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A Project Management Focused Framework For Assuring Quality Work Processes

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Introduction

As a division of AlliedSignal, Federal Manufacturing & Technologies/New Mexico (FM&T/NM) is an organization of approximately 300 associates providing operations support, engineering, and other technical services for the Department of Energy (DOE), as well as New Mexico's National Laboratories and other government entities. Work performed is primarily project-oriented and ranges from executing a major long-term contract for retrofitting and maintaining a large fleet of escort vehicles to creating a single, small, prototype electronic device for measuring radiation in a unique environment. FM&T/NM is functionally organized and operates in a classic matrix format with functional departments providing personnel with technical expertise, necessary physical resources, and administrative support to several project-based groups that have been designated to serve different types of customers.

Like most matrix-based organizations that provide support to a number of diverse customers, FM&T/NM has encountered all of the common problems that occur when a group of project managers is expected to work together in using and scheduling a shared set of limited resources for the good of the organization as a whole. The company has employed generally-accepted project management practices in order to counter these issues which include associates being expected to be responsible to two bosses; the requirement to satisfy internal/external customers; administrative inefficiencies; communication difficulties; uncertain resource priorities; developmental conflicts arising over common processes and procedures; inter-project power struggles; and duplication of effort. Depending on current issues, customer requirements, project leader personalities, and prevalent company management philosophy, the balance of power appears to periodically shift between the project and the functional side of the matrix.

In the past, much of the work performed by FM&T/NM was done by using a set of policies, procedures, and work instructions that did not reflect actual day-to-day practice. Upon being audited to these procedures, FM&T/NM had difficulty in substantiating that they were really being followed. For example, the project management processes were extremely complex and were not well understood or accepted by project managers. To help overcome this problem, in late 1993, several FM&T/NM project managers studied and obtained PMI certification as Project Management Professionals. This has produced a degree of consistency in project management practices that was not previously present.

On October 1, 1994, AlliedSignal Inc. took over the operation of the facility. Since FM&T/NM had been formerly operated by another DOE contractor for many years, the change to AlliedSignal required significant adjustments in management philosophy, organizational culture, operating policies and procedures, and other management systems. In the early 1990s, a decision was made at AlliedSignal corporate headquarters to have each division become certified to the international quality standard, ISO 9000. This strategic decision was based on the premise that survival in the next century will depend upon the ability to remain competitive in the global marketplace.

Soon after becoming an AlliedSignal organization, FM&T/NM was informed of the expectation to become certified to an appropriate ISO 9000 standard before the end of calendar year 1996. ISO 9000 contains a set of process-driven standards designed to provide uniformity in the development of an organization's quality system. This was an extremely ambitious goal for an organization that had prospered on innovation and lack of formality. The purpose of this paper is to describe how the journey toward achieving this goal stimulated thinking about the relationships between issues associated with functionally-based organization structures, process management challenges related to attaining ISO 9000 certification, and the implementation of project management processes and techniques. The result has been the development of a comprehensive framework for conceptualizing a project management-based, process-oriented, R&D organization.

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ISO 9000

In 1987, the International Organization for Standardization in Geneva, Switzerland established a series of standards that are comprised of requirements for quality assurance systems. ISO, the official nickname for these standards, is derived from a Greek word *isos*, meaning equal. ISO 9000 is actually a generic term that refers to a series of five standards that are numbered 9000 through 9004, each of which is concerned with assuring quality as described in Table A (Hambrick and Mann 1995).

ISO STANDARD	SUMMARY of PURPOSE
9000	Provides Guidance for Selection and Use of Appropriate Standard
9001	Provides a Model for Quality Assurance at a Company that Designs, Produces, Installs, and Services Its Products*
9002	Provides a Model for Quality Assurance at a Company that Produces, Installs, and Services Its Products*
9003	Provides a Model for Quality Assurance at a Company Whose Products and Services Can Be Assessed by Inspection and Test
9004	Provides Specific Guidelines for Meeting the Conformance Standards (9001, 9002, or 9003)

* ISO standards consider a product to be a tangible good such as an assembly or processed material, or an intangible such as information, or as a combination of both such as a service.

