to drill holes at precise distances along the boards so they could be taken apart and installed as floorboards in his Model T, a car even his workers could thus afford.

Logsdon has several techniques he explains in longer sessions. You can reformulate the problem, for example. After mind mapping and interface analysis, the problem can clarify itself and become easier to solve. You can also "visualize a fruitful analogy" like Eli Whitney did with the cotton gin after he saw a kitten sticking its paw through a picket fence. Or, you could "search for useful order-of-magnitude changes" such as graphical techniques in a cookbook, replacing the drawn out directions with pictographs. Finally, he suggests, "Be alert to happy serendipity." Ben Franklin may have proposed daylight savings time as a way for Paris shopkeepers to save candles, but the idea did not catch on until the turn of this century when people realized that family outdoor activities and sporting events could fill a summer evening quite happily.

More detail on these and other brainstorming techniques and problem-solving strategies can be found in Tom Logsdon's popular book, *Breaking Through* (Addison-Wesley, 1993). A new mass-market edition is in production, to be issued as *The Midas Touch: Polishing Your Simple, Creative Solutions So Everything You Touched Turns to Pure Gold.*

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Capability Maturity Model

George Albright

The Capability Maturity Model (CMM) is a precise, verifiable representation of an organization or project that is highly effective in producing software. The CMM is an ongoing project of the Software Engineering Institute (SEI) a federally funded research and development center at Carnegie Mellon University.

Like ISO 9000, Certified CMM conformance is often cited as a contractual requirement and is becoming widely recognized and accepted as a standard of excellence. However, achieving a maturity level takes time, organizational commitment, sustained effort, budget and culture building.

George Albright, the Headquarters program executive for Hubble Space Telescope flight science operations and on-orbit servicing since 1993, brings his 30 years of experience at Grumman to explain CMM to the NASA community. "Software technology has outpaced NASA's management capability for software," he notes. "Many program and project managers lack the technical background for exercising an equivalent degree of management insight on software as they do in hardware."

Nevertheless, with CMM, software professionals can develop and improve their ability to identify, adopt and use sound management and technical practices

Level 5 "OPTIMIZING"	• Defect Prevention • Technology Change Management • Process Change Management	Organization executes continuous and measurable software process improvement.	<1%
Level 4 "MANAGED"	• Quantitative Process Management • Software Quality Management	Organization has a quantitative understanding of both the software process and the software products being built.	<1%
Level 3 "DEFINED"	• Organization Process Focus • Organization Process Definition • Training Program • Integrated Software Management • Software Product Engineering • Intergroup Coordination • Peer Reviews	Organization establishes an infrastructure that institutionalizes effective S/W engineering and management processes across all projects.	~ 3%
Level 2 "REPEATABLE"	• Requirements Management • Software Project Planning • Software Project Tracking and Oversight • Software Subcontract Management • Software Quality Assurance • Software Configuration Management	Organization has tools by which individual projects can establish basic project management controls.	~ 6%
Level 1 "INITIAL"	**No Key Practices Defined**	Random successes achieved via heroics in an environment of chaos.	~ 90%

Figure 17. The Key Process Areas

for delivering quality software that will meet requirements on schedule and within budget. Through CMM, an organization can determine the maturity or richness of their software and identify the most critical issues for improving software quality and process.

Basically, there are five maturity levels in the CMM. (See Figure 17, Key Process Areas.) Level 1 is the "Initial" or immature organization where projects operate in varying degrees of chaos. Here, there is low confidence in the organization's ability to repeat a successful project. It may take two years for such a group to achieve Level 2.

The second CMM level is "Repeatable" because individual projects can establish basic management controls in the planning, tracking and oversight of software. Moving on to Level 3, "Defined," may take a year or two as the infrastructure is built to institutionalize effective software engineering and management processes across all projects. Training activities are also provided to develop skills and knowledge needed to perform software management.

About a year later, Level 4, "Managed," can be achieved when an organization has a quantitative grasp of software products and processes. The project's software activities are planned and controlled quantitatively, and measurable goals for quality are defined.

Level 5, "Optimizing," is quite difficult to achieve, and not enough data is available to predict how long it would take to arrive from Level 4. Nevertheless, Level 5 is characterized by continuous software process improvement. Common causes of defects are prioritized and systematically eliminated. New technologies are transformed into normal practice across the organization.

For more information, Albright recommends *The Capability Maturity Model, Guidelines For Improving the Software Process* by the Software Engineering Institute, published by Addison Wesley. He also suggests that the Enterprise Offices encourages Software Capability Evaluation (SCE) certification from SEI, and that the Office of Safety and Mission Assurance establish formal NASA requirements for software training and certification, along the lines of that already offered for ISO 9000. Finally he suggests that PPMI expand offerings in Systems Engineering and Software Acquisition Management to include formal SCE and CMM certification courses.

