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December 19, 2001

RDS - DCNO-45

Ms. Julie Scanlon
Oceanic and Atmospheric Research
National Oceanic and Atmospheric Administration
1315 East-West Highway
Silver Spring, MD 20910

Dear Ms. Scanlon,

Enclosed is our report, Analysis of Operating Procedures in OMI at NOAA. This report represents the work and efforts of the authors over the seven-week period from October 29 to December 19, 2001, with advance preparation conducted in Worcester, Massachusetts prior to arrival in Silver Spring, Maryland. The report describes our background research, project methodology, results and conclusions, and final recommendations to the Office of Management and Information. In addition, the report includes the procedural documentation that we produced for the office as requested.

Copies of this report are being submitted simultaneously to Prof. Richard D. Sisson and Prof. Brigitte Servatius for evaluation. Upon faculty review, the original will be catalogued in the Gordon Library of Worcester Polytechnic Institute. We appreciate the time that you and the rest of the office personnel have devoted to us and thank you for all of your advice and assistance.

Sincerely,

Christopher Barratt
Christopher Barratt

Art Golik
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Travis Schrift
Travis Schrift

Project Number: RDS-DCNO

ANALYSIS OF OPERATING PROCEDURES IN OMI AT NOAA

Report Submitted to:

Prof. Richard D. Sisson, Jr., Ph.D, WPI Professor
Prof.. Brigitte Servatius, Ph.D, WPI Professor

Washington, Project Center

By

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In Cooperation With

Ms. Julie Scanlon, Deputy Executive Director
Office of Management and Information
Office of Oceanic and Atmospheric Research
National Oceanic and Atmospheric Administration

December 19, 2001

Prof. Richard D. Sisson, Jr., Ph. D

Prof. Brigitte Servatius, Ph. D

Abstract

The important internal operating procedures of NOAA Research's Office of Management and information have been thoroughly documented with flowcharts and written narratives. Analysis of these procedures has revealed problems of communication between departments and excessive numbers of individuals involved in simple tasks. Based on this analysis, it is recommended that the office make stronger use of e-mail, document new procedures as early as possible, and trim procedures to the minimum number of necessary personnel.

Authorship

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Analysis of Operating Procedures in OMI at NOAA	Christopher Barratt
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Background: NOAA	Christopher Barratt and Travis Schrift
Background: Total Quality Management	Arthur Golik
Background: Efficiency Research	Travis Schrift
Background: Web Site Design	Christopher Barratt
Methodology	Arthur Golik and Travis Schrift
Results and Discussion	Christopher Barratt
Conclusions and Recommendations	Arthur Golik and Travis Schrift
Appendix A	Christopher Barratt
Appendix E	Arthur Golik

Throughout the project, Arthur Golik and Travis Schrift conducted interviews and devised flowcharts, with input from Christopher Barratt. Christopher Barratt performed edits, authored Web pages, and managed information technology resources. All authors reviewed final results and recommendations before printing.

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Advisors and Liaisons:

Prof. Richard D. Sisson, Ph.D, WPI Professor
Prof. Brigitte Servatius, Ph.D, WPI Professor
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1.0 Executive Summary

Properly documented procedures and a well-defined infrastructure are essential to the optimal performance of any organization. Such elements enable an organization to carry on daily work in a straightforward manner, allowing both for fast and full realization of missions and goals as well as for educated procedural improvements. Unfortunately, a recent reorganization left the Office of Management and Information (OMI) in the research division of the National Oceanic and Atmospheric Administration without any such documentation. Whether this office functions to the best of its ability is thus unclear. As such, OMI chose to define and analyze its operating procedures in a joint undertaking with Worcester Polytechnic Institute.

Documented here are fourteen of OMI's office processes in the forms of flowcharts and written narratives. This documentation comprises a basic procedures manual, which OMI can place both on the desktops of every employee and on their local intranet. Through this manual, OMI hopes to eliminate as much confusion and uncertainty as possible among its employees. In addition, such a manual allows OMI to analyze its daily operations for trouble spots and opportunities for increased efficiency.

Obtaining the necessary flowcharts and narratives made extensive use of employee interviews. Over the course of seven weeks, a series of meetings with each employee drafted, reviewed, and corrected a graphical flowchart for each of the fourteen OMI office processes. These flowcharts led to the construction of written narratives, which describe individual process steps in greater detail than the flowcharts and provide the reader with important procedural notes and points to consider when undertaking the process. The final flowcharts and narratives were

assembled into a desktop procedures manual, both in printed and in Web-based forms for each employee of OMI.

Each of these processes was also analyzed for weaknesses that cause delays and errors. Having too many people involved in a particular task can complicate matters unnecessarily, as well as introduce instances of miscommunication that degrade overall productivity. The analysis revealed that an average of four to five distinct departments within OMI take part in each process; in addition, many of these departments divide the work of one person across two or more people. The inflated departmental complexity that characterizes these processes directly contributes to many of the delays and mistakes that hinder a smooth process flow at OMI.

To aid OMI in its goal of self-improvement and to foster further efforts toward productivity, a series of final recommendations is made to OMI. Three general points are emphasized: swift documentation, increased communication, and written requests. Documenting a new process can avoid undue stress later, as workloads often increase and obligations snowball with time. Prompt communication between employees maintains steady progress despite obstacles and failures, especially in times of serious crisis. Verbal requests for services between employees, while simple, are easily abused and employees are likely to forget them under hectic schedules; OMI should refrain as much as possible from communicating completely in unwritten forms. These points should enable OMI to continue pursuing its goal of self-improvement well into the future.

2.0 Introduction

Modern businesses are rife with procedures. Laws, regulations, and policies mandate that every corporate task address specific issues and concerns in a timely manner. Oftentimes several individual units within an organization must work collectively to achieve a particular goal, requiring careful coordination and cooperation amongst varying levels of personnel. Performed in a clearly documented, efficient manner, business processes can serve an organization well in its mission; performed without a well-defined structure, however, they can cost an organization significantly in wasted time and resources. Unfortunately, many businesses today lack the necessary procedural documentation that is such a boon to success.

Such is the case with the Office of Management and Information at the National Oceanic and Atmospheric Administration in Washington, DC. The OMI, responsible for personnel recruitment, coordination and management of liaisons with other federal agencies, and the financial affairs of NOAA's research, currently has no formal documentation of its daily procedures. Thus, as employees leave the organization over time, new replacements lack a definitive source of information from which to learn their new day-to-day duties. In addition, whether OMI performs many of its existing processes in an optimal manner is unclear; as these procedures are not written down, formal analysis of their efficiency has proven difficult. As such, in 2001 the OMI is seeking to organize and document their daily functions in a joint undertaking with Worcester Polytechnic Institute.

This project seeks to document, organize, streamline, and, if necessary, create, processes and procedures for the OMI. Following this, the project also seeks to create a user friendly and updateable Web page in which to house a procedures reference manual. To this end, the project team shall produce a clear and efficient template for all of the OMI's processes and procedures;

the project team shall also modify existing procedures to satisfy this template. If necessary, the team shall create any new processes and procedures as specified by the OMI, setting an example for the construction and revision of future procedures as the needs of the OMI change and develop. The final product shall consist of a formal reference manual containing the assembly of all the information gathered by the team during this undertaking. With the creation of a web-based version of this manual and the training of information technology staff at the OMI, employees will have instant and ready access to any information that they will need in order to carry out their daily responsibilities.

As this project is quite specific to the OMI of the National Oceanic and Atmospheric Administration, it is unlikely that other organizations would be directly interested in the final product; however, the methodologies explored and results obtained could be of great interest to any organization or agency looking to undertake a similar task. The construction of a basic procedural template through employee interviews, the collection of structural documentation regarding a large office like the OMI, and the analysis of the interoperability of differing subsections within the OMI could provide a solid foundation for similar agencies, both governmental and commercial, who are also looking for improvement in their current organizational structure and processes.

In pursuit of the goal of an Interactive Qualifying Project (IQP), this project seeks to apply the principles of management and procedural flow to the daily workings of the OMI. An IQP, as defined by Worcester Polytechnic Institute, seeks to link the study and application of science and engineering to modern society. To that end, this project aims to document and restructure OMI's office procedure flow. The reengineered process flow will reinforce a structured organization that will allow greater focus on the problems and responsibilities with which the NOAA is charged, reducing time wasted due to the lack of proper documentation.

3.0 Background

3.1 The National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) is one of several institutions responsible for the environmental protection and management services of the United States. Charged with the study and protection of the Earth's environment, this thirty-year-old federal agency functions as the center of many different research and conservation programs, such as weather forecasting, species and ecosystem protection, and climatic change assessment. Many different organizations throughout the country today seek NOAA's efforts and services, including other sections of the federal government and its subsidiaries as well as private organizations that weather and geological conditions directly influence in the course of business (NOAA, 2001).

3.1.1 The History of NOAA

In response to a congressional address that President Nixon made in 1970, the United States Government created NOAA under the Department of Commerce. This act produced an agency that maintains several distinct programs to study and handle a variety of issues directly concerning the global environment (NOAA, 2001).

Federal environmental research is as old as the United States itself. Thomas Jefferson began collecting weather-related information about the eastern seaboard before the American Revolution; during the War of 1812, Army surgeons took up the task of recording climatic conditions. Although private individuals and medical practitioners no longer record the official

history of national weather, NOAA's National Weather Service continues to collect such information today with a network of over 10,000 volunteers across the country. Through the use of modern technology, its observations have saved an estimated 45,000 to 50,000 lives annually and have averted vast amounts of potential property damage. In addition to weather programs, NOAA maintains other departments that it inherited from other governmental agencies. The former U.S. Commission of Fish and Fisheries spawned the modern-day NOAA Marine Fisheries, in charge of the maintenance, promotion, and protection of fisheries and coastal habitats. NOAA Marine Fisheries has rehabilitated the once-struggling striped bass fishery along the Atlantic coast and has kept tuna and swordfish populations healthy and profitable for the nation. Using experienced leaders in environment fields, the NOAA has become a major force in environmental issues (NOAA, 2001).

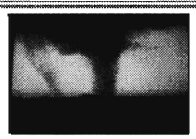
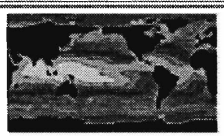
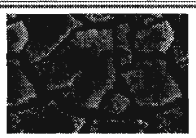
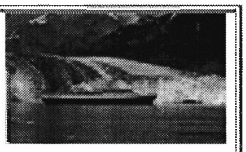
Today NOAA maintains extensive information-gathering operations through the use of spaceborne satellites. These satellites record data on geological events around the world, including volcanic activity, forest fires, and ozone layer fluctuations. Combining this information with that obtained from the differing branches of the Armed Forces, the Federal Aviation Administration, and weather-related organizations, NOAA maintains the largest repository of meteorological data in the world. NOAA recently built "Aquarius", the world's only underwater habitat, which allows scientists to study deep-sea life for up to ten days. With the creation of "hurricane hunter" aircraft that allows pilots to spend up to nine hours at a time researching weather phenomena and the invention of the only measurement system of solar storm intensity, NOAA's studies range from the deepest ocean floor to the outer limits of space. The United States Government, its citizens, and scientists abroad routinely use NOAA's collection of data, assembled by specialists in their fields, to study the Earth's environment (NOAA, 2001).

3.1.2 Mission and Goals of NOAA

"The mission of the National Oceanic and Atmospheric Administration is to describe and predict changes in the Earth's environment, and conserve and wisely manage the Nation's coastal and marine resources". In order to complete this mission, NOAA has divided its operations into seven interrelated goals. These goals cover all aspects of NOAA's domain and are vital to the proper protection of the Earth's environment. These seven goals, as seen in Figure 1, consist of two basic ideas: "Environmental Assessment and Prediction" and "Environmental Stewardship" (NOAA, 2001).

NOAA Strategic Goals:

Environmental Assessment and Prediction

			
Advance Short-Term Warnings and Forecast Services	***Implement Seasonal to Interannual Climate Forecasts***	***Assess and Predict Decadal to Centennial Change***	***Promote Safe Navigation***

NOAA Strategic Goals:

Environmental Stewardship

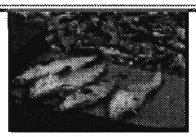
		
Build Sustainable Fisheries	***Recover Protected Species***	***Sustain Healthy Coastal Ecosystems***

Figure 1: NOAA Strategic Goals, 2001. Source: NOAA

NOAA believes that if it successfully meets all seven of these goals, then it will have achieved its mission. By focusing upon these goals, it believes that the world will be both cleaner and better equipped to deal with the disasters that humanity or nature often cause, and that people will be more aware and better prepared for environmental changes (NOAA, 2001).

3.1.3 The Office of Management and Information

Within the Office of Oceanic and Atmospheric Research (OAR) branch of NOAA is the Office of Management and Information, or OMI. OMI is responsible for personnel management, budget acquisition, compliance with congressional financial directions, liaising with outside agencies, and information technology management within the research arm of the administration. Divided into three sections, OMI formally contains OAR's Fields Services Division, its Budget & External Affairs Division, and its Information Management Division. Each of these three individual units works together to serve the research missions and goals of NOAA (NOAA, 2001).

3.1.4 The Need for Procedural Documentation and Quality Management

In 1998, OMI underwent a reorganization that consolidated several previously separate aspects of OAR, allowing better coordination of the agency's different research functions. However, this reorganization has left OMI without any substantial documentation describing internal processes and procedures. As a result, OMI can lose information concerning day-to-day operations over time as existing personnel leave and new recruits arrive. To ensure a smooth transition from departing to arriving employees, as well as to clarify the specifics of daily tasks for existing employees, OMI needs a manual that formally documents its internal procedures (personal communication, Ms. Julie Scanlon, September 20, 2001).

The lack of documentation also prevents OMI from formally assessing its intra-office efficiency. Reorganization is particularly effective if it enables a more efficient means of

carrying out one's objectives; a proper analysis, however, requires a clear and concise description of individual processes as they currently exist. Thus, OMI not only needs documentation for new hires, but also to facilitate the application of quality management.

To these ends, OMI has allied with Worcester Polytechnic Institute to document and analyze its operational procedures. Such an analysis shall consist of process identification and documentation as well as a preliminary application of quality management techniques to improve time efficiency and eliminate mistakes. The final product shall consist of two parts: a procedures reference manual describing the tools and means of performing OMI's mission on a day-to-day basis, and a list of any recommendations as to the optimization of those procedures.

3.2 What is Total Quality Management?

Quality Management, or Total Quality Management (TQM), is the process of continuous improvement in every aspect at every level of operation or function. Manufacturing corporations originally designed TQM for their own use; however, since then offices have easily and effectively applied Total Quality Management to their line of work as well. Total Quality Management operates on the principal of total involvement from every area of a company with a positive outlook on the long-term goals of success and survival (Brocka, 1992, p. 3).

The methods of Total Quality Management provide a means of empowering both the management and the employees of a company to improve the overall operations of business. Communication, determining goals, and active improvement of individual procedures are all processes that require each individual's involvement to create a constructive working relationship. This approach, however, requires complete faith in employees, something that the American way of entrepreneurship has long since lost. Achieving objectives through TQM

requires the establishment of trust throughout a company. It is a shared and guiding goal that the entire company must establish and realize as its leading vision (Brocka, 1992, pp. 7-8).

3.2.1 Why Total Quality Management?

The constant factor of competition as well as the rapid advances in technology necessitate that a business maintain an internal structure that upholds and supports a system of continuous improvement. Total Quality Management helps keep a company abreast of new and efficient methods that increase overall productivity and market share. Today's workplaces also need it to accommodate an employee's desires to participate actively in company affairs concerning daily operations (Brocka, 1992, p. 18).

This project will make use of these methods and ideas of Total Quality Management to analyze processes for problematic areas, possibilities of efficiency increases, and decreased processing times. Not all aspects of the methods that Total Quality Management employs will be applicable or practical; however, several of them will aid in organization, implementation, and recommendations.

3.2.2 Primary Elements of Total Quality Management

The following fundamental pillars of Total Quality Management provide a basis for alternative methods and design suggestions in the reconstruction of office procedures. These pillars are some of the basic concepts and issues upon which TQM builds and that may have relevance to this project:

- Barrier Removal: A goal of TQM is to identify, categorize, prioritize, and remove barriers of operation in order to increase productivity. As a result of eliminating inhibitors and obstacles in any operation, efficiency, yield, and production all increase (Brocka, 1992, p. 26). This project intends to identify and remove any such barriers through the use of flowcharts following its documentation phase.
- Communication: A poor communication network often slows progress and stalls projects. An efficient network with prompt response times and overall efficiency is vital (Brocka, 1992, p. 29). Miscommunication will likely be a root cause of slowed productivity in the office, and this project will look for means of remedying instances of misinterpretation and lack of communication.
- Continuous Evaluation and Improvement: Timely identification of inhibitors, continuous feedback from employees, and constant application of small improvements create a regular cycle of inhibitor removal. The constant analysis of changes and their results leads to simplified processes that reduce problems and foster improvement (Brocka, 1992, pp. 32-36). While time constraints may not allow for the constant application of new changes and documentation of the results, this project aims to identify areas of trouble through close inspection and to analyze the identified impedances in detail to effect improvements.
- Training: To educate employees in new and efficient methods, technology, and processes is a direct investment into a firm itself. Having the workforce gain a common understanding and knowledge of the tasks that they perform brings about a higher level of efficiency and productivity (Brocka, 1992, p. 42). A secondary goal of this project is to train the employees of OMI to use standard methods through the desktop and web-based manuals.

3.2.3 Organizing

The collection, classification, and presentation of information can become a complicated and disordered task with large projects involving multiple processes. Total Quality Management offers several tools that help arrange and categorize data. The various diagrams, charts, and analysis methods that TQM provides can help one recommend and implement changes in an office environment (Brocka, 1992, p. 179). This section describes several tools and methods for the organization of data:

- Data Presentation: Bar graphs, pie charts, scatter plots, histograms, flowcharts, and cause and effect diagrams are all examples of different means of data presentation. To help people understand what a project entails or hopes to accomplish, a visual representation of the data involved is often a good idea. People can then quickly identify the issues that deserve attention and the actions necessary to address those issues. Visual tools are an effective way to convey a message quickly (Brocka, 1992, p. 188). This project will make heavy use of various types and methods of presentations; in particular, PowerPoint®* presentations and graphics will help explain findings and achievements as time progresses. These presentations will effectively keep other personnel informed of intended changes while prompting the input and opinion of those people that might otherwise miss such changes.
- Cause and Effect Diagrams: Cause and effect diagrams are graphical representations of the results of, or the factors amounting to, a particular action. These diagrams are helpful in identifying what actions lie in direct relationship to one another and therefore are capable of pointing out the origins of outcomes. Such diagrams are also a good means of identifying problems early on in the data collection process (Brocka, 1992, p. 179). Cause and effect

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* PowerPoint is a trademark of Microsoft Corporation.

diagrams may be of use in discovering the source of procedural problems and potential solutions thereto.