TABLE A. ISO STANDARD DESCRIPTIONS

In general, these standards provide a common format for developing a quality management system. Originating in the European Union (EU), these standards now reflect worldwide acceptance. Standardization representatives from over 90 countries have been involved in their formation, and subsequently, most of their countries have adopted the ISO standards as written or relabeled them to conform to local conventions. In the United States, for example, the ISO 9000 standards have been adopted by the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) which have labeled them 'the ANSI/ASQC Q90-1994 series'.

Although each company determines the level of certification that is most appropriate for them, most manufacturing firms select the most comprehensive ISO standard, namely, 9001. Earning certification means that a firm has documented the processes it uses to do business and follows them consistently. According to a recent survey (Anonymous 1993), the top four motivations for seeking ISO certification are: customer demands, quality benefits, marketing advantages, and EU buyer's requirements.

Some of the unique characteristics of ISO 9000 standards include:

1. Processes, rather than products or services, are ISO certified. The rationale is that if process management is good, then resultant products or services will also be good.
2. ISO is one component of a Total Quality Management (TQM) initiative or program. The premise for ISO is simply - *say what you do* (document your processes), *do what you say* (follow the written processes), and *be able to prove it* (document process behavior and performance).
3. Remaining certified requires a company to pass an external audit twice per year. ISO is not a one-time award, but requires periodic audits to assure that processes and documentation remain intact.
4. ISO emphasizes a process view of an organization by advocating that all work is accomplished by a network or system of processes. To achieve quality, a firm needs to identify, organize, and control its processes and their interactions.

Process Management

Work is primarily accomplished through systems that have been designed to meet organizational objectives. In the abstract, *systems* can be defined as a set of components, together with relationships between the components and between their attributes, that are connected to each other and to their environment so as to form a whole (Schoderbek, etc. 1990). Purposeful systems consist of a collection of interdependent components that productively interact to achieve a specified goal. The critical components of any system under study include those processes that contribute to goal achievement. Some processes contribute directly to fulfilling customer demands by producing products or creating services such as operations and marketing while others only contribute indirectly through providing the infrastructure of the organization. This latter group of processes includes human resources and information technology that operate in support of the primary factors of production.

A process is only one component of a system (Kartam, Ibbs, and Ballard 1995). To achieve goals in a cost-effective manner, system managers must design and operate networks of processes as well as coordinate the interfaces between those processes. The real challenge to system managers is to assure that the linkages between processes are not neglected as they are critical to goal achievement.

A *process* can be defined as "a bounded set of repeatable work activities that transform material and information into an output" (Melan 1995). Whereas a system shows the relationships between the various processes required to generate the work that is desired by customers, a process depicts the various steps involved in transforming inputs into outputs. It is important to recognize that some process steps add value, while other activities add cost but provide no value relative to the output of the process. These non-value-adding activities include all delays in processing, temporary or permanent storage, inspections, and any rework necessary to meet customer requirements or engineering design specifications. In general, value is added in a process whenever all three of the following conditions are simultaneously met: (1) a desired physical change noticeable by the customer occurs, (2) given a choice, the customer would pay for the activity to be performed, and (3) the activity is done right the first time (American Management Association 1993). Some activities, such as fulfilling legal requirements or satisfying government regulations, may be necessary even though they do not meet the above three conditions. Effective process managers are devoted to continuously improving their processes by eliminating, combining, and/or simplifying those process operations that do not meet these criteria.