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Program Development

David Pugh

Veteran business consultant and trainer David Pugh created the Program Development Course and the materials for Federally Funded Research and Development Centers such as the Jet Population Laboratory. He defines Program Development as a "philosophy and a set of skills" to help "define your role, focus your activities, discover legally and ethically permissible opportunities for serving sponsors, determine your sponsors' needs, and inform current and prospective sponsors of your unique capabilities." Properly done, the PD process should "inform industry, the citizenry and federal agencies of your organization's mission, strengths and unique capabilities." It should furthermore "establish alliances and partnerships with industry, other FFRDCs, not-for-profits and universities to serve the needs of the nation."

The PD process begins with strategic planning, knowing what program to develop. At the core of this effort is the SWOT analysis of Strengths, Weaknesses, Opportunities and Threats to you, competitors and sponsor. The resulting strategic program plan consists of vision and mission statements, assumptions and analysis, realistic strategic objectives and an implementable plan.

Sponsor Identification and Analysis follow, identifying potential sponsors and understanding their needs. People involved usually play one of six roles: decision maker, advisor, user, administrator, champion or external such as lawyer, banker or consultant.

Strategic Positioning follows, keeping potential sponsors informed of your unique, special capabilities. These information modes are designed to reach the three types of learners. Visual people prefer brochures, videos, white papers and line presentations. Auditory learners may prefer briefings, panels, telephone and meetings. Kinesthetic people may prefer prototypes, hands on demonstrations, site visits and interactive media.

Opportunity Assessment, determining what opportunities to pursue, comes next. David Pugh suggests a meeting with the sponsor, spending 40% of your time asking questions about the sponsor's needs, requirements and expectations; 50% of your time listening (an acquired behavior); and 10% informing them of your capabilities and solutions.

Capture Planning results chiefly in writing a proposal that can consist of an executive summary, introduction, technical background, objective, scope of work, schedule, management and personnel, reporting and deliverables, financial requirements, disposition of property, ES&H issues, classification and security, and technical references. The all important executive summary should consist of one third text, one third graphics and one third white space.

Finally, the Ongoing Relationship Management phase leads to a mutually satisfying long term relationship, "creating sponsor delight" without driving up costs. Know your sponsor's business. Help the sponsor respond to opportunities and threats. Provide value engineering and make value-added tangible. Identify what's wrong, not who's wrong. "Everything should be made as simple as possible but not simpler," he notes.

"The Value of Excellence" is also important to Pugh. Since people do not buy products or services per se, they buy hopes, expectations, relationships. Therefore, he suggests five basic approaches to Program Development:

1. Differentiation, how you differ from competition

2. Niche, where you fill a narrow area of technical uniqueness

3. Full Service, your multidisiplinary approach to deliver more expertise quicker

4. Cost, lower because of existing technologies and facilities

5. Teaming/Partnership, your cooperative alliances with universities, laboratories, other agencies, or private industry.

The bottom line in Program Development is higher quality, better performance, state-of-the-art technology, cost effective solutions, lower risk, faster delivery, smart facilities, flexibility, expandability and adaptability.

For more information, Pugh recommends William Davidow's *Marketing High Technology* (New York: The Free Press, 1986) and Theodore Levitt, *The Marketing Imagination* (same publisher, 1983).

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High Performance Organization: Saturn

James L. Lewandowski

Jim Lewandowski spent 35 years at General Motors. His last assignment was vice president for human resources on the Saturn Project in Spring Hill, Tennessee. Now he specializes in organizational culture and change efforts using Saturn-like concepts and principles. He left Saturn in 1990, just as the first cars rolled out. "If you do what you've always done," he says, "you get what you always got." That's why the Saturn Project started with a clean sheet.

The Saturn Project transformed him from a manager to a leader. He notes, "I had to learn to operate out of my comfort zone." He and six other GM executives were given this assignment without being told why they were specifically selected, nor how to create a new car and a new company concept.

Saturn was to be a high performance operation, and instead of mere customer satisfaction, the group of seven committed themselves to "customer enthusiasm." Besides changing buying patterns, this crew had to regain the market share lost to the Japanese and change the worker organizations. The chief engineer bought a fleet of Hondas and Mitsubishis and told his engineers to "drive 'em until you puke."

Lewandowski was in charge of relocating thousands of families from GM plants across the country and dealing with their unions in this new way of doing business. Before Saturn, his job in Detroit was to "screw the union and not let them screw us," but in Tennessee, things were different. "People want to be involved in the decisions that affect them." There were differences of opinion with the UAW, but "we drank