- Check Sheets and Data Collection: Check sheets and data collection are the basic methods of organized data entry whereby one prepares a standard check sheet, checklist, or data sheet and continuously updates it as information is obtained. Various adaptations of each form of sheet or list are available, the formats of which are easily found in many books and web sites. The sheets are most effective when one clearly defines the desired information beforehand (Brocka, 1992, p. 182). This project will use check sheets, checklists, and data sheets as a means of data organization during the identification and collection of information on OMI's process flow.
- Flowcharts: Flowcharts primarily indicate the steps of a current process and illustrate possibilities for improvements. A flowchart begins with a diagram that identifies and reproduces the flow of a process from station to station and continues with a description of the activities performed at each station. The flowchart takes into account every step of the process, allowing one to identify both problematic areas as well as potential improvements in overall efficiency in the process flow (Brocka, 1992, pp. 192-197). Flowcharts can help document the actual flow of procedures at OMI that one can later analyze in order to make recommendations for improved process efficiency.
- Workflow Analysis: Workflow analysis investigates the possibility for enhancements in the quality of work. This type of analysis involves the gathering of data on a current operation, the gathering of information on potential improvements, and a comparative analysis between the two that identifies the gaps between desired and actual performance (e.g., problematic areas, such as bottle-neck processes). After having gathered all the data, one can decide upon and implement changes to achieve the desired level of operation (Brocka, 1992, p. 198). This form

of analysis provides the general conceptual framework of the project; it will gather information on current processes through their documentation, analyze them through the use of several tools (such as flowcharts), and finally make recommendations for new and improved procedures.

3.2.4 Planning

In addition to organization, the various functions of TQM also provide tools and techniques designed for the preliminary stages of project preparation. The following tools help define the problems upon which one should focus in order to achieve the desired result:

- Deming Cycle: The Deming Cycle is a continuous system of evaluation designed for the elimination of a problem in a process or for the simple refining of a process. It has four key components: *Plan*, *Do*, *Check*, and *Act*. During the first stage of the process, the *Plan* component, one hypothesizes a change, design, or test. One then implements the change in the process through the *Do* component and later observes and notes the results in the *Check* component of the cycle. After having gathered enough information to analyze the effect of such implemented changes, one alters the process in the *Act* according to the documented and observed results. The system then returns to the first phase and continues cyclically until it achieves a satisfactory solution (Brocka, 1992, p. 202). While this is a process that could take a long time to achieve great results in large processes, one can apply a slightly modified adaptation of this system during this project to aid in planning possibilities, possibly in conjunction with flowcharts.
- Forced Field Analysis: Forced field analysis takes into account the magnitudes of the positive and negative forces, as well as the various issues, that have a bearing on a proposal. If effectively used, this analysis can become a useful tool in the implementation of changes as it can help identify the risks and benefits of a new process, taking into consideration possible

obstacles and oppositions. Determining the forces that may potentially impact the proposed solution and their magnitudes of affect is the first action for this type of analysis. Next, one attempts to lessen the effects of the negative forces and to greaten those of the positive forces using one of several available methods of TQM (Brocka, 1992, p. 203). This type of analysis may help in evaluating the recommendations that this project plans to make about current processes and procedures.

- Goal Setting: Goal setting is the basic and familiar tactic widely used throughout daily events where one first determines and states an endpoint or condition, after which one directs efforts and resources towards the achievement of that endpoint. The goal is a vision that is important to remember throughout any project. Setting a goal before taking action keeps a project team focused in a common direction and helps ensure the efficient use of resources. Also, the definition of a goal helps identify the objectives to meet along the way in order to ensure project success (Brocka, 1992, pp. 206-211). The goal of this project is to create a business services manual for OMI and to streamline a subset of its business processes, accelerating and reducing errors in its operations.

3.2.5 Group Techniques

As the age-old saying goes, "Two heads are better than one." This is the premise that TQM stresses the most. Collaboration, aggregation of several perspectives, and basic group interaction are effective means of formulating positive and effective results to resolve a problem (Brocka, 1992, p. 250). The preliminary stages of this project have involved the efforts of its team and advisors to properly prepare themselves; once the team arrives on site, it will continue

to practice good group dynamics and to seek input from available personnel in consideration of the best possible actions.

- Brainstorming: Brainstorming is a commonly known, understood, and used tactic of TQM. The process consists of a team of personnel, not necessarily of those involved in the process in question, that quickly generates any possible solutions to a problem without criticism. Once it has listed all ideas, the team then categorizes, clarifies, and eliminates specific ideas, leaving behind the best strategies (Brocka, 1992, p. 251). This tactic may prove useful when new aspects of this project suddenly arise and need solutions.
- Delphi Technique: The Delphi Technique for arriving at a consensus consists of several field experts collaborating together that consider each other's advice and insight. In the original design of the technique, one presents the experts with a problem statement and asks them to independently supply solutions. One then discloses the solutions to the group as a whole, whereupon a discussion follows to consider the best possibilities (Brocka, 1992, p. 256). Since the project team will be dealing with subject matter that is most familiar to OMI staff, it may incorporate a less structured version of the Delphi Technique in which one encourages open collaboration and questioning, rather than the independent thought process.
- Nominal Group Technique: (As named by Brocka) The Nominal Group Technique is actually the traditional and frequently practiced method of informal group interaction. This method suits itself well to areas of concern that require a certain degree of background knowledge beforehand. The entire group carries out all idea generation, discussion, establishment of priorities, and presentation (Brocka, 1992, p. 258). The project team has and will continue to use this method of collaboration throughout the entire project.
- Quality Circles: A quality circle is a group of employees that perform various operations within the company and that meet regularly to discuss various minor problems and their

respective solutions. This method works well once a company has resolved major problems and only minor issues of a certain process or operation remain that require simple and basic solutions (Brocka, 1992, p. 262). As the team will be starting a new project and organizing it from the ground up, it cannot afford to concern itself with this level of refinement at the current time. The team will promptly address and rectify any minor problems that become apparent after the project has reached a nearly completed stage.

3.3 Basics of Interviewing

Information exchange is a necessity in any project or major undertaking. To successfully achieve a goal or reach an objective, one must adequately inform involved individuals about the background and general workings of their operations (Lopez, 1975, p. 7). One method of obtaining information and gaining needed knowledge in a project is the direct interview of personnel; this is a method that this project aims to use as a part of its methodology of preparation and implementation.

There exist three varied structures of a direct personnel interview: Information-Exchange, Problem-Solving, and Decision-Making. Part of the preparation in interviewing determines beforehand the structure of the interview. This structure depends upon the specific needs or intentions of the interviewer, whom the demands of the project itself govern in turn (Lopez, 1975, p. 9).

The Problem-Solving interview structure will define the primary interview format for data collection in the preliminary stages of this project. One frequently and commonly uses this interview structure to resolve conflict. The interview serves as a tool by which the interviewee transfers information to the interviewer; the interviewer initiates interaction with the desires of directly applying gained knowledge and insight to a problem (Lopez, 1975, p. 12).

Interviews, being a form of communication, are most effective when properly organized and prepared. While the skill of conversation makes up a significant part of the communication process, one can use several rules of thumb to ensure a good interview. First and foremost, the interviewer must be fully aware of both his or her own physical actions as well as those of the interviewee. As in everyday communication, bodily expressions, commonly referred to as *body language*, are significant factors in understanding what feelings and emotions are supporting the information presented. The interpretations of such general behavior affect the judgments and understandings of all parties involved in an interview (Lopez, 1975, p. 11).

Also important is that the interviewer prepare sets of well thought-out questions that effectively identify problematic aspects prior to the interview and establish a precise time schedule for each aspect of the meeting. Providing a well-prepared interview helps keep the meeting orderly and heading in the right direction, whereas a disorganized interview may result in confusion between parties and skewed responses (Lopez, 1975, p. 11).

Being a good interviewer generally requires the qualities of a good listener, but one must also exhibit the qualities of a participant observer. In order to remain effectively in control of the interview, the interviewer needs to participate constantly and actively in the process. Active participation entails remaining aware of body language, possessing awareness of where the conversation is leading, the initiation of proper behavior, and quick responses to behavioral leads, cues, and suggestions. This method of immediate reaction is vital in leading and guiding the interview towards useful information and covering the most ground on key elements and aspects of the matter (Lopez, 1975, p. 30).

Interviewing will constitute the primary means of obtaining information from OMI employees about their current processes and procedures. The Problem-Solving method of interviewing will be the most common, which will acquire the necessary information along with

opinions on making each specific process and procedure more efficient. Interviewing will generally serve as a means of revealing the interworkings, or *interoperability*, of OMI.

3.4 Flowcharts

The *flowchart* is a commonly used tool for depicting the steps of a process. This section explains their structure and usefulness with respect to Total Quality Management.

3.4.1 The Use of Flowcharts

A *flowchart* is a graphical representation of the different steps of a process. Flowcharts describe four major types of processes: macroprocesses, subprocesses, activities, and tasks. Macroprocesses depict the high-level aspects of a procedure, while subprocesses detail the workable component jobs. At a finer level of granularity, activities constitute the major events that must occur in order to complete each subprocess; tasks provide specific checklists for each activity. For example, a macroprocess could be the holding of a fundraiser. An example subprocess would then be the confirmation of a hotel conference room. An activity could be the setup of equipment in the room, while one task would consist of determining whether the proper number of pens is available at each table (Harrington, 1991, p. 30-31).

Flowcharts often significantly aid the improvement of processes. Different styles of flow charts exist and each has its advantages and disadvantages as an analysis tool. Block diagrams are the most common type of flowchart; these charts depict a process in terms of its fundamental activities and physical movements. Block diagrams are popular because they provide a quick overview of entire processes and often enable one to identify major areas of concern. The American National Standards Institute (ANSI) standard flowcharts provide the detailed

relationship between each activity within a process. ANSI standard flowcharts are more complex in nature than block diagrams but often highlight both problem areas and specific causal factors. Functional flowcharts describe the process flow between two or more organizations. These charts are useful if an entire organization is reorganizing its internal processes or if two or more organizations are cooperatively restructuring processes between each other. Geographical flowcharts illustrate process flow between physical locations within or between offices; they are extremely useful in manufacturing plants where workers construct individual machine parts in separate locations, passing them around for assembly (Harrington, 1991, p. 87-108).

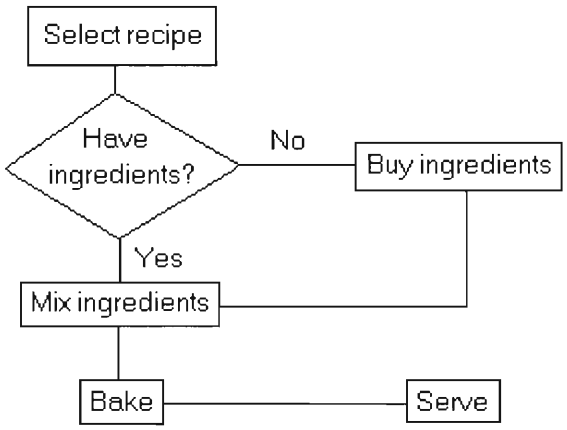

Figure 2: Sample Flowchart

3.4.2 Streamlining Flow Charts

Trimming waste and excess are the basic goals when streamlining a process. A twelve-step method exists that can help (Harrington, 1991, p. 132-140):

- The first of these steps calls for the elimination of bureaucracy, removing unnecessary administrative documentation and excessive reviews. To this end, one asks whether the process calls for double- or triple-checking at various stages, whether one seeks multiple signatures for a

document, and whether workers send information to individuals not directly involved in the process.

- The second step then deletes any similar or identical subprocesses.
- Value-added assessment, the third step, reviews the usefulness of each subprocess in accomplishing the process' goal. To conduct such an assessment, one considers the contribution of each phase of the process and drops those phases that do not materially satisfy the core requirements.
- One then simplifies the remaining subprocesses at the fourth step, combining similar activities and possibly reordering individual phases so as to make the work flow smoother. For example, one could eliminate fields on an office form that no one uses and/or reduce the amount of photocopying of such forms.
- Continuing further, one then looks for opportunities to perform individual activities faster, more accurately, and with the appropriate equipment at the fifth, sixth, and seventh steps, respectively.
- At the eighth step, one simplifies the language that workers use in their daily communication and job-related documentation, reducing the chance of misunderstandings amongst coworkers.
- Standardization of and training for each analyzed activity constitutes the ninth step.
- The remaining steps call for the improvement of input from suppliers, the complete overhaul of utterly ineffective methods, and the automation of routine tasks. These steps are particularly useful in manufacturing environments, where several workers construct and assemble individual parts for a physical product.

Together, these twelve steps help to minimize the time necessary to complete a process and thereby facilitate a smooth workflow for that process (Harrington, 1991, p. 132-140).

3.5 Walking Through the Process Flow

Physically walking through the flow of a process can give one a detailed understanding of what a particular procedure entails, both at a high and a low level. Walk-throughs allow one to interact directly with each person involved in a particular process and to produce an informative flowchart that details all significant steps, requirements, and delays (Petrozzo, 1992, p. 78).

Walking through a process involves three steps. First, one should collect and become familiar with any current documentation. Second, one observes and interviews the operations personnel; this step will further provide a high-level understanding of the workflow. Finally, one documents each step in the process, providing a concrete, first-hand look at the nature of the procedure. After having repeated these steps for a while, one can obtain an understanding of how individual processes are linked, how much time each process takes, and where problems with each process lie, as well as potential solutions for such problems (Petrozzo, 1992, p. 80).

With respect to OMI, the first step is of little use. Currently, OMI lacks any documentation about its office procedures (though a few supplementary aids, such as form checklists, do exist). In addition, OMI is seeking a fresh perspective on its daily operations; this necessitates a "clean slate" approach to the project. The critical components of the project will stem from interactions with personnel, which will help provide complete and accurate documentation so that a proper analysis may occur later. Correct documentation is essential to the success of the project; without it, any analysis quickly becomes useless. Those people who play a role in a particular process can not only supply information for this documentation, but also name other people that perform important tasks at particular steps and provide insight as to where specific errors and delays lie.

Accurately capturing the workflow of a process often requires multiple iterations. This project proves no exception to this rule. Having a graphical flowchart for a process, even if in draft form, can be of great help here; one can show the chart to those who carry out the process and ask for clarifications. Flowcharts can reduce the number of passes required and can lead directly to an accurate depiction of current practices (Petrozzo, 1992, p. 82).

Process walk-throughs can greatly augment the core of this project. One can quickly and correctly obtain a clear trace of each procedure at OMI through such methods, facilitating effective recommendations during the ensuing process analysis phase.

3.6 Efficiency Research

People have developed a fair amount of information concerning the evaluation of procedural efficiency over the years. This section addresses research pertaining specifically to interoperability and internal organizational policies.

3.6.1 Interoperability

Interoperability, or the sharing of information, is strategic in the success of companies (Landsbergen & Wolkern, 2001, p. 206). One person should be in charge of organizing processes and procedures. He/she should understand all the information with which they will be dealing and should be familiar with the technology available to help organize that information. The person should attempt to increase efficiency, increase services, and increase production while at the same time keeping cost increases to a minimum (personal communication, Frank Conti, Sept. 20, 2001).

Starting with an inventory of all the known information of the organization, policy documents, and knowledge from sister organizations, one can assemble a basic structure for sharing the data. The supervisors of each organizational section should pool the information relevant to their departments (Landsbergen & Wolkern, 2001, p. 206). Along with these procedures should be a list of potential problems to avoid (personal communication, Michael Elmes, Sept. 26, 2001). These steps allow all information to accumulate over time in one place. Tracking the progress of each process is difficult, but can yield significant results in the long run. Using all documents and potential problems, one can achieve an efficient method of sharing information (personal communication, Frank Conti, Sept. 20, 2001).

Major points of successful factors in sharing information are identification, planning, and implementation (Landsbergen & Wolkern, 2001, p. 206). The planning stages should involve technical standards, government regulations, and public interest (personal communication, Michael Elmes, Sept. 26, 2001). The updating of these standards throughout implementation and maintenance is of great importance (personal communication, Frank Conti, Sept. 20, 2001).

Interoperability will be a major section of this project, since the project itself involves the assembly and distribution of the information that the administration has assembled over many years. Using these basic suggestions, the final template for procedures may become more efficient and complete. By viewing the internal workings of OMI, one may find redundancies within their current processes. Also, good interoperability helps organizations follow regulations; one must include these regulations in each process and template. In addition, one must address the maintenance of interoperability as a possible problem.

Creating a web page containing all the information of all procedures is an ongoing process (Rothaermel, 2001, pp. 297-312). Due to constant adaptation of the web page throughout the years, one should establish a set of rules that govern changes. For example, who

can make changes, when can they make changes, and why are they making changes? Setting priorities keeps the page manageable and useful. A company uses the web page to educate its employees and customers about the workings of the organization; it adds any information perceived as valuable as documentation to the web page. The sharing of information on the page provides a collection of reference material and one should treat it as such, meaning that it should display any information that an individual finds useful to help everyone (personal communication, Frank Conti, Sept. 20, 2001).

Some guidelines on keeping a web page from getting too much "junk" information and staying organized are a concern for OMI, especially when updating the page to contain new processes and procedures. The key factor lies in supervision: the easier the supervision of the web page, the higher the quality of material displayed (Rothaermel, 2001, pp. 297-312). One should consider the "test of time" as OMI will use this system over an extended period of time.

3.6.2 Internal Policies

Government regulations and new court cases are not the biggest problem for companies (Daniels & Groner, 2001, pp. 40-42). Rather, the internal policies of each organization are becoming more difficult as procedures become more complicated. As a backlash to complex and internal processes, external processes become more complex, in turn forcing many employees to have two or more interviews with a customer before filling out any forms. Even the employees themselves are unsure about the procedures of their own companies; supervisors are spending significant time on "monitoring, supervising and auditing" their own employees, applications, and forms (personal communication, Frank Conti, Sept. 20, 2001).