Process managers are responsible for process design, resource deployment, and overall performance. Thus, understanding the process with its inputs, transformations, outputs, feedback loops, and interactions with other processes is of primary importance. Moreover, as *organizational boundary spanners*, process managers must be constantly alert to changes in the external environment that have the potential to impact their process performance. This means that process managers must be concerned with the interactions between activities internal to the process, as well as those interfaces that are external to the process. The reason that the whole is greater than the sum of the parts is because the whole includes the linkages between the parts. Thus, it is necessary to recognize that both internal and external entity interrelationships must be well-managed if the entire system is to efficiently achieve its goal.

FM&T/NM Business Model and Process Management Approach

The effort to become certified to the ISO 9001 standard has caused FM&T/NM to review and characterize all of its procedures and work instructions from a process perspective. Moreover, this effort has encouraged the incorporation of the principles of process management, as defined in the ISO standards, into the forefront of the organization's management philosophy. In order to operationalize this concept at FM&T/NM, a method developed by several other organizations within AlliedSignal was used to define and structure work processes.

"Processes are at the core of other standards. For example, the International Organization for Standardization's quality standards (the ISO 9000 series) are based on identification of business processes." (PMBOK Guide, PMI Standards Committee 1996, preface). By using project management tools and techniques, an organization may better understand and manage the various interactions and hand-offs that occur in any work situation. Thus, FM&T/NM chose to use the ISO certification initiative as an opportunity to formalize good project management practices throughout its operations. Moreover, the development of a quality management system and associated process descriptions and work instructions in accordance with ISO 9000 requirements has provided FM&T/NM with a process-based method of performing work.

The ISO certification initiative involved a thorough examination of the interactions between and among these various process descriptions and work instructions. This effort resulted in a system that integrates these instructional

documents into a smoothly functioning, integrated network of processes in accordance with specific clauses of the ISO 9000 guidance document (ANSI/ASQC Q9000-1-1994). In order to define this network of processes, a work breakdown structure (WBS) for all existing work processes was developed. This WBS has since come to be known as the FM&T/NM Business Model. The first three levels of the Business Model are shown in Figure 1.