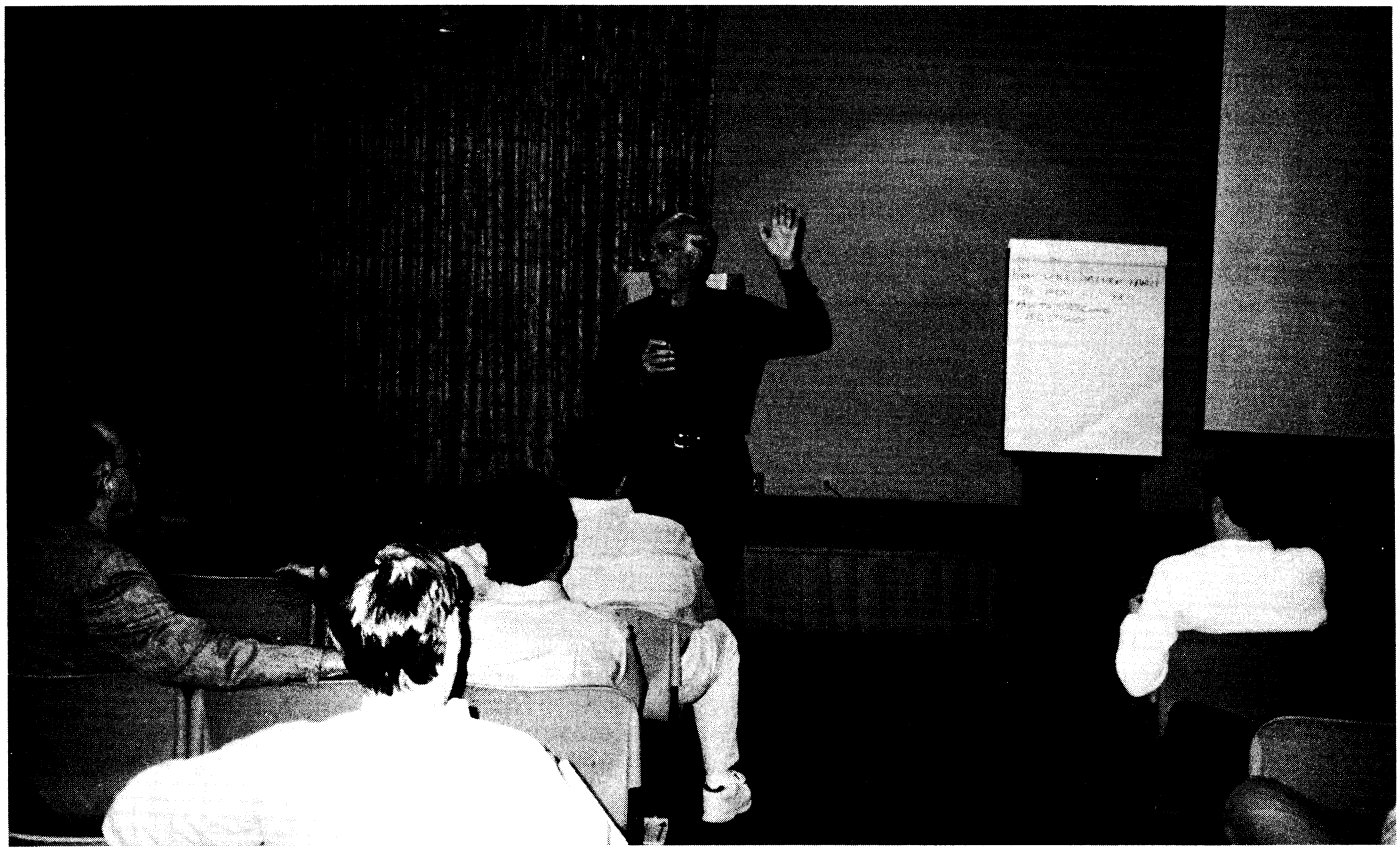

Figure 18. Jim Lewandowski at the PMSEP in Virginia Beach

beer afterwards, never held a grudge and never tried to get even." The result was a total of only three written grievances in the first five years, filed by the union to avoid unfair labor practices. Lewandowski found it "much harder to be a coach or champion than a Boss."

His biggest challenge was to move thousands of union families from Detroit to a rural community in a dry county of a right-to-work state. "High performance companies live and die by mission statements," he noted, and his was simple and clear: "No teen suicides." Families, thus, assumed an importance unheard of before in an organization on the move, and kids got a lot of attention during the big change. Saturn did have a rather high rate of divorce among couples, but Lewandowski figures that many urban folks brought some problems with them to the country. "People come first," was their slogan. "Some people never learn to trust though," Lewandowski said. So, what do you do? Fire them? "No," he said. "Coach them, counsel them and hope that they quit or retire soon." His first challenge was to get his fellow executives to stop wearing neckties.

Another big change for GM was this Tennessee transformation into a learning organization. "We called Spring Hill a 'campus' for we were continuously learning," he recalls. Trying to involve the whole family in Saturn events and celebrations was a priority.

Lewandowski drew applause from the delegates to the Project Management Shared Experiences Program when he said: "You know, the problem is we rely too much on metrics" and not enough on people. He advises project managers to "involve your stakeholders in any change process."

Change and continuous improvement are part of the culture at Saturn. Employees are even required to get 90 hours of training per year, with part of their risk/reward compensation tied to their objective.

Lewandowski remembers the glory days of Saturn, but faced with the prospect of returning to Detroit to push papers, he chose to keep the dream alive by telling the Saturn story over and over again, hoping that his experience-based perspective will assist leaders and managers confronted by the cross currents of change.

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Achieving Credibility as a Project Manager

Hal Mooz

Hal Mooz was co-developer of an innovative government/industry Project Management Training Course, and he has trained more than 5,000 high-technology project managers. A graduate of Stevens Institute of Technology, he was a project manager and systems engineer at Lockheed before he founded CSM. His new book with Kevin Forsberg, *Visualizing Project Management,* was published by John Wiley & Sons in 1996.