Since the internal processes and procedures are becoming more cumbersome, companies are nowadays writing procedures on carrying out procedures. Increasing amounts of regulations and legal requirements cause irregularities among different sections of the company, producing multiple processes for the same basic task. Many companies are spending more money on specialists to handle the paperwork, which causes the company to waste time and money on "red tape" (Daniels & Groner, 2001, pp. 40-42).

"The streamlining effort that ignores the impact of compliance on agents cannot succeed". Interviewing the employees can find information about potential problems and tie-ups. Filling out forms is a day-to-day requirement of everyone's job and asking them will give an indication of problem areas (Daniels & Groner, 2001, pp. 40-42).

OMI will not want more procedures and processes to organize their information; instead, the project methodology must produce more efficient and straightforward procedures (Daniels & Groner, 2001, pp. 40-42). Ignoring the information known about the problem can cause more work and can actually hurt OMI's situation rather than help. Therefore, the project must keep processes short, train the employees sufficiently, and make help available after its completion (personal communication with Frank Conti, Sept. 20, 2001).

3.7 Designing Web Sites as Repositories for Information

OMI has expressed an interest in a Web-based version of the desired procedures manual. Making such a web site effective necessitates careful planning and research into the issues surrounding human-computer interaction.

Fuccella and Pizzolato document a four-step process to web site design aimed at producing well-structured, usable web sites: audience definition, requirements definition,

information organization, and wire-frame site construction. Taken in order, these steps allow a designer to construct a site that can best service its users, as well as attract new ones (Fuccella & Pizzolato, 1999). In addition, corporations have used this general model not only in the production of public commercial web sites, but also in their own internal sites; Sun Microsystems used a similar approach to coordinate the creation of its own internal information network, called SunWeb. Following a concept similar to that of Fuccella and Pizzolato, Sun Microsystems gathered information both on content and on the effectiveness of particular graphical icons, placing each into a series of mock-ups of potential sites for later evaluation. Their process, known as "discount usability engineering," relies less on formal statistics and more on generalized observation. Interpretation of general observations allowed them to complete their internal web site network rapidly, despite chances of missing some minor flaws in the specific design (Nielsen & Sano, 1994).

To define the audience, Fuccella and Pizzolato recommend that a designer allow the end users to describe themselves. A designer can solicit these descriptions through surveys; such surveys are often qualified as either *active* or *passive*. An active survey seeks out the audience members directly, whether in person or by means of a telephone or electronic mail. Passive surveys make use of an existing web site, providing a link from the main page to the survey questionnaire. Whether active or passive, audience definition surveys must ask the appropriate questions: what job does the end user hold, for what purposes and how often does the end user make use of the World Wide Web, and what would the end user like to be able to accomplish through the completed web site? The last question is particularly important; it enables the site designer to ascertain specific features of the finished product that will bolster its effectiveness (Fuccella & Pizzolato, 1999).

A popular approach to the organization of web site information involves the use of *card sorting* to divide items of subject matter into groups that are intuitive to the end user. One describes and records individual elements of content on a series of 3 x 5-inch index cards and shuffles them randomly. One gives these cards to a small group of end users, who then arrange the cards into categories that, in their opinion, appear logical and consistent. As individual opinions about proper categorical divisions may vary, a designer should heuristically seek those classification schemes that yield an eighty- percent consensus among the participating users. Once one reaches such a consensus, the designer and end users formally and explicitly label and describe each category of information; this step helps clarify and reinforce the suggestions and ideas of the end users that will ultimately make use of the site (Fuccella & Pizzolato, 1999).

Card sorting is particularly useful as a means of organizing pieces of content as it reveals people's mental models of the relevant information (Nielsen & Sano, 1994). Software engineers have employed card sorting repeatedly in the design and construction of modern software applications, using it to design the layout of structured menu commands and to discover differences across different users of varying expertise. Web site designers have also found it extremely useful in determining the content and functionality required in the products that they produce and have used combinations of focus groups, iterative and exploratory surveys, and creative exercises to gather the necessary information for use in card sorting (Fuccella & Pizzolato, 1999).

Graphical icons comprise a significant portion of modern Web sites, associating small, concrete images with generalized, abstract concepts. As such, choosing icons such that their intended meanings are clear and intuitive to the end user is important. Web site designers test icon intuitiveness by asking small groups of end users to consider groups of icons and report the concepts that they associate with the images; designers then compare these reports against the

icons' intended meanings. For their SunWeb project, Sun Microsystems extended icon intuitiveness testing to card sorting, wherein users correlated the icons presented to them with the information categories that they produced during the card sort. (Interesting to note is the observation that the use or lack of textual icon labels played no substantial role in the effectiveness of this exercise (Nielsen & Sano, 1994).)

The final proposal for a Web site design often consists of a structural mock-up, or a *wire frame* site. These mock-ups contain no content; they exist solely to portray a potential layout for future content, which end users can evaluate and critique for the design team (Fuccella & Pizzolato, 1999). Sun Microsystems walked through its proposed designs for SunWeb with its users and asked them to discuss their thoughts aloud as they proceeded. These users also provided commentary on the overall aesthetics of the Web site mock-ups (Nielsen & Sano, 1994).

Given the time constraints of this project, a modified approach to web site construction seems ideal. Task and requirement identification, card sorting, and wire-frame construction provide ample information for the design of a new web site that one must address during the construction of a web-based procedures manual. Following a model similar to the one described here should produce an effective and easy to use web site for any employee of OMI.

4.0 Methodology

4.1 Obtaining More Information in D.C.

The project proposal will first be reviewed with interested personnel at OMI. The meeting will obtain the names and schedules of those involved with the specific processes that OMI would like to develop, as well as their approval for participant observation and interviews. At the same time, the project team will familiarize itself with the structural details of OMI.

A meeting with the OMI liaison, Julie Scanlon, and managers from the Field Services, Budget and External Affairs, and Information Management divisions will discuss goals and intentions with respect to this project. At this time, one will begin to collect and assemble any available information that pertains to the procedures that the project will address. In addition, the basic purpose for each procedure and how one differs from the other internally will be defined.

4.2 Interviewing & Documentation

Once the key personnel have been identified, three meetings with each individual will be scheduled. The first will be an introductory meeting to acquaint and orient the project team with the staff, discussing the staff's various responsibilities, obligations, and day-to-day activities. The interview will touch upon each individual's goals and intentions for the WPI/NOAA project, as well as establish time frames for future meetings.

The second of the three meetings will be an interview to gather information about OMI's processes. These interviews will use open-ended questions to determine a basic structure of each task involved. Later, participant observation will gather more specific details. By observing the participants as they work, one can better learn each step in the processes and may be able to

identify smaller activities that an interview failed to reveal. From the information that each individual gives, a series of flowcharts will then be constructed. For large procedures, interviews and participant observation may prove difficult; instead, physically tracking a process through each of its stages may produce a better understanding of the workflow. Physical tracking will entail a personal "walk-through" with each of a process' forms through each stage.

Taking into consideration any similarities between individual processes, the project will then produce a preliminary process template. This template will serve as a prototype for each specific procedure in order to create and maintain an OMI standard. This standard template will give the basic outline for documenting the tasks that OMI performs internally during a process; one can then structure all future documentation using this template to preserve consistency. This template will be revised in close collaboration will all interviewees and Worcester Polytechnic Institute advisors throughout the entire WPI/NOAA project.

The third and final meeting will test and evaluate the results of our data aggregation and analysis. A more detailed discussion of this meeting appears in section 3.5, Testing and Evaluation.

4.3 Process and Procedure Analysis

The analysis will focus upon three major topics: process flowcharts, Total Quality Management (TQM), and the Balanced Scorecard (Appendix C). Each process will be evaluated using all three of these analysis tools; from the results will stem a series of recommendations for improvements. Further research may be conducted before making recommendations depending on the overall state of these processes.

The process flowcharts will be reviewed for delays and/or unnecessary stages. When drawn, a flowchart of paper or e-mail exchanges can reveal a wealth of information, including

the existence of bottlenecks and areas of miscommunication. These flowcharts will present a length of time that each process should optimally require as well as a realistic cycle time for each process. Interviews with the appropriate personnel will discuss any delays and unnecessary stages to find ways of rectifying such situation.

The project will also apply Total Quality Management to each process. TQM is a means of analysis of problematic procedural elements; its tools and methods will foster improvement through an approach of decisive actions towards more efficient processes. The tools, methods, and techniques that section 2.2 describes will be available during this analysis phase. Not all of these methods will apply to every process, however; in some cases, one will need to make an educated guess as to the most appropriate methods. Because some of these tools are inadequate for all processes, such decisions must be made on a case-by-case basis. Recommendations may need to address external processes in the effort to make internal processes more efficient.

The project will also focus on two of the four major sections of the Balanced Scorecard: learning and growth, and internal business processes. The Balanced Scorecard and associated key indicators (Appendices C&D) focus upon the measurable aspects of procedures. Attention to these two sections will create objectives, measures, targets, and initiatives for the processes upon which OMI should focus. Analyzing these four functions with an emphasis on failure to meet targets can reveal possible problems in existing processes. The Balanced Scorecards will be specific to each process and procedure; such a method should ensure helpful documentation that employees can use to set and meet appropriate goals. The Balanced Scorecard can give an employee's view of a process and how to improve it, based on the employee's personal experience. A set of key indicators will also be established to measure the efficiency and accuracy of OMI's work. This method will bring to light any problem areas that OMI can later address with TQM.

4.4 Web Site Design

Once all of the necessary information regarding the daily operations of OMI has been collected, the project will proceed with the construction of a web-based reference manual. This process consists of three stages: task and requirement identification, object sorting, and mock-up construction.

The first stage will actually begin during the initial interviews at the outset of the project. These meetings will ask employees to describe briefly their professions and usage of web-based resources. Combining this information with that gathered during the process-specific interviews will provide a list of the key informational elements necessary for an effective procedures reference manual. Each of these elements will appear on a 3 x 5-inch index card.

Once all of the major informational objects have been identified, a small group (approximately five people) will be randomly chosen from the office personnel. These people will then be asked to sort the index cards from the first stage into groups that they feel are logical and to describe these groups as they do so. This sorting process will provide insight into how the office personnel of OMI perceive and categorize data relative to their daily duties and reveal which organizational structure for the final product is most likely the best.

Lastly, site mock-ups will test the results of the card sorting. A simplistic model of the final reference manual will be constructed and feedback solicited from as many office employees as possible concerning its potential usability. This feedback will then be used to revise and evaluate iteratively further mock-ups until a suitable site design for the web-based procedures manual can be found.

4.5 Testing and Evaluation

The project will conclude by compiling the gathered procedures information, process analyses, and recommendations for presentation to OMI personnel. This meeting will solicit comments and suggestions for various improvements regarding the usability and design of the final product. This meeting (and others, if more should prove appropriate) will seek to correct any flaws in the procedures manual and clear up any confusion regarding analytical findings. The process of evaluation and revision shall continue as time permits or until the results obtained are satisfactory.

5.0 Results and Discussion

5.1 Flowcharts and Narratives

The project documented and analyzed the following OMI processes:

- Personnel Recruitment
- Off-site Conference Room Requests
- Reporting of Operating Budgets
- Internal and External Service Awards
- Review and Approval of Financial Operating Plans (FOPs) and Reimbursable Task Plans (RTPs)
- Intergovernmental Personnel Actions (IPAs)
- Property Procurement
- Annual Budget Formulation
- Clearance of Congressional Testimony
- Operation of the Personnel Management Advisory Committee (PMAC) and Operating Personnel Management Board (OPMB)

While most of these processes reflect common tasks at OMI and address policies and regulations that the office and/or government requires, some processes contain ad hoc elements that OMI included to solve problems that no longer exist; others are completely new. A few of these processes consist of two or more subprocesses that required separate documentation. No substantial documentation existed for any of these processes (though a simple procedural diagram did exist for the clearance of congressional testimony).

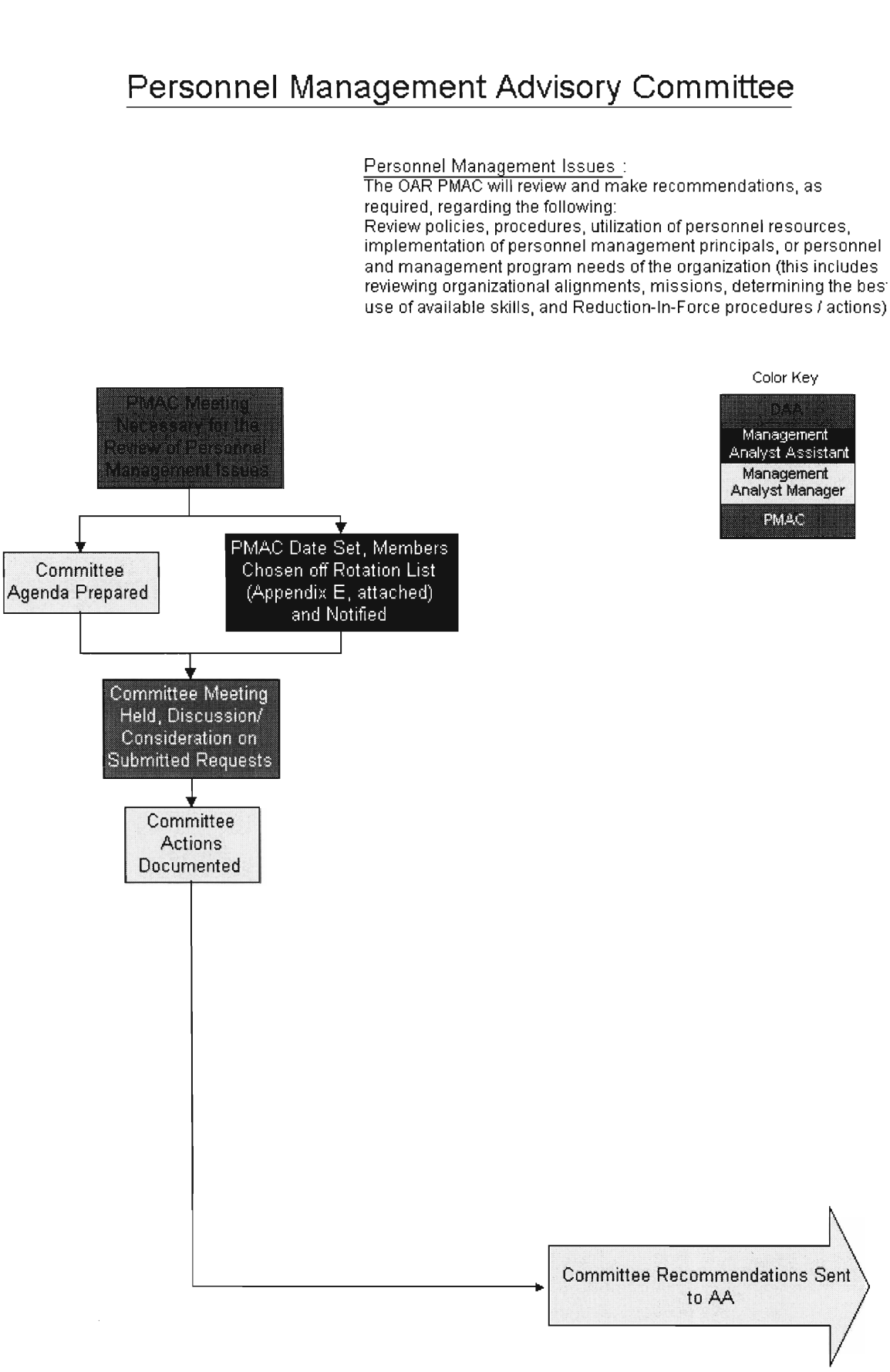

Figure 3: Sample OMI Process Flowchart

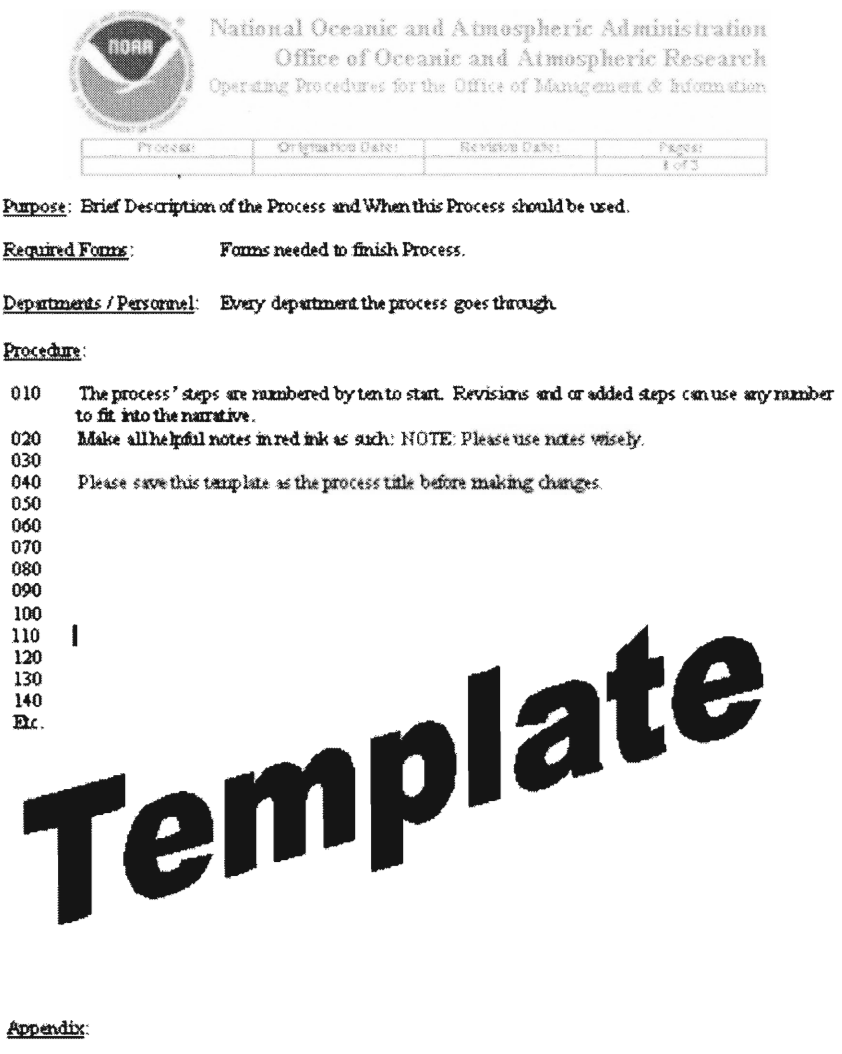

Figure 4: Sample OMI Process Template

For each of the fourteen processes, a graphical flowchart similar to the one shown in Figure 5.1 was produced. The color of each flowchart step depicts the person or department responsible for that step; these colors are standard across all fourteen charts. These charts visually demonstrate the number of people involved in a particular process, an important factor to consider when attempting to streamline cycle times and ensure accuracy.