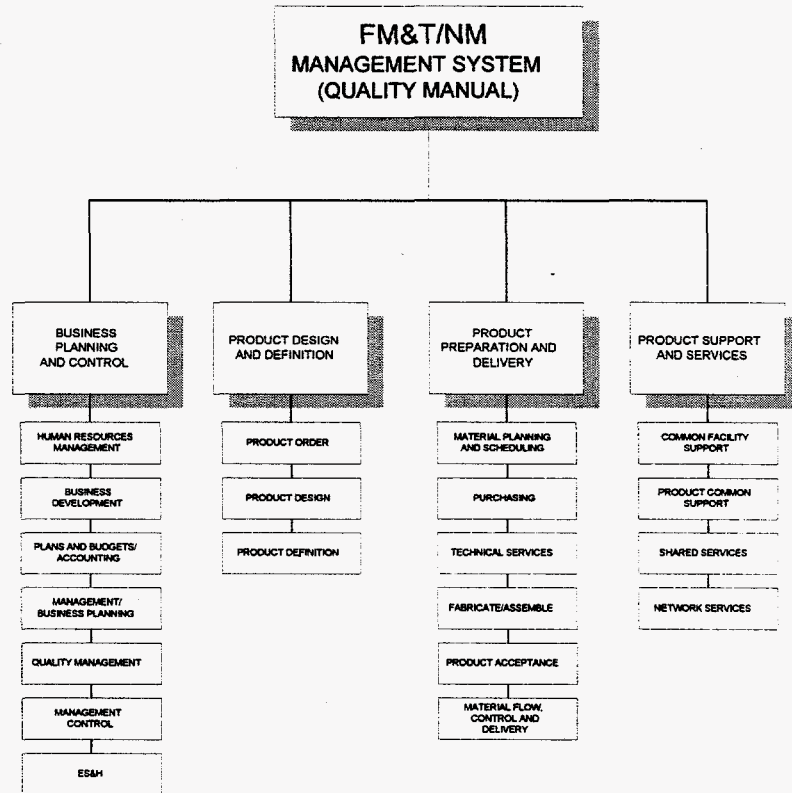


FIGURE 1. FM&T/NM BUSINESS MODEL

This approach was patterned after a similar model developed by our sister AlliedSignal organization in Kansas City operated for the U.S. Department of Energy. It has provided an excellent way of assimilating unique processes into an organization-wide framework while promoting the change process that is required in adapting to a new AlliedSignal corporate culture. The first step in designing this Business Model was to partition the various elements of the present management processes into an organized group of components. The top level of this WBS or Business Model is entitled the "Quality System" and is documented in the ISO 9001-specified FM&T/NM Quality Manual. The Model further identifies functional business areas, business functions, and business processes in a three-level hierarchy. At the lowest level (not shown), business processes are documented in process descriptions and are supported by work instructions. Moreover, the Business Model describes the complete network of processes used to perform work in a consistent manner. All processes are firmly rooted in the standard project management process categories of initiating, planning, executing, controlling, and closing as described in the new PMBOK (PMI Standards Committee 1996). This ensures the mandatory use of generic project management processes in performing all work.

A complete description of the Business Model as characterized under the four major headings or "functional business areas" follows:

Business Planning and Control. This is a group of business functions supported by processes that provide the general aspects of accepting, planning, managing, and controlling all business activities. It includes the personnel and marketing functions plus the definition and application of the quality system. These are processes that define the basic business philosophy and management policies and processes of the organization to be used for the performance of all work. Specifically, the business functions included are: Human Resource Management; Business Development; Plans, Budgets, and Accounting; Management/ Business Planning (which includes the processes of Project Management); Quality Management; Management Control; and Environment, Safety, and Health.

Product Design and Definition. This is a group of business functions supported by processes that provide methods for accepting new work and defining customer-specific products. This includes planning, definition, and designing the specific hardware, software, or service. Specifically, they include: Product Order; Product Design; and Product Definition.

Product Preparation and Delivery. This is a group of business functions supported by processes that provide methods to create or produce the specific product (hardware, software, or service) being developed. The specific functions involved include: Material Planning and Scheduling; Purchasing; Customer Services; Fabricate and Assemble; Product Acceptance and Material Flow, Control, and Delivery.

Product Support and Services. This is a group of business functions supported by processes that provide common support and services performed to support work and other activities performed throughout the organization. Specifically, they include: Common Facility Support; Product Common Support; Shared Services; and Network Services.

The use of this Business Model has become widely accepted throughout the organization. It has helped break down organizational "silos" and feelings of organizational "ownership" for many of the various processes. In addition, it has assisted in enhancing communication between all departments and among work group members. The cross-organizational aspects of all processes have been recognized, and this tool has been responsible for many breakthroughs in improving processes that would not have been possible in the past. The Model is managed by a cross-organizational team that is known as the Process Steering Committee which meets every week to maintain its currency, assure that global issues are addressed, and that the ISO initiative, as a whole maintains its integrity. Changes and improvements to the Business Model are continually being implemented as processes are modified and updated.

The Three Dimensional Matrix

A business is unique. It cannot "adopt" a generic set of processes for managing all aspects of its business as described in PMBOK, Chapter 3. We have designed a WBS which contains all (project management as well as product oriented processes) of the processes needed to completely operate the business. The use of this model (called our business model) overlaps the functional organizational breakdown structure (OBS) and the project work breakdown structure (WBS) and provides an integrating link that acts as a catalyst for smoothing out the traditional problems associated with a matrix organization. This section explains how that link works and describes its many advantages in providing operational efficiency, communication improvement, and process consistency.

Figure 2 is a graphical presentation of the project, organization and process elements that have evolved at FM&T/NM. A traditional two-dimensional matrix structure would show intersects between the organization and project elements, representing the assignment of personnel to work. In this new framework, those project/organization intersects have been replaced by processes that perform work. Personnel are assigned to processes with projects then using these processes, instead of specified personnel, to meet customer requirements. This framework has been called the three-dimensional matrix reflecting the fact processes now have a dimension of their own.