Leadership is the most important factor in the successful management of projects, Mooz asserts, and the most important element of leadership is credibility. Citing Jim Kouzes and Barry Posner's book, *Credibility* (Jossey-Boss, 1993), Mooz claims that credibility is earned and depends on the project manager's competency as observed, valued and appreciated by stakeholders, those who can affect or are affected by the project.

He laments the fact that few project managers are trained in systems engineering, and few systems engineers are trained in project management. Fewer yet belong to both the PMI and INCOSE. Yet, the skills and knowledge of both are needed to achieve the competency and earn the credibility to manage projects with clarity and purpose.

Four things are essential to project management, according to CSM.

1. Common Project Vocabulary. Projects that do not define their terms and explain their jargon are vulnerable to serious miscommunication that can

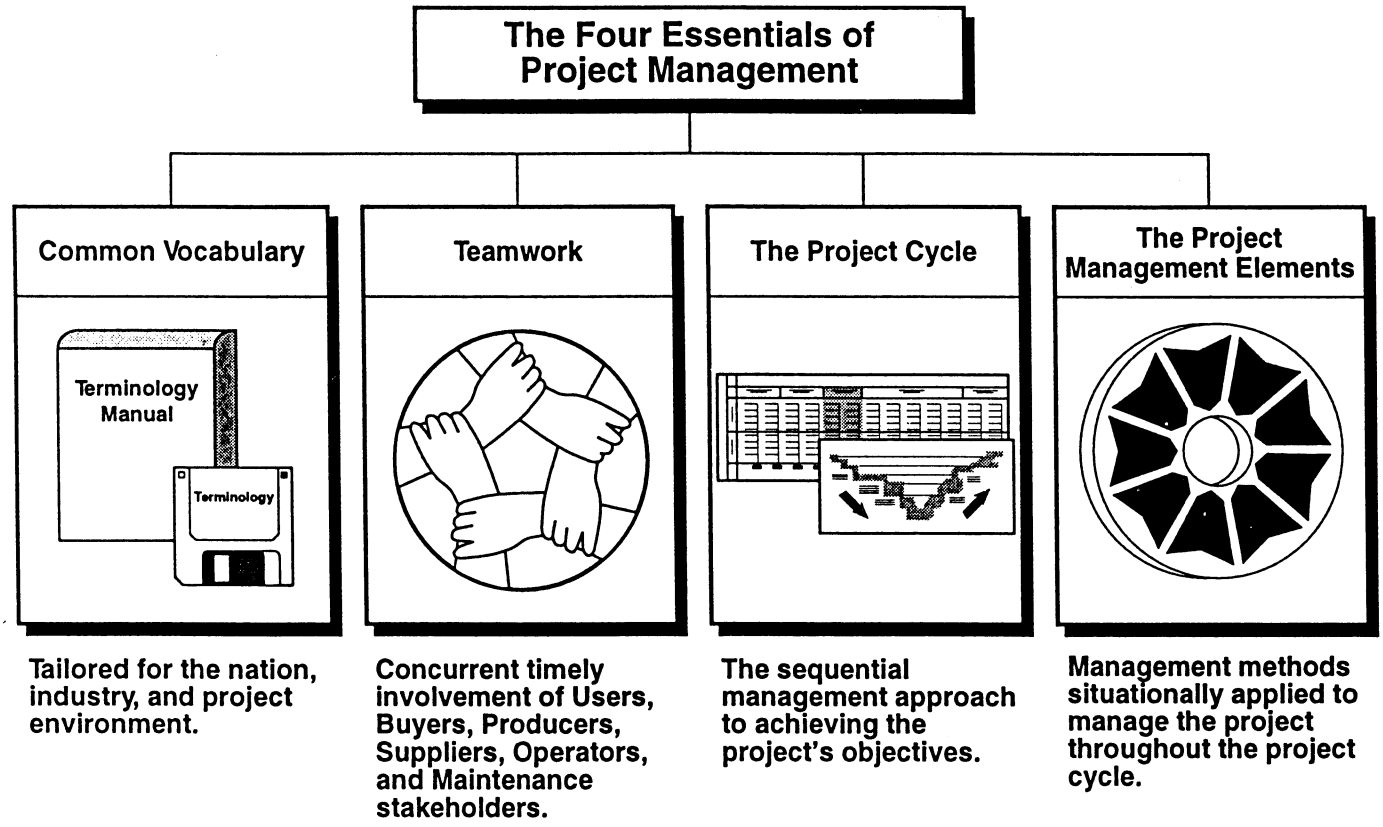

Figure 19. The Four Essentials of Project Management

lead to mistakes, even disasters. A project dictionary or glossary, in hard copy and soft, is essential. A competent project manager gains credibility through mastery and mentoring of such vocabulary.

2. The Project Cycle. Competent project managers can also earn credibility by involving stakeholders in the development of a coordinated project cycle. Many professional project management organizations have their own standards or template of a project cycle, based upon their preferred approach. CSM prefers the "Vee" format for the technical aspect of the project cycle to show the sequence for system or product decomposition, definition, integration and verification.