A written narrative was also derived for each process, both in hard copy and in Web-based formats. These narratives, as shown in Figure 5.2, use a tabular format that lists sequence numbers on the left and descriptions on the right for each procedural step. In this format, one

numbers each step in increments of ten; the resulting gaps allow for future expansion without extensive renumbering of existing steps. These narratives, along with the process flowcharts and screen shots of the Web-based narratives, appear in Appendix F.

5.2 Employee Observations

Many employees made observations regarding recurrent problems in process flow during the interviews:

- Personnel Recruitment: Managers often fill out several forms incorrectly before they learn that budget constraints and/or regulations prohibit the hiring of a new employee, that hiring a new employee would require substantial reallocation of their program funds, or that such hiring would require special administrative approval. Ideally, managers would like to identify and correct such situations before filling out most of the paperwork.
- Procurement and Reporting of Operating Budget: Many managers are completely unfamiliar with the amount of mandatory paperwork and statutory regulations that govern the use and reporting of government funds. They often fail to define clearly the services that they wish to obtain, the specific reasons for such services, or the breakdown of funds earmarked for such services. Managers need to address such issues before attempting to procure services. In addition, they need a clearly defined process for reporting their operating budgets.
- Intergovernmental Personnel Actions: Many managers are unfamiliar with the nature of intergovernmental personnel actions (temporary reassignments of federal employees or contractors to different governmental agencies) and the associated deadlines. They need to allow sufficient time for processing when attempting to transfer an individual between sections of the federal government, as well as properly specify the reasons and track the funds for such actions.

- Property Procurement: The tracking of newly acquired personal property was in disarray, necessitating a system of close, centralized monitoring for such acquisitions. Today, OMI acquires and tracks new property in an organized manner; however, the process still contains the now-defunct checks and controls that OMI originally instituted to resolve the old, problematic situation. OMI now needs to remove such controls and simplify the process.
- Personnel Management Advisory Committee and Operating Personnel Management Board: The PMAC procedure calls for tightly-packed meetings that often run late, resulting in a series of scheduling conflicts. The OPMB procedure is completely new to OMI staff. In both cases, OMI needs a clearly defined, well-structured process that outlines the purpose and time required for such committee meetings.

In addition, managers sometimes remarked that some processes unnecessarily involve too many people, leading to confusion and scheduling dilemmas to accomplish otherwise simple tasks. On average, a process involves four to five distinct departments or personnel. Government regulation coerces some processes to this structure, however, as some require approval for certain tasks from several levels of NOAA.

5.3 General Findings

While many OMI processes are linear in nature, some contain steps that OMI could conduct simultaneously, and most involve documents that change hands several times. Unnecessary serialization inherently lengthens cycle times; at the interface between departments, one can lose time due to processing delays and miscommunication. As such, this project finds that most problems of office efficiency at OMI concern the assignment of tasks to individuals, which should seek to limit waiting times and the passing of paperwork. Streamlining these two

aspects of office procedures will likely yield a faster and more accurate workflow at OMI, increasing overall productivity.

6.0 Conclusions and Recommendations

6.1 Specific Recommendations

Based upon the results of interviews and discussions with employees, the following changes to office processes are recommended for improved efficiency:

- Personnel Recruitment: The Human Resources Advisor and the OAR Human Resources Assistant should review criteria on action appropriateness to minimize the number of times that one or more departments must return paperwork for corrections. A better understanding of common mistakes and the format for appropriate recruitment requests can allow OMI to fix mistakes as early as possible in the process. In addition, OMI can review salary and other financial information pertinent to the action independently of the rest of the request; performing such review steps in parallel with one another can reduce the cycle time of recruitment actions. These changes would decrease the number of procedural steps from eleven to ten and the number of involved departments from six to five.
- Off-site Conference Room Requests: The first section of the conference room request process involves a meeting in which the Administrative Officer asks the requesting employee a set of questions to ascertain the needs of the particular conference. As these questions are standard across requests, failure to address them at the outset results in wasted time and frustration for both the Administrative Officer and employee. Standardization of these questions in the form of a template that the employee completes before making requests can eliminate much of this frustration. This background information can allow the Administrative Officer to process the request as quickly as possible and reduce the number of procedural steps from twenty-one to eighteen.

- Reporting of Operating Budgets: The draft of the spending plan that the area managers prepare should be a working document; that is, area managers should begin drafting their plans when the Administrative Officer first requests them. Early drafting can give area managers a better idea of what they should cut or expand when they later receive the conference mark. Overall, the process concerns only four departments and involves mandatory reporting stages that are linear in nature. The rest of this process already exists in an optimal state; therefore, no further changes are recommended.
- Internal and External Service Awards: The processing of internal awards largely concerns the Management Analyst Assistant, who oftentimes must wait for input from several different departments. The work that these departments carry out, however, is quite necessary. Similarly, external award processing is extremely straightforward and already involves as few people as possible; making any procedural changes would thus likely be detrimental to productivity. As such, no changes are recommended to the selection and notification of service awards.
- Review and Approval of FOPs and RTPs: The OAR Budget Execution Team should attempt to match negative and positive FOPs electronically, rather than by hand. These FOPs exist already in an online database and such matching could reduce much of the paperwork involved. In another vein, the quarterly deadlines of the FIMA system sometimes require the OAR Budget Execution Team to contact individuals either verbally or electronically and fix erroneous FOPs and RTPs on the fly, rather than return them to their originators for correction. This "crisis-mode" handling should be the norm, rather than the exception, in the graduated approval process. Solving problems in this manner would reduce the number of times one needs to review the same FOP/RTP and would lower the number of steps taken in the worst case from twenty-three to thirteen. In addition, the total number of distinct steps that exist within the process (across all possible flow paths) would be reduced from nineteen to eighteen.

- Intergovernmental Personnel Actions: No structural changes are recommended with respect to the IPA process, as it involves only three departments and is linear in nature. It is recommended, however, that OMI or managers that initiate IPAs maintain a "tickler" file of termination dates. Two months prior to the termination of an IPA, one should dispatch an e-mail message reminding managers of the impending IPA renewal deadlines. Also, OMI should attempt to impress upon its employees the need for a one-month lead before beginning an IPA.
- Property Procurement: The process of procuring IT equipment should be distinct from the one that procures standard equipment, with IMD tracking newly acquired IT equipment and a "floor secretary" maintaining the whereabouts of standard office resources. The floor secretary should use the same database structure as the one that IMD uses for tracking equipment and should report its contents once a year in tandem with IMD for auditing purposes. In addition, OMI should investigate the possibility of using wireless barcode scanners when logging the movement of equipment that bears a Department of Commerce tracking code; such scanners cost approximately $1,000 at the time of this writing.
- Annual Budget Formulation: Although the portion of the budget formulation process selected for documentation in this project is quite involved, to make effective recommendations would require that OMI document the entire OAR budgeting process. This task is beyond the scope of this project.
- Clearance of Congressional Testimony: The critical elements of the process by which OMI clears Congressional testimony involves several external departments that are best suited to the jobs that they perform. External Affairs has the best understanding of the wishes of Congress, while the scientist is the expert in the field. All of the checks and balances in the clearance process appear necessary to the accuracy and professionalism of the produced testimony; therefore, no recommendations are given.

- Personnel Management Advisory Committee: The division of work between the Management Analyst Manager and Management Analyst Assistant should be consolidated so as to avoid potential miscommunication and unnecessary coordination of personnel. PMACs for awards should revise the method by which nominators contact the committee; rather than the nominators calling at five-minute intervals, the committee should call the nominators. The committee can establish twenty-minute time slots during which they will contact nominators for information, avoiding scheduling conflicts when such calls run long. PMACs for individual personnel actions should distribute topics of discussion to the labs and programs beforehand, reducing the chance that conversations with the calling labs or programs will digress needlessly. Such changes would reduce the number of steps and the number of departments involved for the awards process from twelve to ten and five to four, respectively. For the IPA process, the reductions are from fourteen to thirteen and from six to five, respectively.
- Operational Personnel Management Board: A recommendation calls upon the OPMB to establish meetings at regular intervals. Under such a system, necessary meetings avoid much of their setup time while unnecessary meetings can be quickly and easily cancelled. Such a change would reduce the number of procedural steps from thirteen to eleven and the number of involved departments from four to three.

6.2 General Recommendations

In addition, three general recommendations are made to OMI. Each of these recommendations is presented here using the Balanced Scorecard (figure 6.1), which defines goals in terms of specific objectives, metrics, targets, and initiatives (Sisson, 2001).

As this project demonstrates, procedural documentation is crucial to ensuring effective office processes; such is the first goal that Figure 6.1 outlines. The early documentation of new

processes is important, and the number of process cycles that occur before an office produces complete documentation provides a valuable means of measuring success at this goal. Ideally, OMI should undertake a process no more than two times before documenting the major steps; to this end, it can designate a recorder that takes procedural notes whenever beginning a new process for the first time. This early documentation can outline the tasks and goals of an office before confusion arises and other obligations snowball.

As with all things planned, unforeseen problems often arise. A fast response to such problems minimizes the negative impacts that they may have; therefore the quick notification of process failures to the affected personnel is important. Figure 6.1 outlines this goal in terms of the speed with which employees communicate such concerns. As a rule, no more than twenty-four hours should elapse between the time at which a process step fails and the time that all affected personnel receive notification. To better expedite such notification, an office can make increased use of e-mail and return phone calls at regular intervals, which carry the added benefit of reduced paper for the office.

Requests made only verbally ("napkin deals") are inherently at risk for confusion. As the amount of work that an office shoulders increases, the likelihood that an employee will remember a verbal request diminishes. In addition, an employee may miss crucial procedural steps. Figure 6.1 attempts to quantify the number of such requests and establish an upper bound on their use; while some such requests pose no problem, heuristically no more than ten percent of all requests should fall into this category. To avoid the overuse of undocumented requests, office employees can switch to making all requests through e-mail, which automatically provides a basic tracking system.

Objective	Metric	Target	Initiative
Earliest possible documentation of new processes	Number of process cycles before documentation	Maximum of two	Designation of a recorder
Immediate communication of failure	Time between failure and notification	Maximum of twenty-four hours	Increased use of e-mail, fast returning of phone calls
No undocumented requests ("napkin deals")	Percentage of requests not documented	Maximum of ten percent	Making of requests through e-mail

Figure 5: OMI General Recommendations

6.3 Key Indicators

To measure performance, three processes lend themselves to the use of key indicators. OMI can gauge the effectiveness of property procurement by the number of unreconciled acquisitions, which the Department of Commerce reports at regular intervals. Those FOPs and RTPs that one must rush through the approval process indicate potential trouble spots. Similarly, the number of packages returned for corrections can provide one with a measure of problems in the recruitment process. Each of these metrics shows at-a-glance the effectiveness of office procedures in a quantifiable manner.

6.4 Future Work

This project leaves several possibilities for future work. Continued documentation of processes on a larger scale, as well as the further application of Total Quality Management techniques, can broaden the scope of this project to include more OMI processes and related departments. In addition, OMI can dramatically reduce the effort required for such an undertaking by extending the existing documentation templates provided here.

6.5 The IQP Experience

For the authors, this project constitutes an Interactive Qualifying Project, a requirement for all undergraduate degrees at Worcester Polytechnic Institute. Equivalent to three courses, this project carries seven weeks of full-time work, with an additional seven weeks of preliminary preparation. As stipulated in the WPI Plan, the Interactive Qualifying Project demonstrates a student's understanding of the relationship and influence that technology bears upon modern society.

6.6 Acknowledgements

The authors would like to thank advisors Prof. Richard D. Sisson and Prof. Brigitte Servatius, as well as OMI liaison Julie Scanlon, for all their help and support in the pursuit of this venture. In addition, they would also like to extend their gratitude to the employees, staff, and support personnel of OMI, without whom none of this project would have been possible.

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Appendix A: Overview of the National Oceanic and Atmospheric Administration

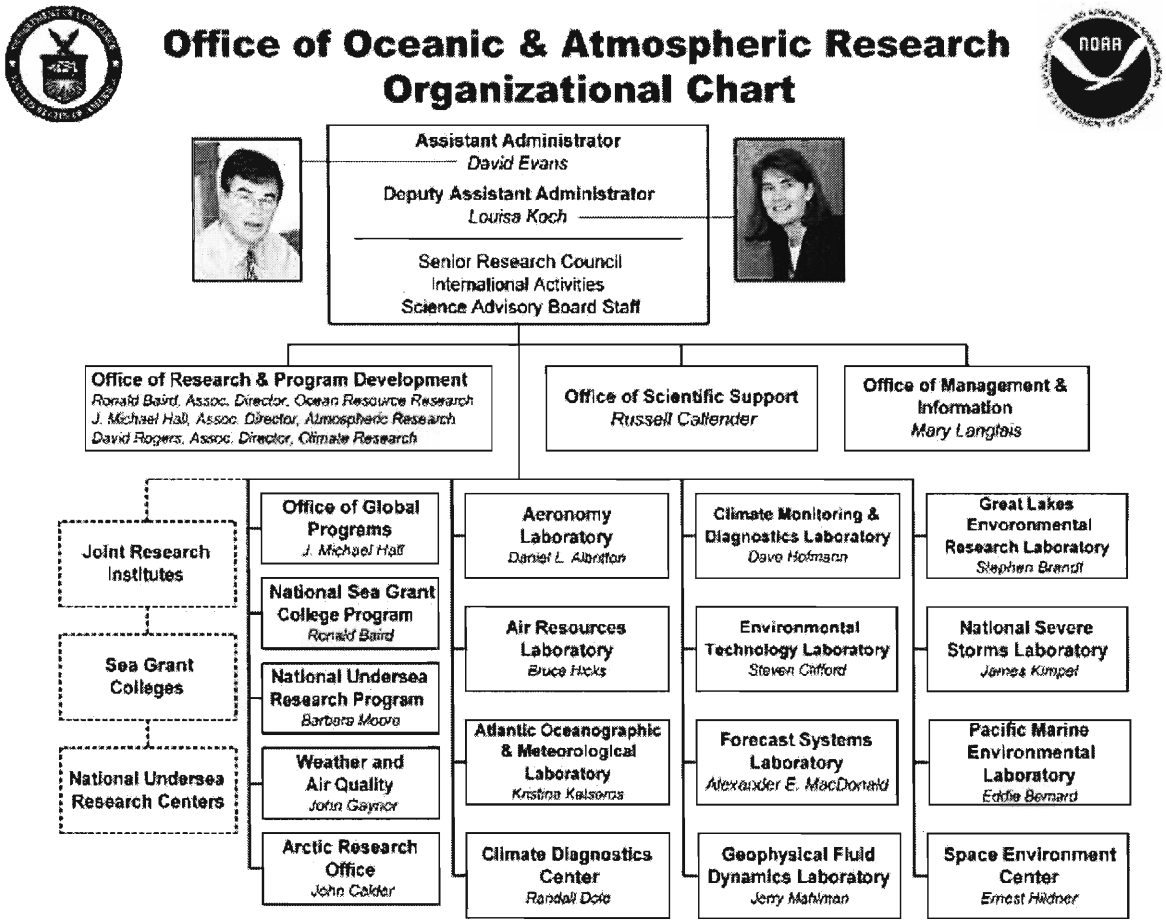
The mission of the National Oceanic and Atmospheric Administration is "to describe and predict changes in the Earth's environment, and conserve and manage wisely the Nation's coastal and marine resources to ensure sustainable economic opportunities." (NOAA, 2001.) The U.S. Government created NOAA following an address to Congress that President Nixon made in July 1970, in which he called for an agency to satisfy the need "...for better protection of life and property from natural hazards...for a better understanding of the total environment...[and] for exploration and development leading to the intelligent use of our marine resources..." NOAA exists today as a collection of several organizations, ranging from the National Weather Service, the National Environmental Satellite, Data, & and Information Service, and the National Marine Fisheries to NOAA Research.

Office of Oceanic and Atmospheric Research

Working with several of the individual components of NOAA is the office of Oceanic and Atmospheric Research (OAR, also called NOAA Research), the research and development organization of the administration (NOAA, 2001.). OAR seeks to provide the rest of NOAA with products and services that forecast the varying conditions in the Earth's climate. Twelve laboratories (with eleven research partners), the National Sea Grant Program, the Office of Global Programs, and the National Undersea Research Program comprise OAR; these components carry out academic research on the Earth's atmosphere, climate, and oceanic resources. NOAA Research has accomplished several notable feats in its field, including detection and analysis of the cause of the hole in the Antarctic ozone layer, improvement of the

National Weather Service to predict the weather condition El Nino six months in advance, and effective modeling of hurricane tracking that over fifty million residents of the east coast use. Congress appropriated $334.2 million in FY2001 to NOAA Research, continuing a trend of steady increase in funding for the agency's scientific study and development plans.

Organizational Chart of OAR



Source: Office of Oceanic and Atmospheric Research, 2001

Office of Management and Information

The Office of Management and Information manages, among other items, human resources, budget acquisition, liaisons with outside agencies, and information technology for OAR (NOAA, 2001). Formally, OMI contains three sections: the Field Services Division (FSD),

the Budget and External Affairs Division (BEA), and the Information Management Division (IMD). FSD concerns itself with assisting in-field operations and ensuring the compliance of such operations with congressional standards; BEA allocates, approves, and tracks funds for individual research programs; and IMD develops, implements, and coordinates information technology-based systems and standards. Below are excerpts from OMI's web site further describing the functions of each division:

Field Services Division

The Field Services Division (FSD) manages and tracks field financial allocations and related resources and provides operations services to field laboratories. FSD is responsible for receiving targets from the Office of Oceanic and Atmospheric Research (OAR) budget office and breaking those targets out by line item to laboratories and programs. It ensures that congressional direction for funding field programs is followed. FSD prepares financial operating plans by line item and by object class for all field Financial Management Centers, and maintains the field services internal allocation database for each line item. FSD is responsible for year end [sic] closeout and reconciliation for the field; deobligations for the field; field facility budgeting; and Full-Time Equivalent (FTE) tracking for the field. FSD manages and controls reimbursable agreements, Memoranda of Understanding, and funds OAR-wide. FSD is also responsible for distributing and tracking of programmatic research funds associated with the Office of Research and Program Development. FSD provides representation for DOC/NOAA and the OAR Boulder-based laboratories in interactions on facilities and administrative issues with other Federal agencies, state and local government, local Congressional staff, the news media, industry, business, and academia. FSD explores operational and research needs, as appropriate, that can be met by the Boulder laboratories and develops mechanisms of cooperation with other institutions.