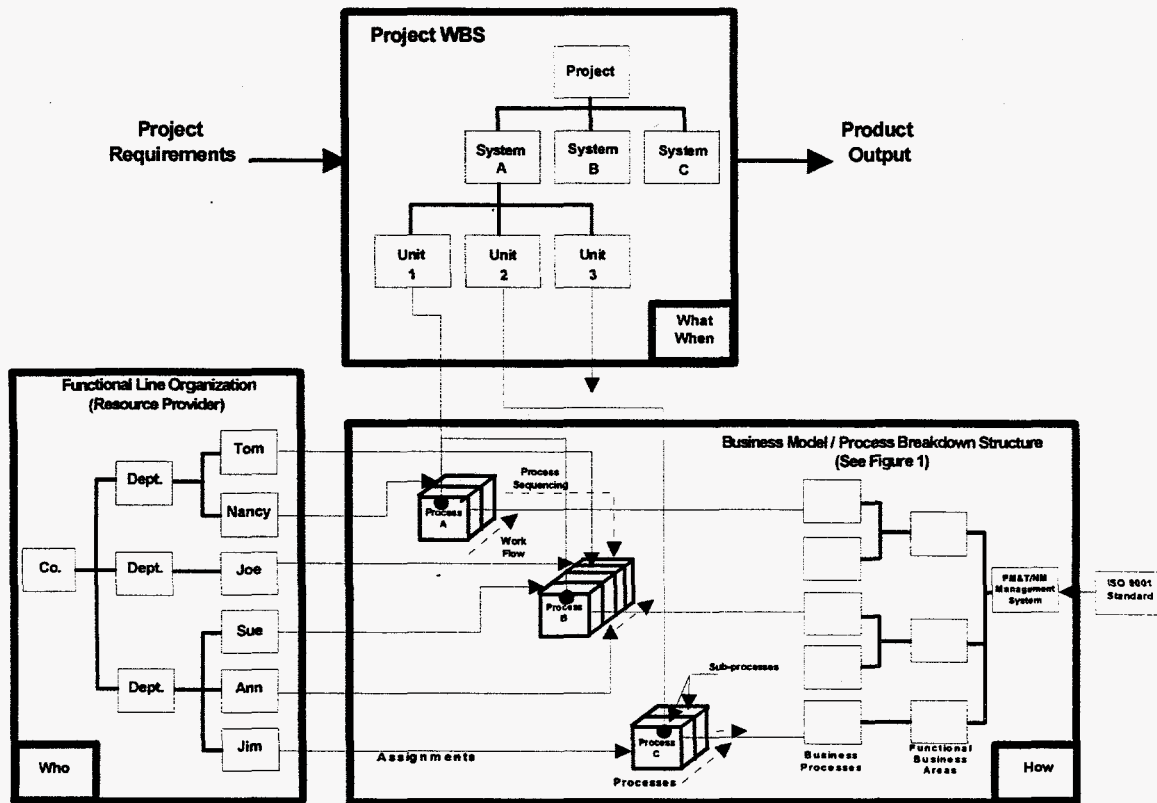


FIGURE 2 THE THREE-DIMENSIONAL MATRIX

Although shown simplified, the functional line organization at FM&T/NM is typical of most companies. It partitions the company into departments, and eventually through subsequent subdividing down to the identification of individual workers. The resources of the functional organization are assigned to processes or sub-processes. These assignments include both process leaders, who are responsible for the development and maintenance of specific processes, as well as process associates, who perform process-oriented work.