3. Ten Project Management Elements. The competent project manager earns credibility by demonstrating skill and tool proficiency in each of the following categories:

   1) Requirements must be created and managed.

   2) Organization options, ranging from functional and matrix to integrated teams and "skunk works," must be applied to the situation.

   3) Project Team selection must include the right mix of skills and attributes.

   4) Project Planning should be an ongoing process.

   5) Risks and Opportunities must be continuously identified and evaluated and then mitigated and enhanced, respectively.

   6) Project Control should be proactive and reactive, to ensure that planned events happen and unplanned events do not.

   7) Project Visibility includes physical techniques like MBWA and electronic techniques like Email, FAX and videoconferencing.

   8) Project Status should involve tools like earned value to detect unacceptable variances and determine the need for corrective action.

   9) Corrective Action may include overtime, alternate technical approaches or new leadership.

   10) Project Leadership, the most important element, is based on credibility. "The competent leader makes sure the team is doing the right things before making sure things are being done right," Mooz says.

4. Project Teamwork. The fourth essential of effective project management is teamwork, not just individuals working together to achieve a common goal but rather mutual respect and trust, a common code of conduct, shared rewards, and team spirit and energy among all the project shareholders. Projects often fail, notes Mooz, because of adversarial relationships. Timely involvement of users, buyers, producers, suppliers, operators and maintenance stakeholders can reduce conflict considerably.

Beyond technical management, the savvy project manager must also manage the budget and business aspects of a project. Leadership, however, is the force that inspires and motivates the team to accomplish their personal and collective best, and effective leadership is based on credibility.

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The Cypress Freeway Relocation

Michael Chan

Michael Chan is the acting construction manager of the $900 million reconstruction of the Cypress Freeway in Oakland, involving seven major contracts and 15 smaller ones since the October17, 1989, earthquake.

Forty-one people lost their lives on the elevated highway that leads to the San Francisco Bay Bridge. Chan has to coordinate the work with more than 15 federal and state agencies, but thanks to fast track construction schedules, Interstate 880 to Westbound I-80 was expected to open to traffic in the summer of 1997. Eastbound freeway traffic is expected to flow by winter of 1998.

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Figure 20. Michael Chan shows a slide of a car on the elevated Cypress Freeway in 1989 about to fall through