It provides a NOAA focus for coordinating management and administrative functions among the NOAA tenants in the David Skaggs Research Center, in Boulder, Colorado (NOAA, 2001).

Budget and External Affairs

The Budget and External Affairs Division is responsible for preparing all budget submissions to NOAA, DOC, and Congress. This Division coordinates with the Office of Scientific Support on the scientific and technical aspects of the budget submission, including the development of narratives, exhibits, tracking tables, briefing books and other justification materials--this also includes facilities budgeting and representation for the Office of Oceanic and Atmospheric Research (OAR) on budget issues in the NOAA Facilities Council. It allocates funds to programs, approves OAR Headquarters Financial Operating Plans, coordinates variance explanations, and directs Full-Time Equivalent (FTE) planning and tracking. This Division also coordinates OAR-wide year end closeout, conducts quarterly financial program reviews, coordinates OAR-wide input into CAMS planning and ensures NOAA audit corrective actions, evaluates and manages NOAA assessments, evaluates ADF requests, monitors the gift fund, inputs financial data into the OAR operating plan, and conducts quarterly reviews on this plan with NOAA. This Division reviews appropriation reports and ensures that congressional directions on program spending are carried out and periodically reports to OAR senior management on the status of spending. The Division houses the Chair of the new OAR Grants Council and coordinates OAR wide issues with the NOAA Grants Office. This Division works with programs and field operations staff on OAR-wide finance issues, such as travel, credit cards, obligation and payment issues, and develops financial requirements for the OAR management information system. This Division provides safety officer duties for OAR Headquarters. This Division is the focal point for coordination of activities in congressional

affairs, constituent affairs, and education; leads and directs development of the annual plan for activities in public affairs, constituent affairs; develops strategies for OAR congressional communications on program and budget issues; coordinates development of testimony; clears comments on legislation and responses to congressional information requests; develops briefing and issue papers; and works with the NOAA Office of Legislative Affairs to schedule briefing and site visits with congressional staff and OAR scientists. This Division coordinates the dissemination of general interest information to employees, university partners and others through the OAR web page and an OAR quarterly newsletter. This Division is responsible for OAR web page content and coordinates efforts of the OAR Outreach Committee; development of customer service plans which are part of the OAR operating plan submission to NOAA; and development of communication plans, in conjunction with program staff, for activities involving constituents and university partners (NOAA, 2001).

Information Management Division

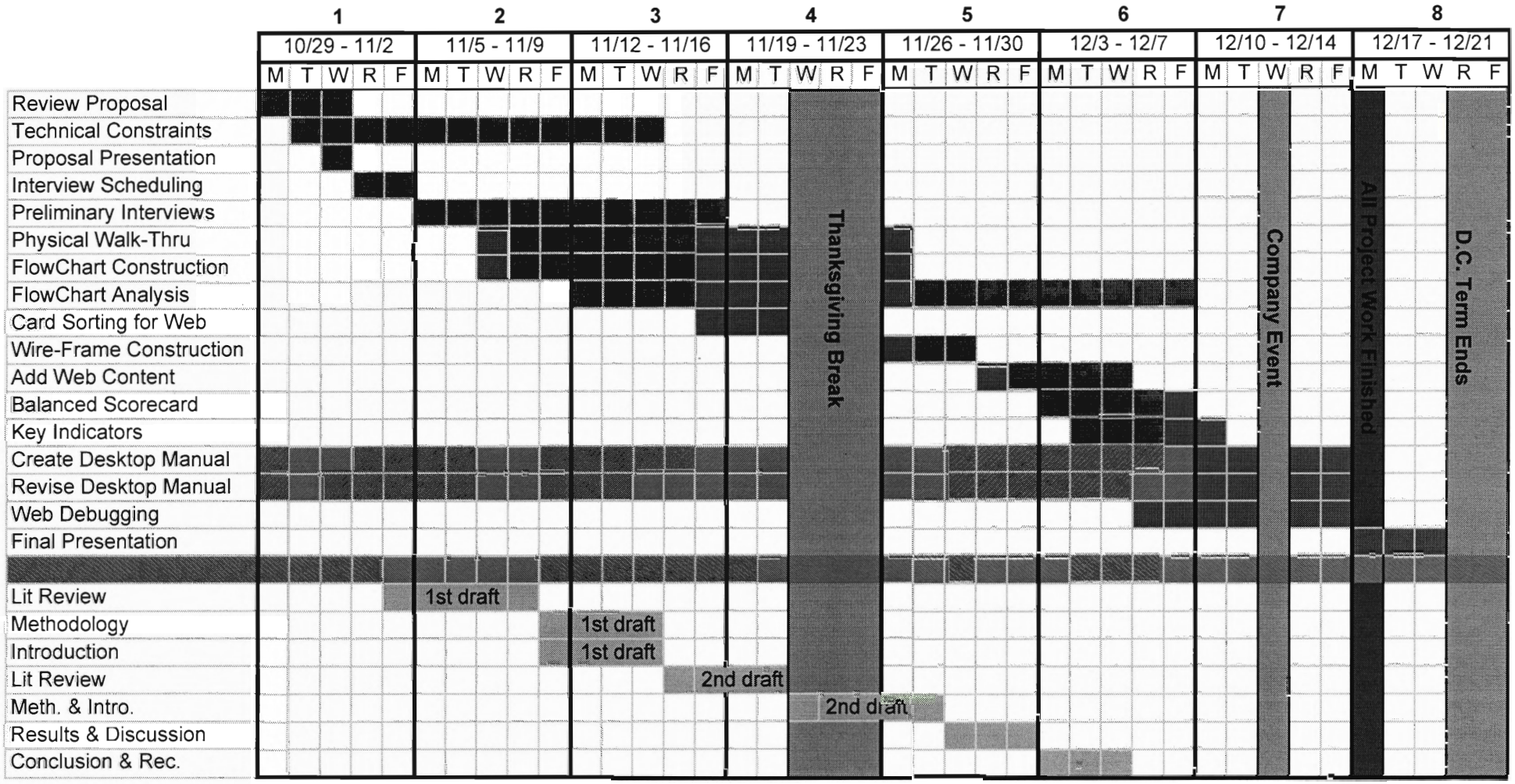
The Information Management Division (IMD) provides advice and guidance on information management matters for the Office of Oceanic and Atmospheric Research (OAR) Headquarters, as well as agency-wide initiatives; develops Information Technology (IT) policies; coordinates IT standards; develops IT national systems; and operates agency-wide information management systems and networks. The IMD Chief is the OAR Chief Information Officer responsible for implementing the Clinger-Cohen Act and other related statutes in the areas of IT planning, investment review, computer security and architecture and standards. The Division coordinates information resource management, information technology security, and omputing/communications [sic] matters with NOAA/DOC. IMD is responsible for national and headquarters data base coordination and development; operates local and wide area networks;

maintaining personal computers; administering agency e-mail systems; supporting headquarters computing and computer training needs; developing and maintaining the agency intranet; interacting with the SSMC network operations center; and providing computer support and services to headquarters and OAR laboratories (NOAA, 2001).

Appendix B: Work Plan

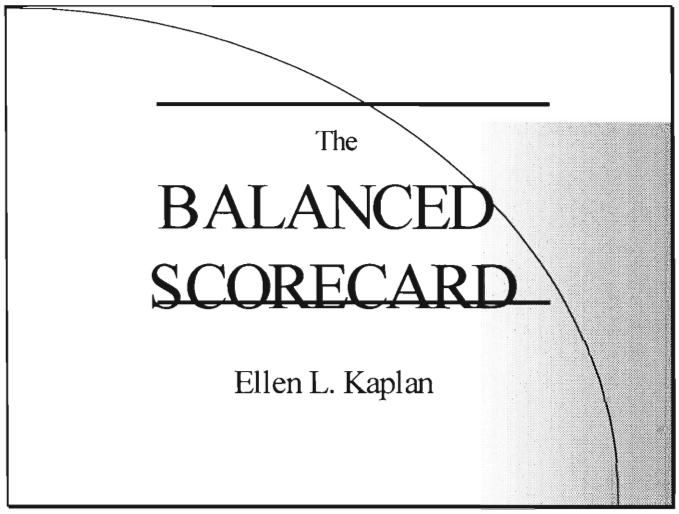
Following is a Gantt chart depicting the proposed schedule of tasks and events during the WPI/NOAA project:

National Oceanic and Atmospheric Administration Timeline



Appendix C: The Balanced Scorecard

Slide 1



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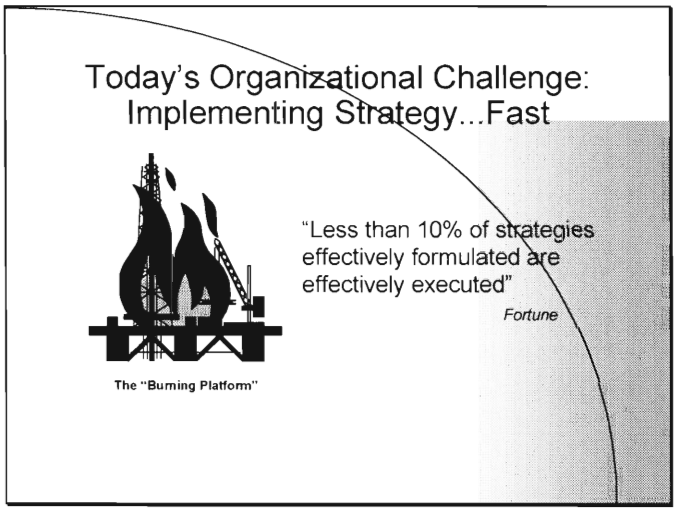

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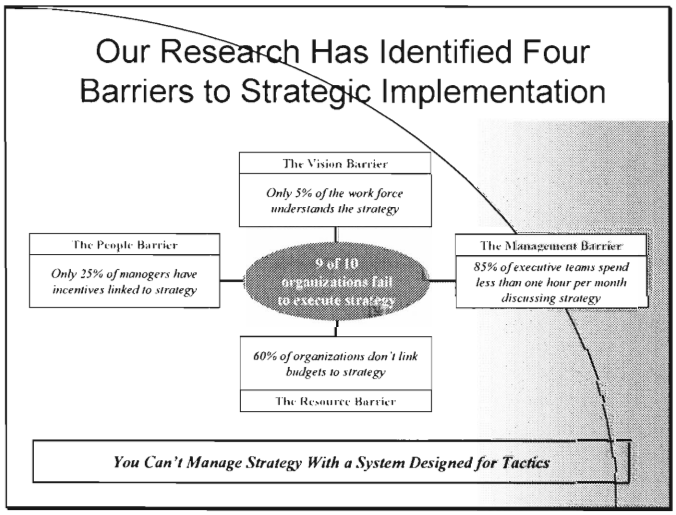


Slide 4

Why are Organizations Adopting a Balanced Scorecard?

- **Change**

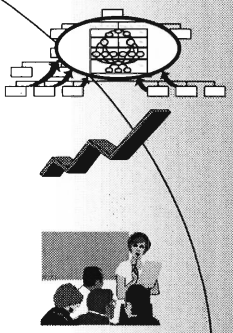
Formulate and communicate a new strategy for a more competitive environment

- **Growth**

Increase effectiveness, not just cut costs and enhance productivity

- **Make Strategy an Everyday Job**

Every employee implements the new growth strategy in day-to-day operations



Slide 5

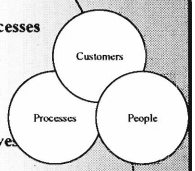
The Balanced Scorecard Focuses on Factors that Create Long-Term Value

Traditional financial reports look backward

- **Reflect only the past: spending incurred and revenues earned**
- **Do not measure creation or destruction of future economic value**

The Balanced Scorecard identifies the factors that create long-term economic value in an organization, for example:

- **Customer Focus: satisfy, retain and acquire customers in targeted segments**
- **Business Processes: deliver the value proposition to targeted customers**
  - **innovative products and services**
  - **high-quality, flexible, and responsive operating processes**
  - **excellent post-sales support**
- **Organizational Learning & Growth:**
  - **develop skilled, motivated employees;**
  - **provide access to strategic information**
  - **align individuals and teams to business unit objectives**



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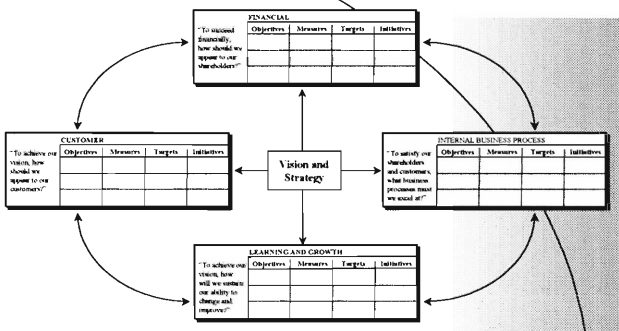
Translating Vision and Strategy: Four Perspectives



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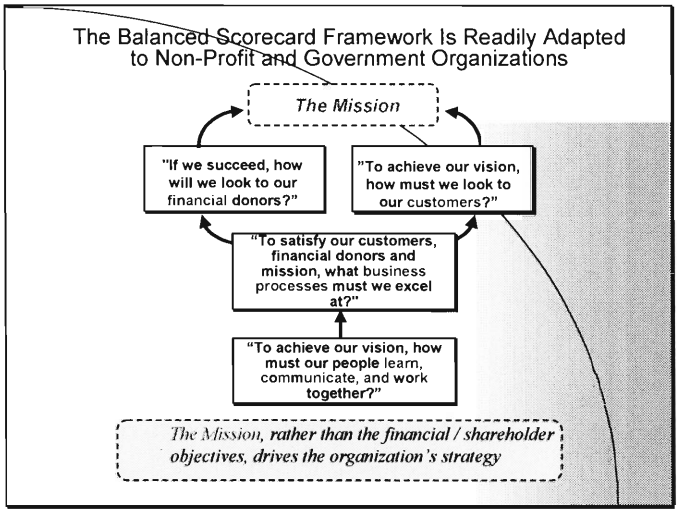

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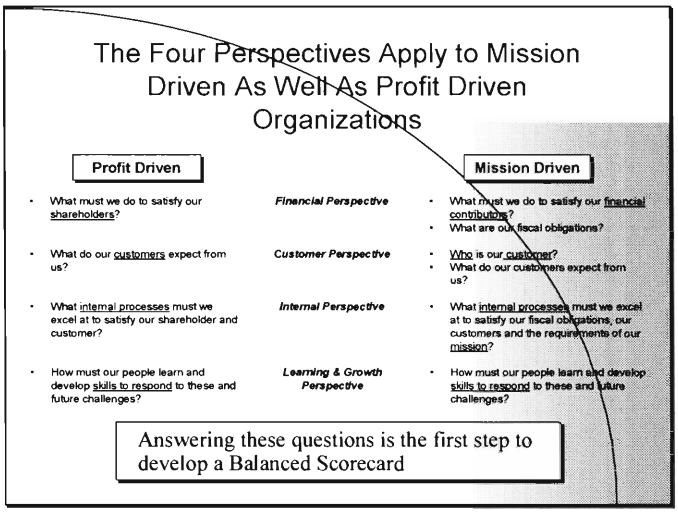

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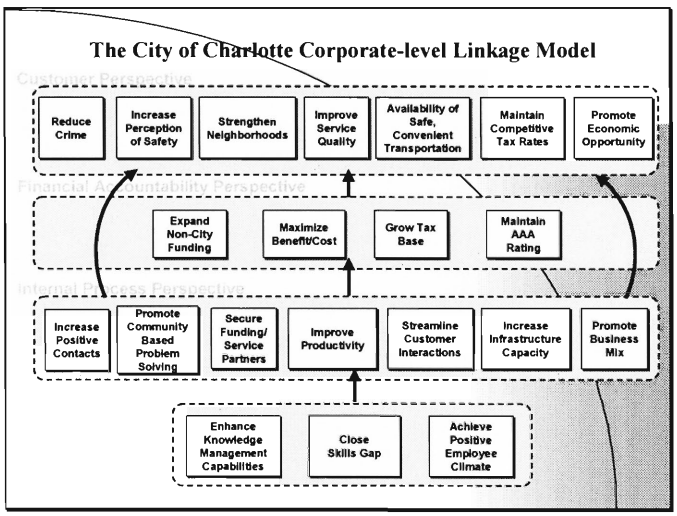

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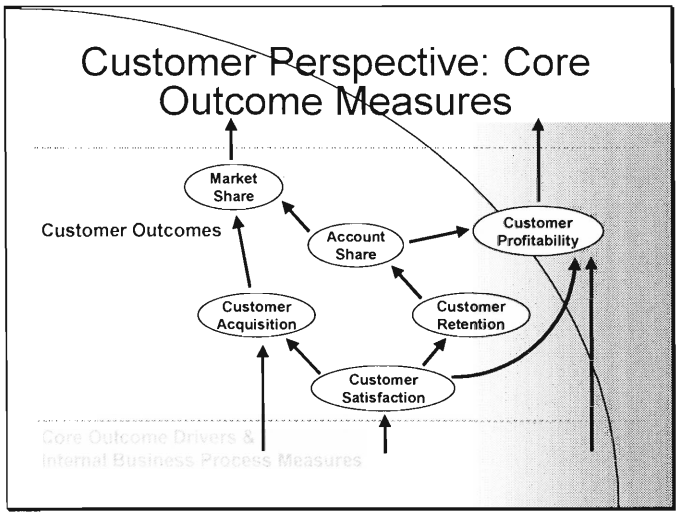

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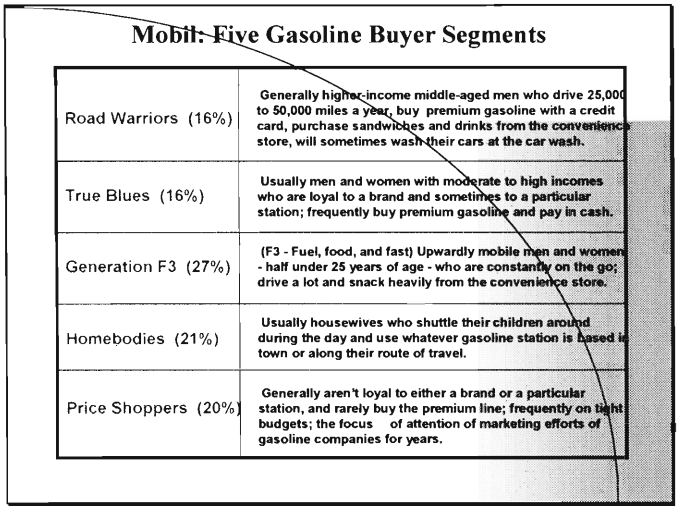

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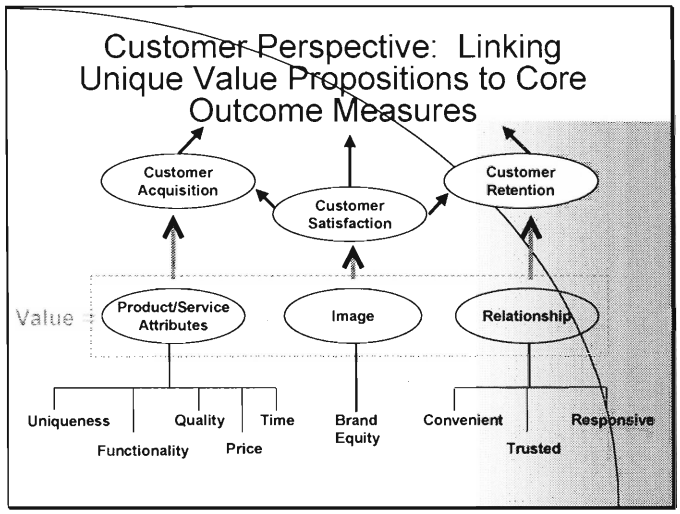


Slide 13

Strategy is deciding what not to do!