The process-based Business Model is key to implementing a continuous improvement mindset within an organization. Process leaders are responsible to develop, monitor, and maintain their assigned processes independent of project requirements or functional structure affiliations. Ownership by the process leaders and their process teams leads to accountability, which in turn, leads to a responsibility to implement cost-effective, quality-oriented, and highly productive work processes. A collection of processes are created to perform work. With work, comes the task of selecting the right processes, connecting them in a proper sequence, and monitoring performance of the work relative to customer requirements.

The project is represented in Figure 2 by the project WBS. The WBS is a hierarchical tree that successively subdivides work until the smallest product elements and work activities are defined. Again, it's important to note that the project WBS elements are serviced by processes instead of individual staff. This is a key factor to understanding the benefits of the three-dimensional matrix, to be summarized later.

The following example is given to help understand the inner workings, sequencing, and utility of major components in the three-dimensional matrix. Again, referring to Figure 2, assume that Unit 1 of the project WBS needs to be designed. The first activity or subprocess in the design work process (Process A) is design planning which consists of two stages-design project initiation and the design testing plan. The diagram shows Nancy to be the only one assigned to this process, but there could be others as well. At the completion of design planning, the detailed design process is initiated. After receiving the design requirements, four stages in the design process (Process B) are encountered, namely, perform design, perform design review, perform design verification and produce a design output. Here Tom, Joe, Sue, and Ann are all assigned to the process. They may work as an integrated team for the entire process, or they may be assigned individually to specific stages. Next, a process of design validation would

likely follow, with its own assignments and stages of work flow. The process teams are responsible for the sequencing of stages in the processes and the quality of work performance, and the project managers are responsible for the application of processes and assuring that they meet project requirements. Project management is the structure through which the processes produce work.

Summary and Conclusions

In order to satisfy customers, the framework for managing projects that has been presented focuses on developing, understanding, and managing the relationships between the functional organization structure, the system of work processes, and the management of projects. FM&T/NM has retained its functional structure which is primarily responsible for assigning personnel to work processes. The evolving role of the process leader focuses primarily on designing, managing, and improving the process, and the interactions among the subprocesses. The project manager is responsible for (1) translating customer requirements into product specifications, (2) determining the sequence of activities needed to meet project goals, (3) scheduling the required work processes, (4) monitoring project progress, (5) providing liaison between the customer and process leaders, as needed, and (6) having the desired product and/or service delivered to a satisfied customer in a timely manner.

Although not initially obvious, this framework for managing projects has provided a variety of benefits relative to the more traditional two-dimensional matrix organization. Consider the following factors:

- In a process-based work performance system, process leaders are responsible for developing, maintaining, and improving their assigned process(es), independent of and prior to specific project needs. This ensures that when a project is scheduled to utilize a process, it will perform in a cost-effective manner.
- In the new project management framework, the traditional "two boss" conflict is somewhat diffused because the functional managers assign resource personnel to processes and the project utilizes processes instead of individual personnel. Thus, team-based process performance, rather than individual performance, becomes of primary importance.
- The difficulties associated with crossing functional barriers have been basically eliminated in a horizontally-based, process-oriented system for performing work. Empowered teams are encouraged by process leaders to continuously identify and eliminate non-value-added activities to reduce process cycle time and improve quality.
- Work-oriented communication is easier and more effective because different functionally-based personnel are now routinely interacting within a relatively stable work process. Customer-oriented project managers relate any concerns directly with the process leader who, in turn, facilitates team-based process improvement and/or problem solving activities.
- The project manager maintains responsibility for orchestrating both the sequential and the parallel use of processes required to meet customer job requirements. This involves coordinating the hand-offs between work performing processes. In contrast, the project manager under the traditional matrix organization also was responsible for integrating activities within a process. This latter assignment was often beyond the project manager's organizational authority and level of expertise, and therefore, provided an additional burden.

These advantages represent a significant improvement in the potential effectiveness of project management principles within firms. In short, with its emphasis on process management, the proposed three-dimensional matrix approach provides a relatively comprehensive framework for managing work required to implement projects.

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