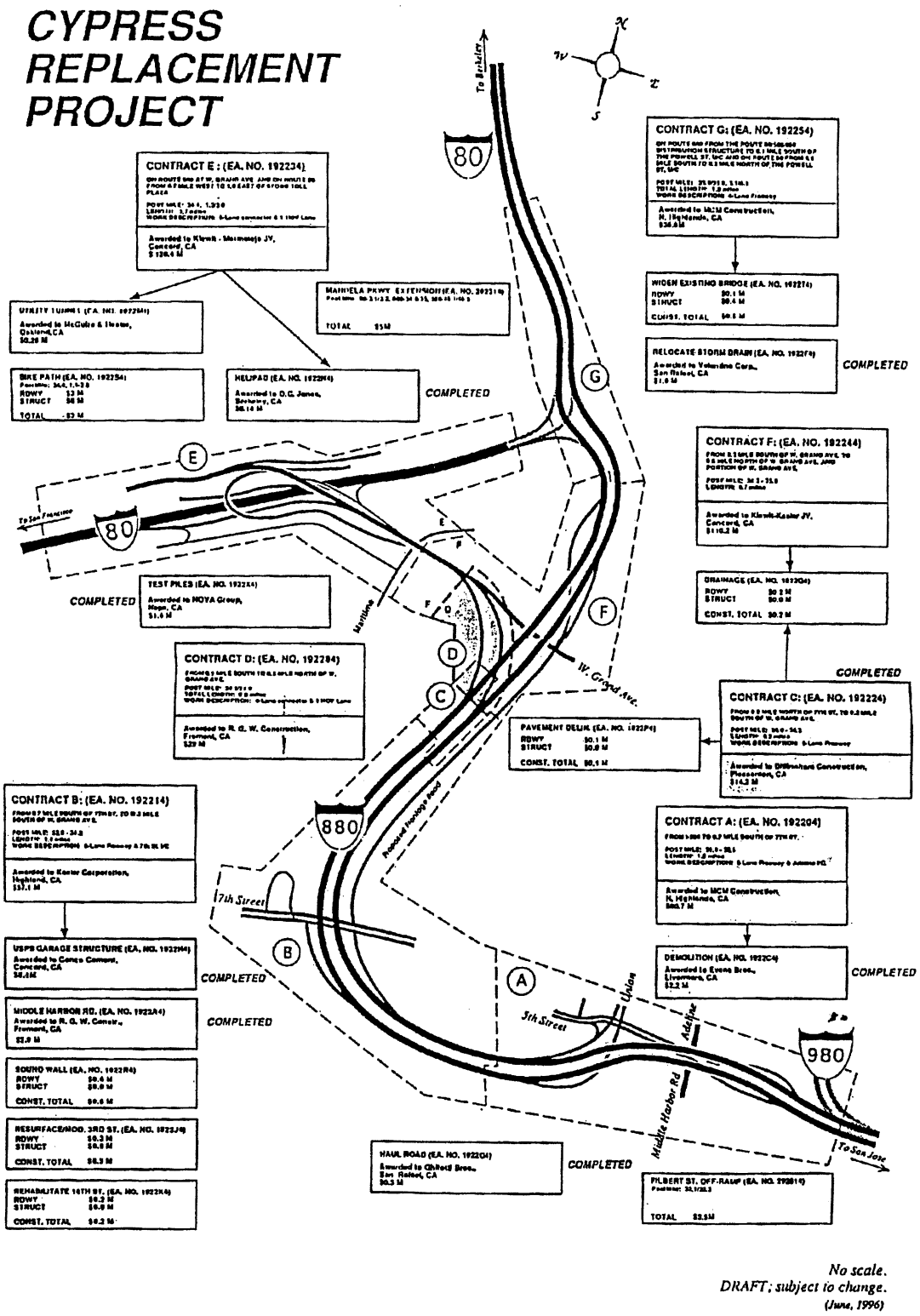

Figure 21. Cypress Replacement Project

Construction of the Hong Kong Airport

Tudor Walters

Tudor Walters is the Consultant Project Manager for the massive Hong Kong Airport Core Programme, a $21 billion project with a very tight timeframe, a wide variety of engineered components and a high level of inter-contract dependencies. To further complicate matters, the British were about to turn their six million citizens and the airport project over to the mainland Chinese for governance, following a 99-year lease.

A single runway with no opportunity to expand supports the current Kai Tak airport, overburdened with the world's third largest number of international passengers and air cargo tonnage, located in the densely populated Kowlson area. Noise pollution is a serious problem, so developers decided on a site just off the north coast of Lantau Island, 30 km from Hong Kong's central business district. The two new runways would be partly on land, mostly on reclamation, stretching out into the bay off the fishing village of Tung Chung.

The cost of the expressways and railway to the new landing site would exceed that of the actual airport, but would also achieve a number of long-standing planning objectives and development needs. The road/rail double-deck Tsing Ma suspension bridge stretches to the island, longer than the Verranzano Narrows Bridge, and the Kap Shui Mun cable stayed box girder bridge enables a 23-minute rail ride to central city. Tunnels, terminals and elevated highways were built by a wide range of international contractors using a 30% proportion of imported labor.

"Exceptional projects demand exceptional client and governmental responses," he said. By 1994 all contracts were awarded after debt-to-equity ratios for the airport and airport railway (being developed by wholly owned government corporations) were worked out among the UK, PRC and Hong Kong governments. Lump-sum fixed price contracts were awarded with strict penalties for schedule slips. On alternate Saturday mornings the contract managers would meet with government department heads related to the project to deal with issues, concerns, regulations and needs. Integrated management teams trimmed the overall budget twice, saving $1 billion.

As of April 1997, every contract was running on budget. The freeways were open, and the airport platform was dredged and reclaimed, with terminal construction well underway. The new airport, within 270 minutes of half the world's population, along with its railway, is expected to open April 1998.

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NASA's Faster, Better, Cheaper

Dr. Noel W. Hinners

Dr. Noel Hinners is vice president of Flight Systems at Lockheed Martin in Denver, having left NASA in 1989 as Associate Deputy Administrator and Chief Scientist. Earlier he served as NASA Associate Administrator for Space Science, Director of the Smithsonian's National Air and Space Museum and then Director of the Goddard Space Flight Center.

He asks, "NASA's Faster, Better, Cheaper: Useful New Paradigm or Path to Disaster?" Either way, it is risky.

The Mars Global Surveyor, with the Mars Pathfinder, was Lockheed Martin's first FBC project. Pressure to perform is great, and a 5% cost overrun triggers a review or possible cancellation. Reviews, inspections and redundancies have to be reduced, but if performance proves good, the company has a good chance for FBC missions in 2001, 2003 and 2005.

Hinners contrasted the program manager's environment in the past and now. In the past, cost overruns were forgiven if there was mission success, but today cost is an independent variable. In the past, failures were an integral part of experience, but now failure is increasingly unacceptable and/or "unavailable," out of the question. In the past, the program manager exercised significant authority, but today that authority is constrained by bureaucracy and leadership of the Integrated Product Development team. In the past, program managers developed systems experience through career development opportunities, but today many engineers are pigeonholed with little or no flexibility. In the past, program managers had greater trade space for redundancy as well as cost, mass, technology and schedule. Today, however, the PM is boxed in on all sides with cost, mass, LV and schedule. Finally, now a project is based on performance based contracting while in the past it was requirements driven. "Its a tougher job now," Hinners noted.

On the positive side, FBC is the "path to success." It is THE way of life for NASA and thus Flight Systems, the FBC leader at Lockheed Martin Astronautics. Their Product Development Organization was set up for FBC; however, this does not always make things go easy. FBC challenges the way they do business, in which design-to-cost is a must. Teamwork and risk management are paramount, but an unexcelled workforce is the key to making it work. "Mantra aside," he notes, "mission success is still what counts."