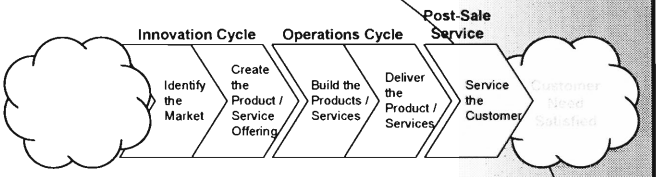
"Strategy renders choices about what not to do as important as choices about what to do. Indeed, setting limits is another function of leadership. Deciding which target group of customers, varieties, and needs the company should serve is fundamental to developing a strategy. But so is deciding **not to serve** other customers or needs and **not to offer** certain features or services. Indeed, one of the most important functions of an explicit, communicated strategy is to guide employees in making choices that arise because of trade-offs in their individual activities and in day-to-day decisions."

Michael Porter, "What Is Strategy?" *Harvard Business Review* (Nov.-Dec. 1996), p. 77.

Slide 14

The Internal Perspective

Generic Value Chain Model



Slide 15

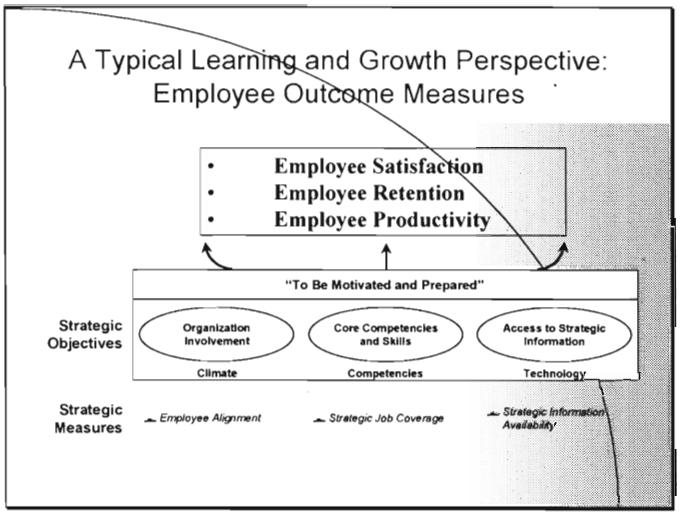
Learning and Growth: Identify the Enablers of Organizational Learning

$$\text{Organization Learning} = f\left[\begin{pmatrix}\text{Human}\\ \text{Competencies}\end{pmatrix}, \begin{pmatrix}\text{Technology}\\ \text{Infrastructure}\end{pmatrix}, \begin{pmatrix}\text{Climate for}\\ \text{Action}\end{pmatrix}\right]$$

Typical Learning & Growth Objectives

Skills & Competencies	Knowledge & Technology Assets	Climate for Action
• Strategic skills • Training levels • Core competencies	• Strategic technologies • Strategic databases • Experience capture • Best practices • Patents, copyrights	• Accountability / empowerment • Alignment • Morale • Teaming

Slide 16



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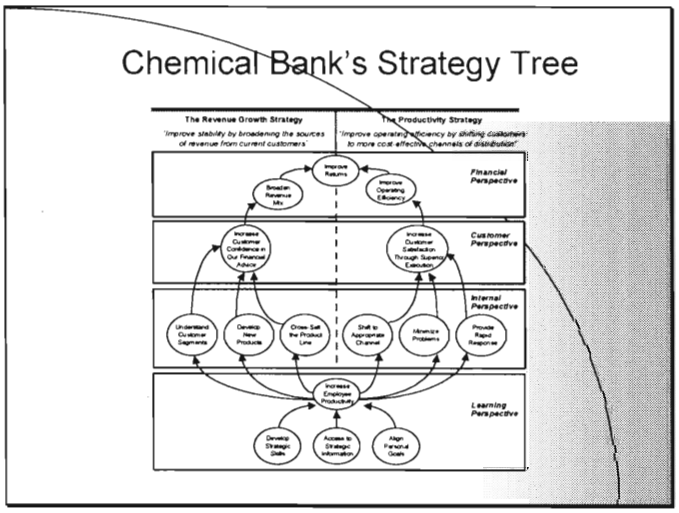

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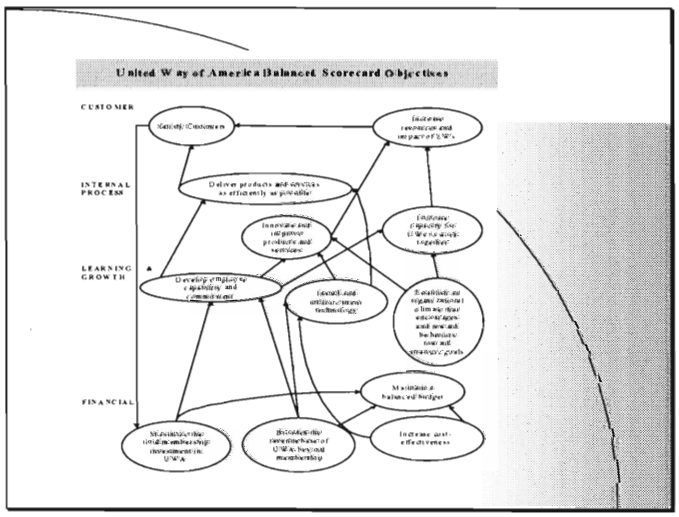


Slide 19

A Good Balanced Scorecard Tells the Story of Your Strategy

Every measure is part of a chain of cause and effect linkages

Every measure eventually ties to a measure of organizational success

A balance exists between outcome measures (financial, customer) and performance drivers (value proposition, internal processes, learning & growth)

Slide 20

The Balanced Scorecard: Strategic vs. Diagnostic Measures

Strategic Measures

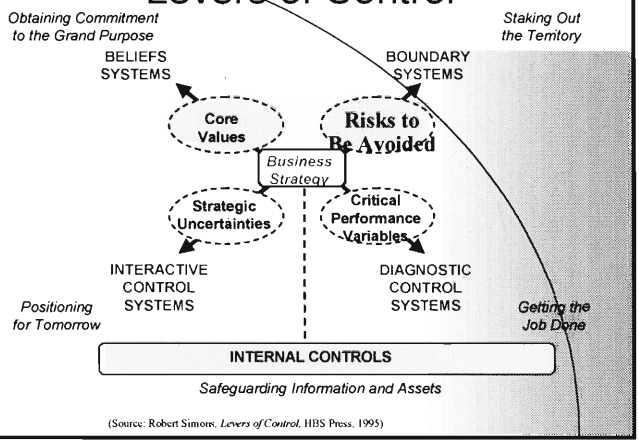
- Outcomes and Drivers of Long-Term Value Creation
- 4-7 Measures/Perspective
- Management Communication, Planning, and Feedback

Diagnostic Measures

- Vital Signs (e.g., body temperature, blood pressure)
- Management by Exception

Slide 21

Levers of Control



(Source: Robert Simons, *Levers of Control*, HBS Press, 1995)

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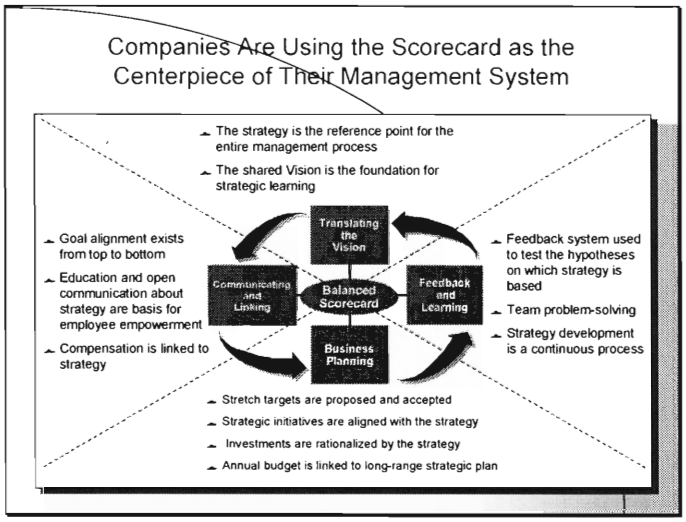

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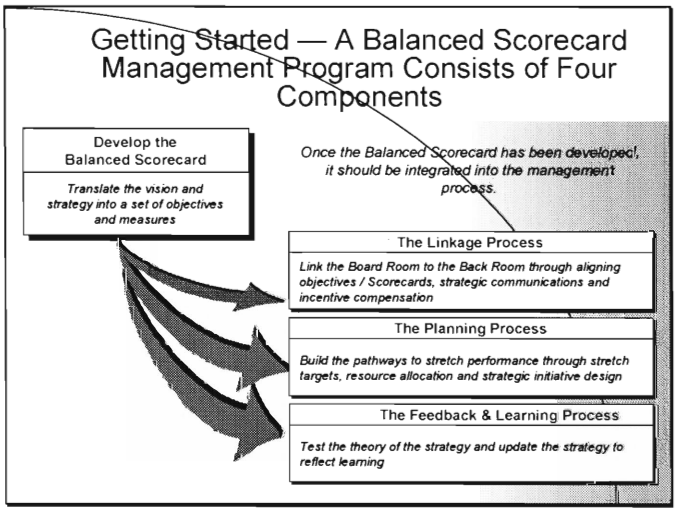

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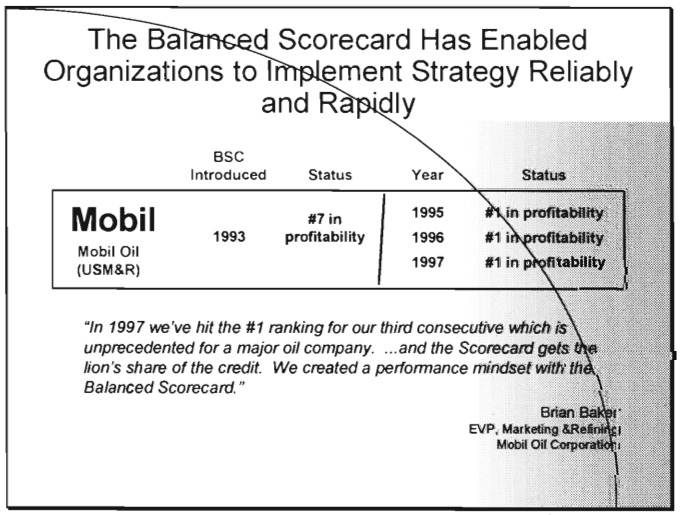

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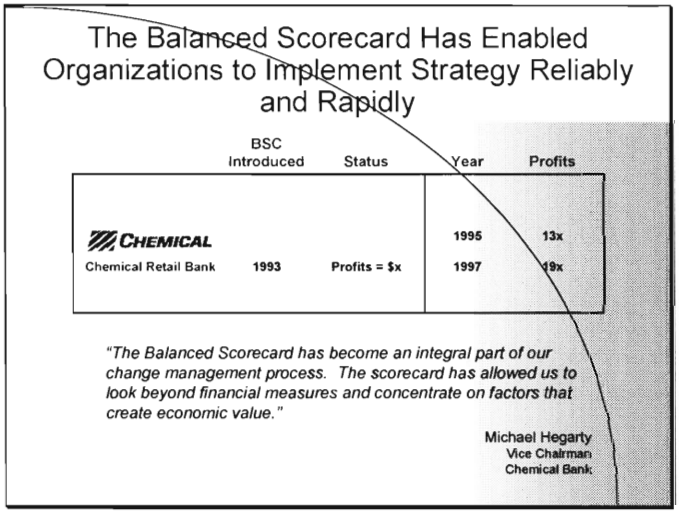

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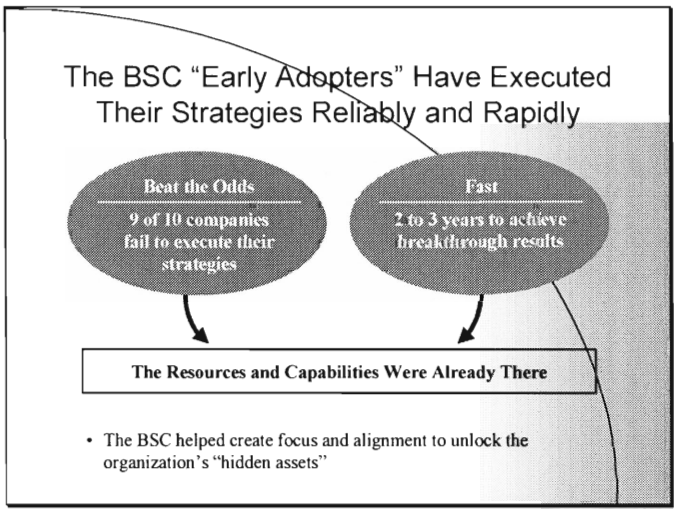

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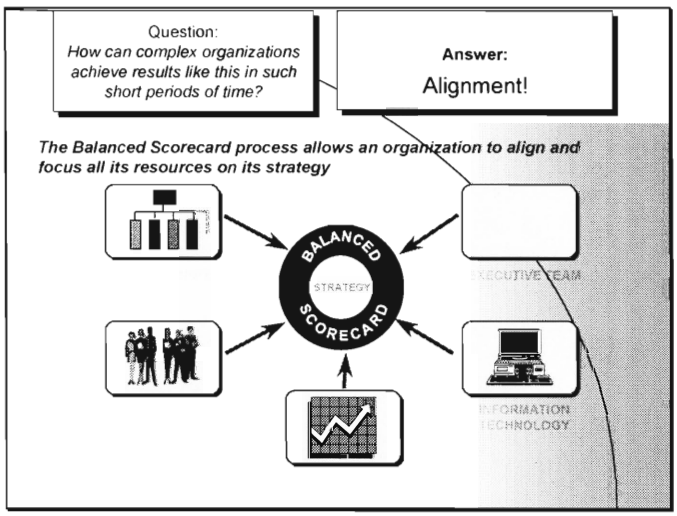

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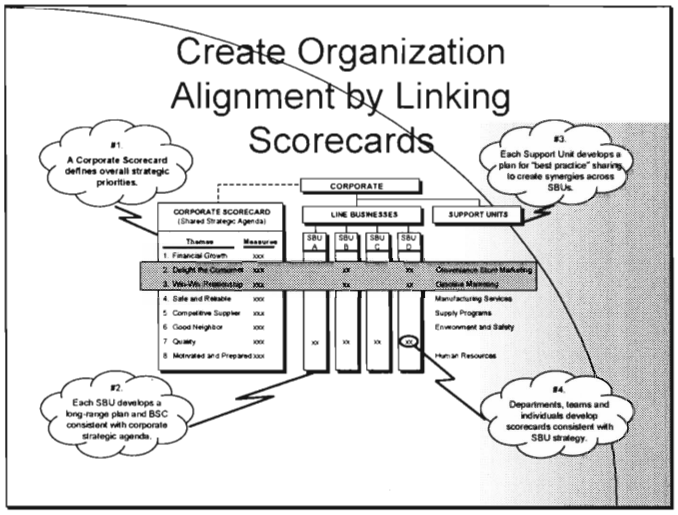

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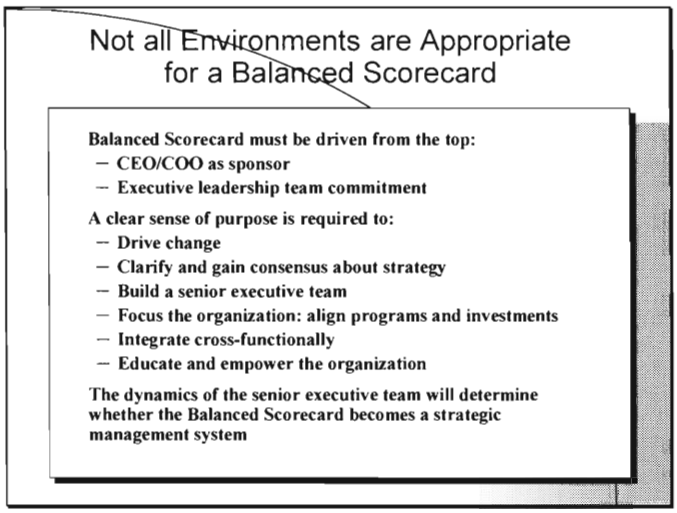
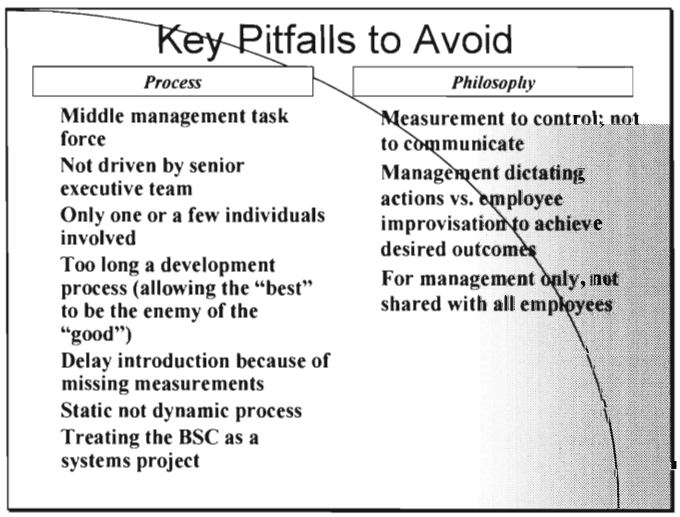


Slide 30



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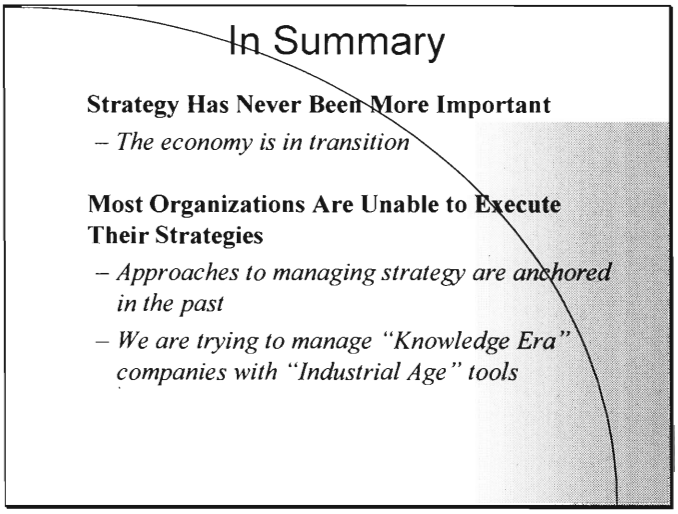

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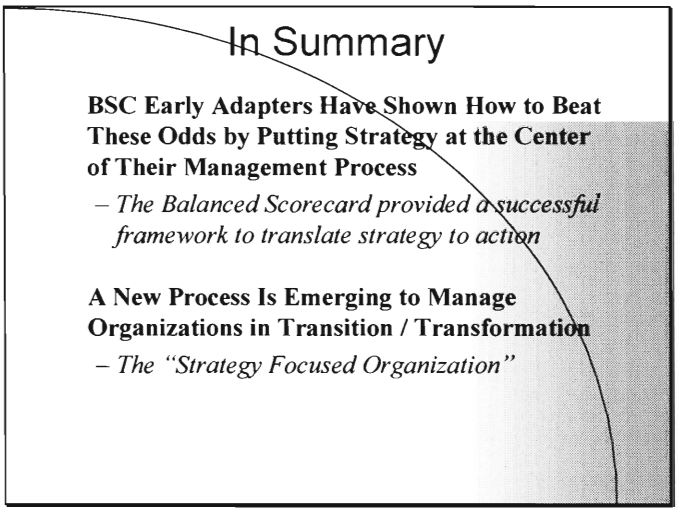

Appendix D: Key Indicators

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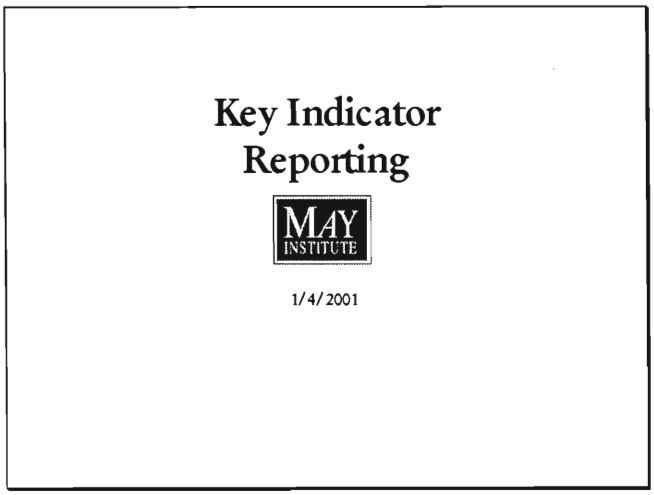

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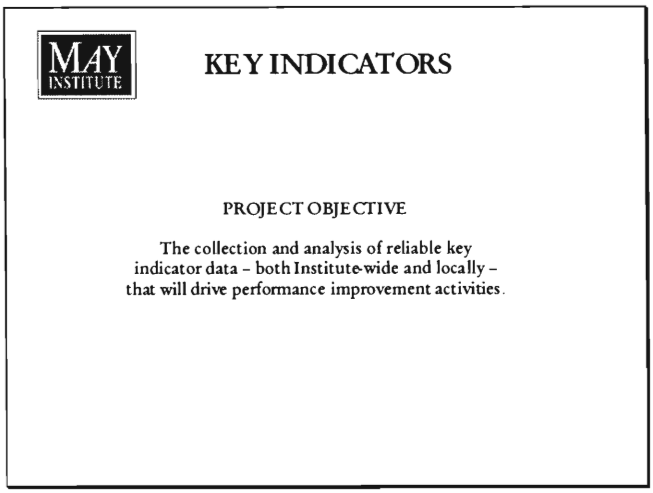
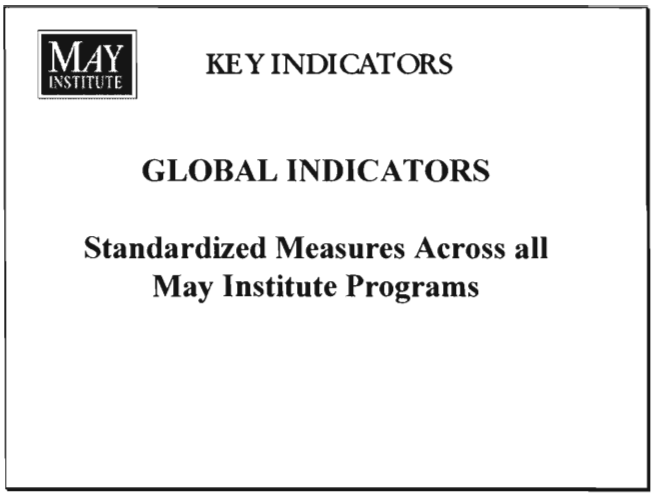


Slide 3

Slide 4



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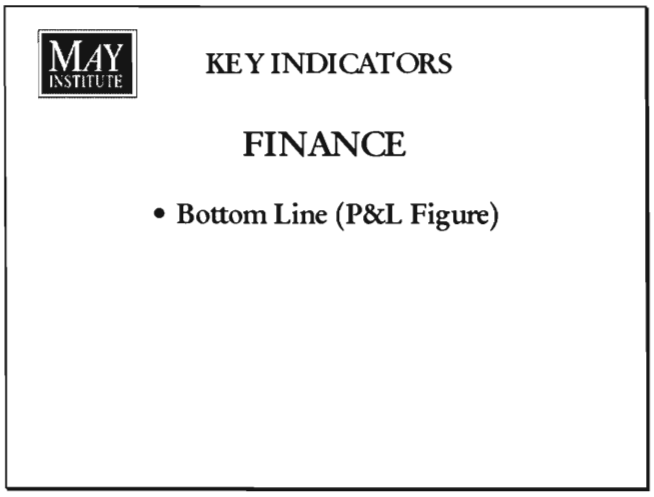
Slide 6



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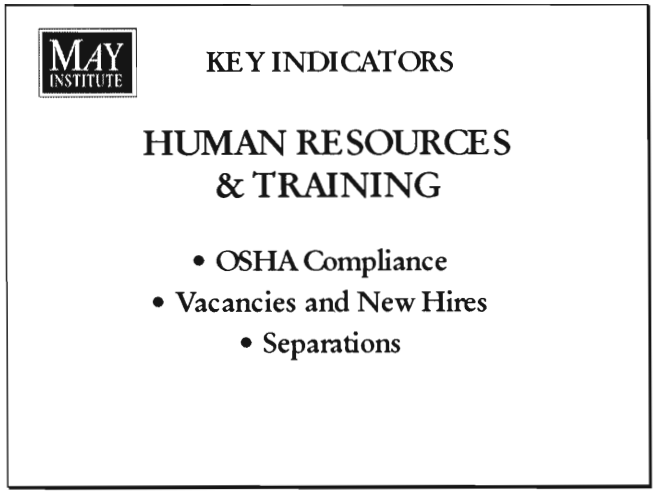

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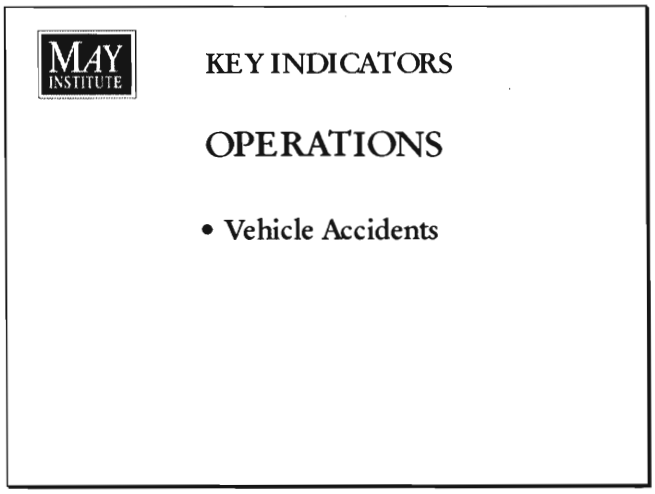

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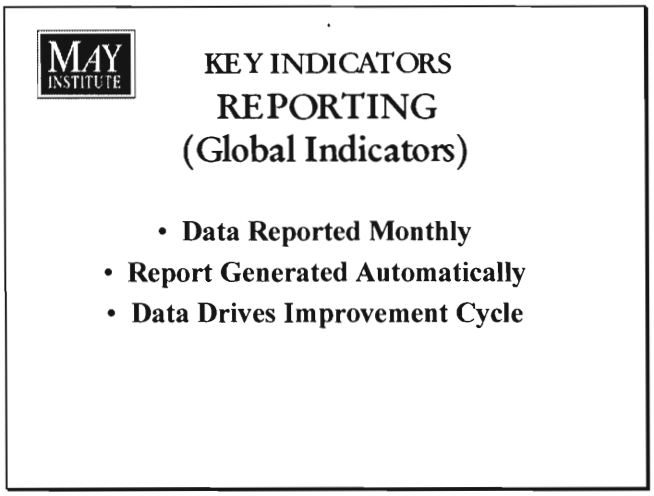

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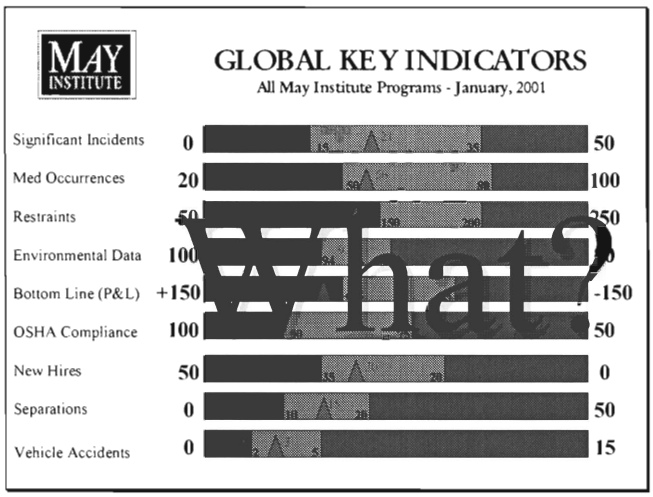

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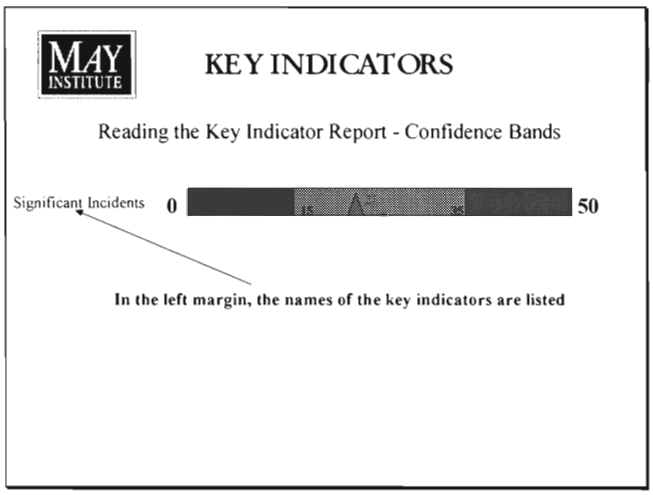

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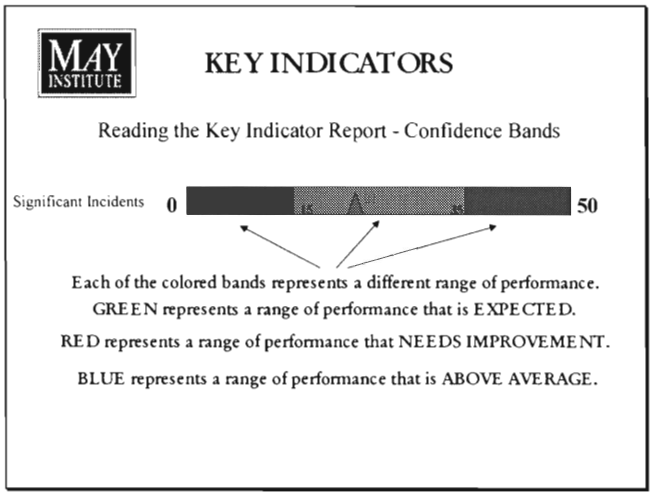

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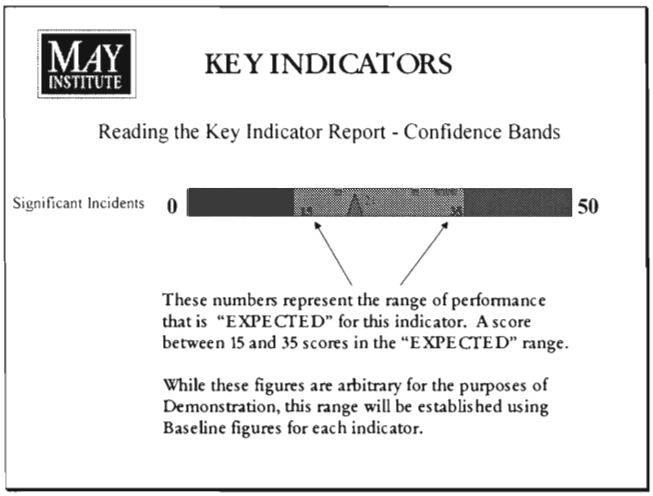

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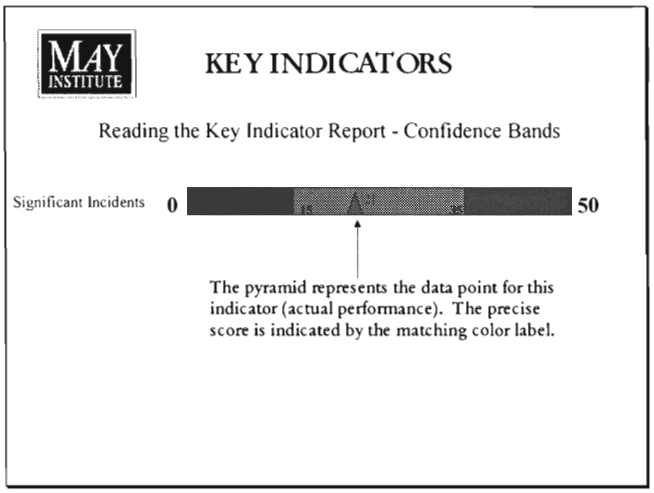

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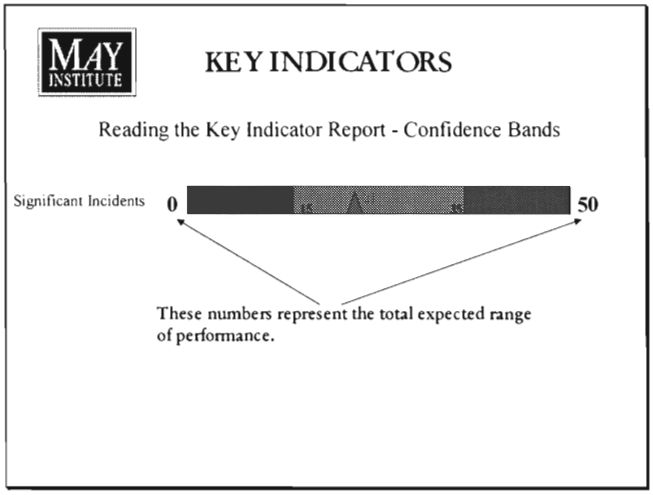

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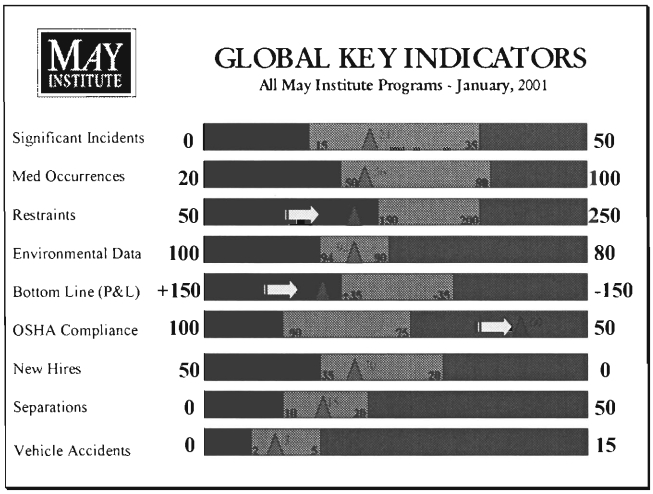