On the negative side, FBC can potentially lead to science that is uninspiring or trivial, in which case both scientists and the public may lose interest. The higher risks path can result in "too many" failures, but no one seems to know how many is too many, and there is still a low political tolerance for any failure. The new starts "numbers game" may get us one or two missions a year regardless of size. A poor technology plan could lead to the wrong technology investment plan, wrong choices and few applications. Finally, FBC can burn out our engineers with pressure to succeed and excessive overtime. Some engineers, for example, routinely spent 70 to 80 hours a week on Clementine and Pathfinder.

Hinners identified four required engineering skills that need to be emphasized by today's engineers:

1. Teamwork. "The Lone Ranger is dead," he notes, but "Integrated Product Teams are alive."

2. Communication. All engineers need to know how to write and speak clearly and accurately.

3. Business. "As a NASA engineer I couldn't care less if a TRW made a respectable profit or not," he admits, but in industry you must focus on ROI, ROE, profit, loss and debt ratio. Also, the global economy suggests more international cooperation and collaboration.

4. Intuition. Besides being a world expert and having a "systems sense," engineers need "brown envelope talents." Continuing education and consulting with experts are increasingly important for mission success.

"We build trust by taking responsibility," Hinners said, "and with mission success."

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Resources

Heather Crump

This bibliography was compiled by Heather Crump, Reference Librarian at NASA Headquarters Library.

The following print resources are located in the NASA Headquarters Library Program/Project Management and Main Circulating collections. The electronic resources are available on the World Wide Web and are accessible to everyone. The designation before the call number indicates the collection. All items are available to NASA employees at all NASA installations. For more information, call the library at (202) 358-0172.

Strategic Planning

Dew, John R. *Quality-Centered Strategic Planning: A Step-by-Step Guide.* Quality Resources: New York, 1997.
PM HD30.28 .D484 1997

NASA Strategic Management Handbook 1996.
http://www.hq.nasa.gov/office/codez/strahand/frontpg.htm

NASA Strategic Plan 1996.
http://www.hq.nasa.gov/office/nsp/cover.html

Schwartz Peter. *The Art of the Long View: Paths to Strategic Insight for Yourself and Your Company.* Currency Doubleday: New York, 1996.
Circ HD30.28 .S316 1996

Construction of the Hong Kong Airport

Bow, Josephine. "Plans Soar for Hong Kong's New Massive Airport." *Distribution.* 95 #3 (March 1996): 20. BPO 01196745

Flint, Perry. "Chek, Please." *Air Transport World.* 31 #5 (May 1994): 81 82. BPO 00852333

Hong Kong's New Airport at Chek Lap Kok.
http://www.hkairport.com/

"Project Funding Worked Out." *ENR* 233 #20 (November 14, 1994): 13. BPO 00934297

ISO 9000

ISO Easy.
http://www.exit109.com/~leebee/

Randall's Practical Resources ISO 9000 Executive Overview.
http://home.earthlink.net/~rpr-online/9kExecOv.htm

Todorov, Branimir. *ISO 9000 Required: Your Worldwide Passport to Customer Confidence.* Productivity Press: Portland, OR, 1996.
PM TS156.6 T639 1996

Wilson, Lawrence A. *Eight-Step Process to Successful ISO 9000 Implementation: A Quality Management System.* ASQC Press: Milwaukee, 1996. PM TS156.6 .W545 1996

NASA Procurement Initiatives

Alston, Frank M. *Contracting with the Federal Government: 1996 Cumulative Supplement.* Wiley: New York, 1996 Circ KF849 .C664 1996

Cibinic, John Jr. and Ralph C. Nash, Jr. *Cost-Reimbursement Contracting.* George Washington University: Wash., DC, 1993.
Circ KF841.5 .C525 1993

Cole, Peter S. *Technical Evaluations in Government Contracting: A Complete Guide.* Holbrook & Kellogg: Vienna, VA, 1995.
Circ HD3858 .C65 1995

Laurent, Anne. "Buying Smarts." *Government Executive.* 29 #4 (April 1997): 28-37.

NASA Acquisition Internet Service. http://procurement.nasa.gov

NASA Procurement Initiatives. http://www.hq.nasa.gov/office/procurement/int.html

Full Cost Accounting

Kehoe, Joseph. *Activity Based Management in Government.* Coopers & Lybrand: Wash., DC, 1995 Circ HF5686.C8 A27 1995

NASA CFO Full Cost Accounting. http://booster.nasa.gov:443/codeb/fcost.htm

Phillips, William R. *Public Dollars, Common Sense: New Roles for Financial Managers.* Coopers & Lybrand: Wash., DC, 1997. Circ HD3857 .P83 1997

MacArthur, John B. "Cost Management at the IRS." *Management Accounting.* 78 #5 (November 1996): 42-48. BPO 01334879

Project Management Career Development

Allen, Thomas J. and Ralph Katz. "The Project-Oriented Engineer: A Dilemma for Human Resource Management." *R & D Management.* 25 #2 (April 1995): 129-140. BPO 01005289