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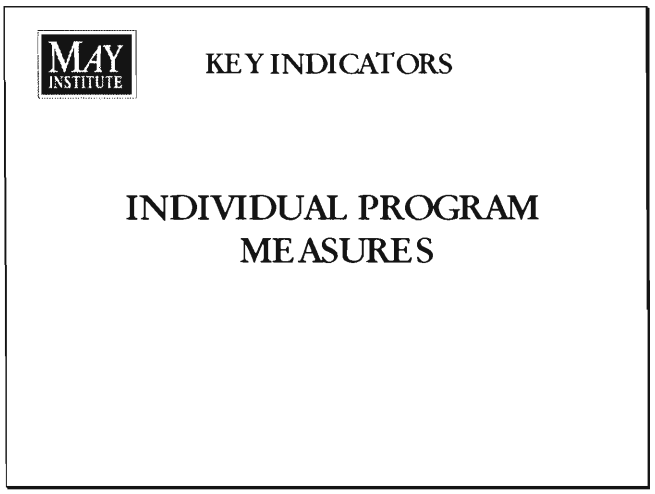

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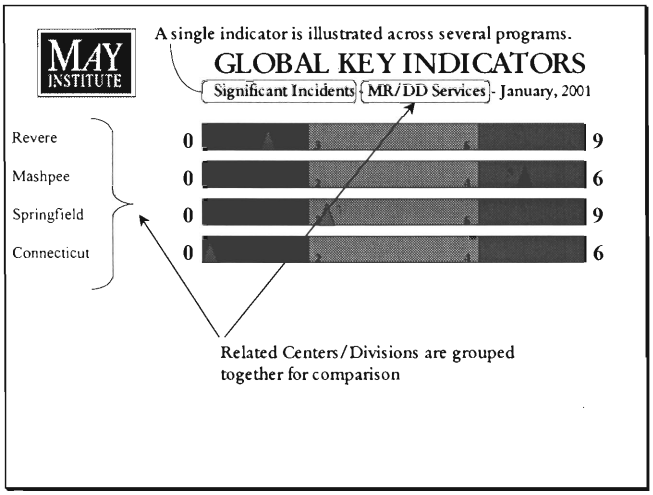


Slide 19

MAY INSTITUTE

KEY INDICATORS

LOCAL MONTHLY MEASURES

Slide 20

MAY INSTITUTE

KEY INDICATORS

Local Monthly Measures

AT LEAST ONE MONTHLY LOCAL INDICATOR FOR EACH OF THE KEY AREAS:

Quality Assurance - Finance

HR & Training - Operations

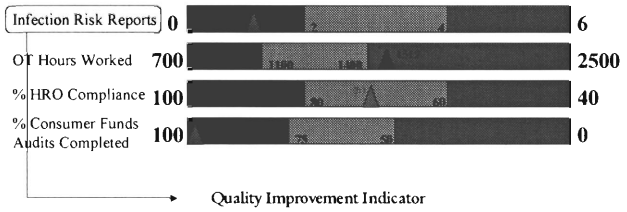
SELECTION OF INDICATORS WILL REFLECT CONTRACTUAL REQUIREMENTS AND JOINT CORPORATE/LOCAL PRIORITY DETERMINATION

Slide 21

MAY INSTITUTE

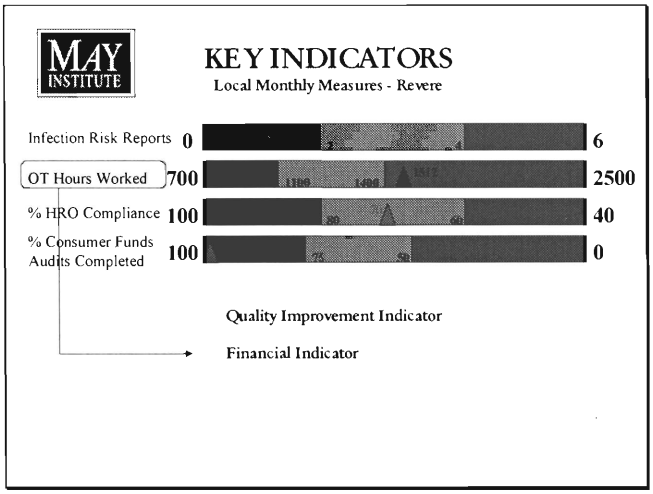
KEY INDICATORS

Local Monthly Measures - Revere



Quality Improvement Indicator

Slide 22



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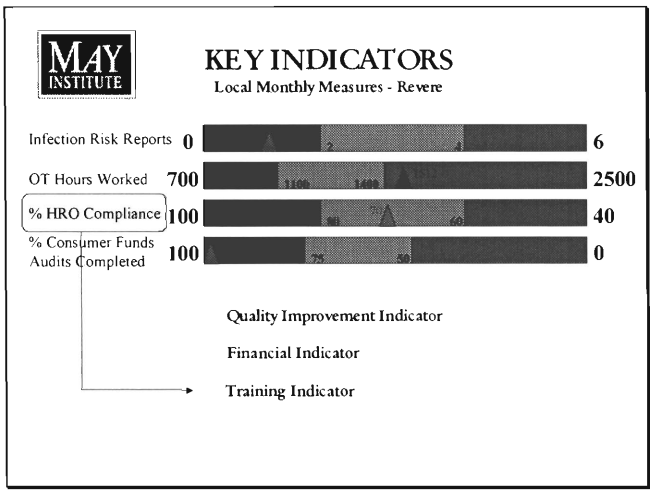

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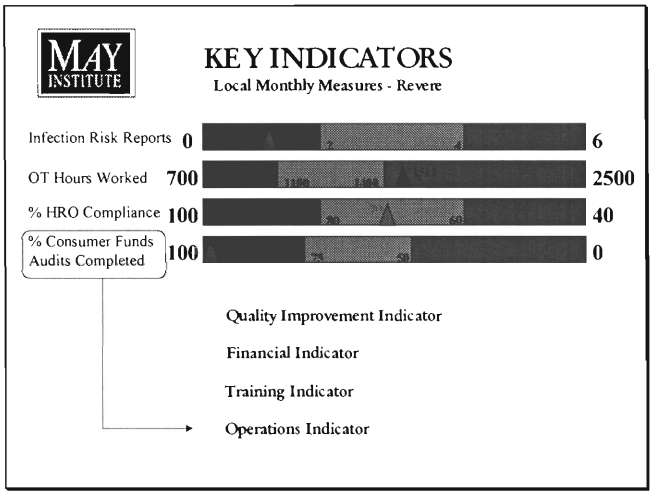


Slide 25

MAY INSTITUTE

KEY INDICATORS

LONGITUDINAL MEASURES

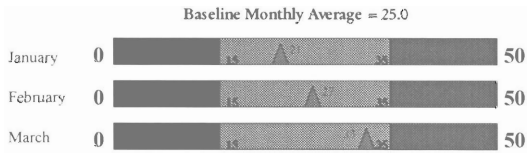
Slide 26

MAY INSTITUTE

KEY INDICATORS

Longitudinal Measures

Data used for monthly Confidence Band reporting can be easily converted for longitudinal trend analysis. For example, the following is baseline and three months of Confidence Bands for "Significant Incidents":

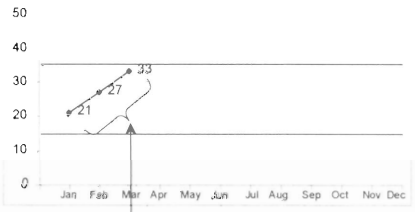


Slide 27

MAY INSTITUTE

KEY INDICATORS

Longitudinal Measures



In this example, the number of "significant incidents" remains in the "expected performance" range, but the monthly total is clearly on an upward (negative) trend.

Appendix E: ANSI Standard Flowchart Symbols

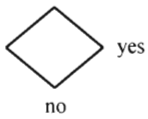
The following section describes a subset of the symbols that the American National Standards Institute define for flowcharts:

Arrow *Direction of Flow* (Harrington, 1991, p. 97):

An arrow denotes the direction and order of process flow, representing movement from one flowchart symbol to another. While ANSI standards do not require an arrow when the direction of flow is from top to bottom or from left to right, they recommend them in all situations nevertheless so as to avoid misinterpretation.

Rectangle *Operation* (Harrington, 1991, p. 96):

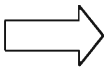
A rectangle denotes an activity, either of manual labor or with the assistance of a machine. For clarity, a written description of the operation appears within the rectangle. This shape is the general symbol that one uses when no others apply.



Diamond *Decision Point* (Harrington, 1991, p. 96):

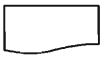
A diamond signifies a point in the process at which one makes a decision. As illustrated, the diamond typically has "yes" and "no" labels (or "true" and "false") from which arrows lead to

the paths appropriate for the decision. For clarity, the question addressed appears within the diamond.



Fat Arrow *Movement/Transportation* (Harrington, 1991, p. 96):

A fat arrow indicates movement of activity output between physical locations (e.g., sending papers between offices, moving a piece across a factory).



Curved Rectangle *Paper Documents* (Harrington, 1991, p. 96):

This curve-bottomed rectangle indicates that information recorded on paper is part of the output of an activity (e.g., reports, letters, printouts).

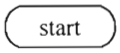
Interrupted Arrow *Transmission* (Harrington, 1991, p. 98):

A transmission symbol denotes an immediate transfer of information in a process (e.g., email, fax, telephone call)

Triangle *Storage* (Harrington, 1991, p. 97):

The storage symbol denotes a holding condition at a point in the process. One stores the output of this symbol until a certain action occurs (such as the ordering or the requesting of an item). The streamlining of a continuous-flow process looks to eliminate such storage, thus minimizing

wasted time. An example of a storage event in business would be a procurement department's withholding of an order request pending approval from the finance department.



Elongated Circle *Boundaries* (Harrington, 1991, p. 98):

An elongated circle marks either the beginning or the ending point of a process. For clarity, the word *start*, *beginning*, *stop*, or *end* appears within the elongated circle.

Small Circle *Connector* (Harrington, 1991, p. 98):

A small circle, always with a letter inside for identification, connects the output of one flowchart to the input of another. This connector commonly appears in flowcharts that are too large for a single sheet of paper. An arrowhead pointing from a small circle denotes an output connector; an arrowhead pointing from and small circle denotes the input connector. Every output connector must bear a different letter or symbol and may re-enter a process at multiple points.

Appendix F: OMI Procedural Documentation

The OMI Office Operations Manual, presented separately, contains all of the flowcharts and narratives produced during the project. In addition, the manual contains copies of all office forms that are required to complete each procedure. Each of these flowcharts and narratives also appears on the CD-ROM accompanying this presentation.

The OMI Office Operations Manual also exists on NOAA ResearchNet; screen shots appear on the following pages. This online version is also included on the CD-ROM.

Each of the flowcharts was created using Microsoft® Visio® 2001. The individual shapes come from the Basic Flowchart Shapes stencil, while most of the colors used come from the standard set provided in the drop-down box of the Fill Color icon. The names of each color and the corresponding person/department as used in the flowcharts appear on a color code key on the first manual page. For those colors that are not directly provided by Visio®, the corresponding RGB color values are given.

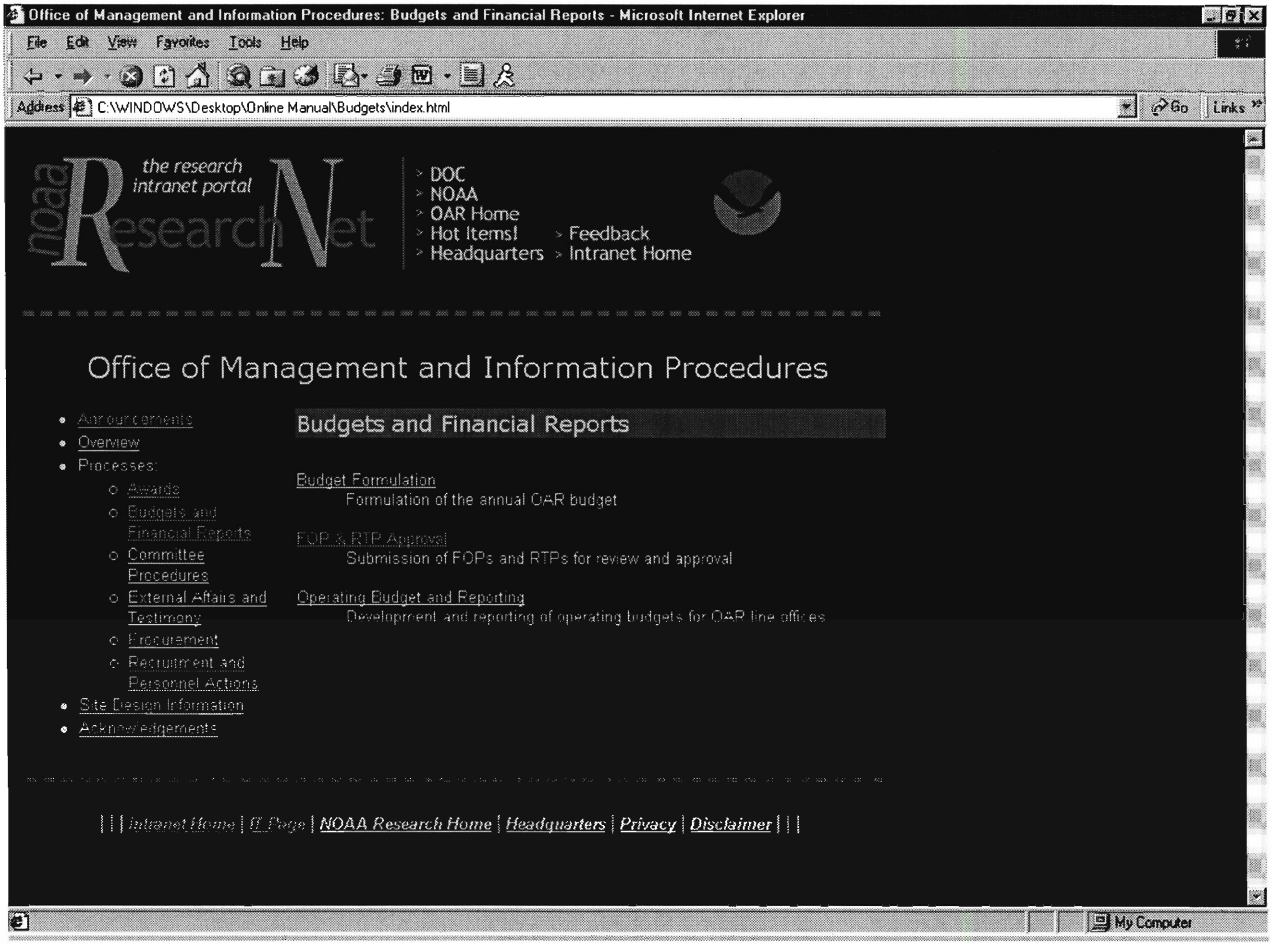


Figure 6: Sample Screen Shot 1

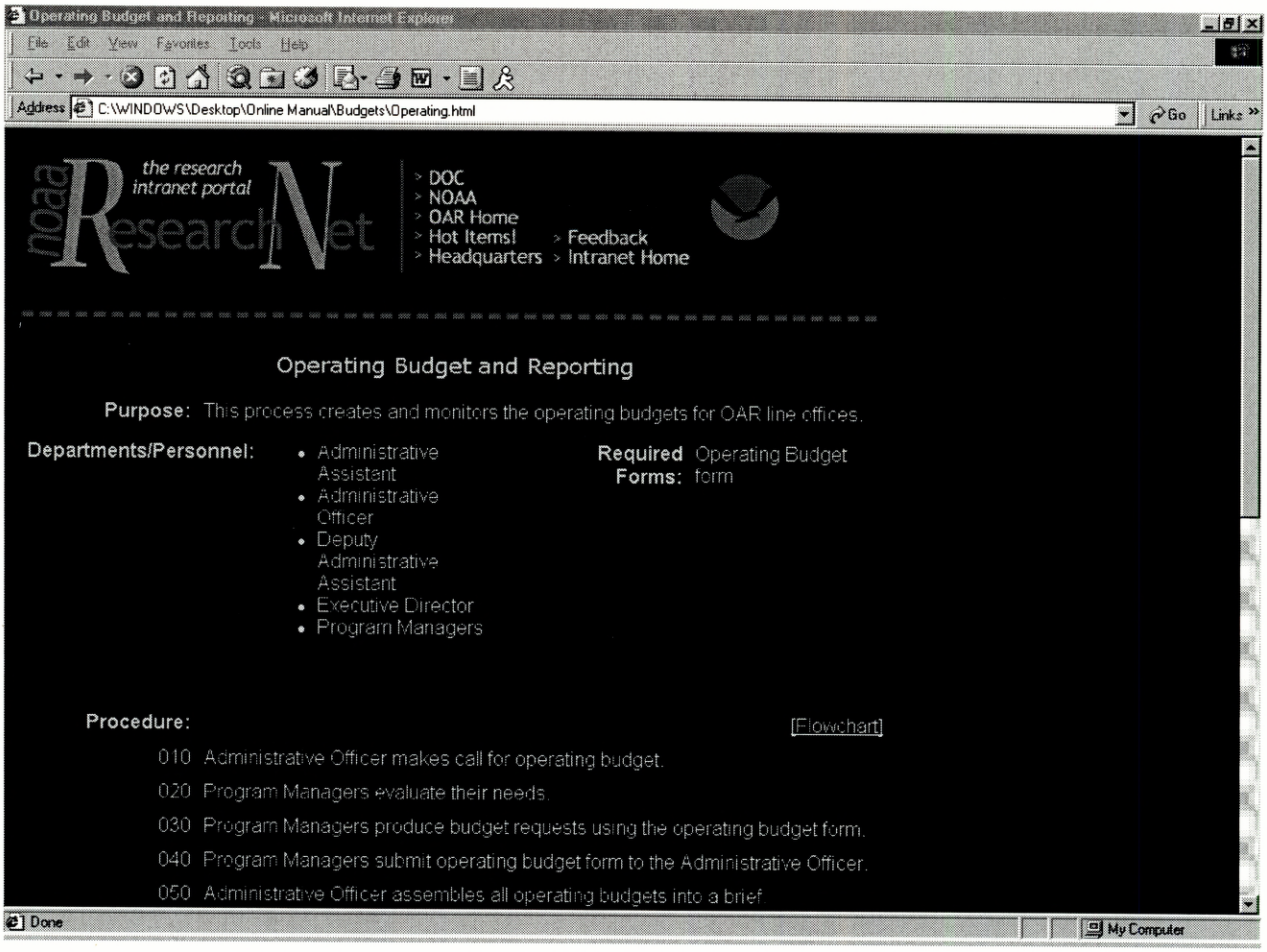


Figure 7: Sample Screen Shot 2