Project Management Institute. http://www.pmi.org

Stewart, Thomas A. "Planning a Career in a World Without Managers." *Fortune.* 131 #5 (March 20, 1995): 72-80. BPO 00990485

Wirth, Itzhak. "The Generic Project Management Career Path." *American Association of Cost Engineers Transactions.* 1994 Transactions (1994): CE31-CE34. BPO 00905784

Fast Track Project

NASA APM-23 Special Study Group Fast Track Study. Falls Church , VA: Strategic Resources , Inc., 1996. PM HD69 .P75 N37 1996

Earned Value

Abba, Wayne. *Earned Value Management Rediscovered!* http://www.acq.osd.mil/pm/newpolicy/misc/abba_art.html

Cass, Donald J. "Improve Schedule Forecasting Via Earned Value." *American Association of Cost Engineers Transactions.* 1994 Transactions (1994): CSC71-CSC79 BPO 00905796

Earned Value Implementation. http://www.safaq.hq.af.mil/acq_pol/evalue.html

Fleming, Quentin W. And Joel M. Koppelman. "Earned Value Project Management." *Cost Engineering.* 39 #2 (February 1997): 13-15. BPO 01388834

Metrics

Brown, Mark Graham. *Keeping Score: Using the Right Metrics to Drive World-Class Performance.* New York: Quality Resources, 1996. PM HD58.9 B76 1996

Software Metrics Research & Development. http://satc.gsfc.nasa.gov/SATC/RND/wmetrics.html

Global Work

O'Hara-Devereaux, Mary. *Globalwork: Bridging Distance, Culture and Time.* San Francisco: Jossey-Bass, 1994. PM HD62.4 O36 1994

Odenwald, Sylvia. "Global Work Teams." *Training & Development.* 50 #2 (February 1996): 54-57. BPO 01162179

Rifkin, Jeremy. *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era.* New York: G. P. Putnam Sons, 1995 Circ HD6331 .R533 1995

Coaching

Gilley, Jerry W. *Stop Managing, Start Coaching: How Performance Coaching Can Enhance Commitment and Improve Productivity.* Chicago: Irwin, 1996. PM HF5549.5.T7 G476 1996

Longenecker, Clinton O. And Gary Pinkel. "Coaching to Win at Work." *Manage.* 48 #2 (February 1997): 19-21. BPO 01396253

MacLennan, Nigel. *Coaching and Mentoring.* Brookfield, VT: Gower, 1995. PM HF5385 .M232 1995

Olalla, Julio and Rafael Echeverria. "Management by Coaching." *HR Focus.* 73 #1 (January 1996): 16-17. BPO 01139462

Team-Based Problem Solving

Klubnick, Joan P. *The Team-Based Problem Solver.* Burr Ridge, IL: Irwin Professional, 1994. PM HD66 .K59 1994

Pollar, Odette. "Sticking Together." *Successful Meetings.* 46 #1 (January 1997): 87-90. BPO 01359906

Schulte, Tom. "Synchronized Team Thinking: The Secret to Continuous Improvement." *National Productivity Review.* 16 #3 (Summer 1997): 5 12

Uhlfelder, Helene F., ed. *The Advanced Team Guide: Tools, Techniques and Tips for Experienced Teams.* Atlanta: Miller Howard, 1995. PM HD66 .A39 1995

Capability Maturity Model

Dadkalantonakis, M. K. "Achieving Higher SEI Levels." *IEEE Software.* 11 #4 (July 1994): 17-24. IEEE 4733061

Herbsleb, James and others. "Software Quality and the Capability Maturity Model." *Communications of the ACM.* 40 #6 (June 1997): 30-40. BPO 01430799

The Software Engineering Institute. http://www.sei.cmu.edu/

Pressman, R. "Software Process Impediment." *IEEE Software.* 13 #5 (September 1996): 16-17. IEEE 5377692

SEI Capability Maturity Model. http://rbse.jsc.nasa.gov/process_maturity/CMM/

Credibility

Kominkiewicz, Scott. "(Credibility.) It's Not Only What You Say." *Communication World.* 13 #6 (June/July 1996): 24-28. BPO 01236784

Kouzes, James M. and Barry Z. Posner. *Credibility: How Leaders Gain and Lost It, Why People Demand It.* San Francisco: Jossey-Bass, 1993. PM HD57.7 .K678 1993

Robinson, Everett T. *Why Aren't You More Like Me?: Styles & Skills for Leading & Living with Credibility.* Amherst, MA: HRD Press, 1994. PM BF698.3 .R622 1994

Rusaw, A. Carol. "Achieving Credibility: An Analysis of Women's Experience." *Review of Public Personnel Administration.* 16 #1 (Winter 1996): 19-30. BPO 01176480

Cypress Project

Cypress Project Page. http://tresc.dot.ca.gov/Cypress/Cypress.html

Faster, Better, Cheaper Projects

Achieving Mission Success in the New Business Environment: A Program Manager's Guide to Faster, Better, Cheaper. http://www.hq.nasa.gov/office/codeq/aqshp