



CORE ATTRIBUTES OF REQUIREMENTS MANAGEMENT IN THE PERFORMANCE BASED AIR TRAFFIC ORGANIZATION

**NAS Configuration Management and Evaluation Staff
Program Evaluation Branch (ACM-10)**

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Executive Summary

The Air Traffic System Requirements process, developed by the Federal Aviation Administration's (FAA) Air Traffic System Requirements Service (ARS), is the agency's current requirements process. The requirements process serves as the official guide for the collection, validation, translation and promotion of Air Traffic (AAT) and Airway Facilities (AAF) requirements in developing effective solutions. The requirements process spans all four phases of the Acquisition Management System (AMS) lifecycle, which includes Mission Analysis, Investment Analysis, Solution Implementation, and In-Service Management.

On January 10, 2002, the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) conduct an evaluation on how requirements should be handled under the performance-based Air Traffic Organization (ATO).

The objective of this evaluation is to identify the core attributes of an effective requirements process under the performance-based Air Traffic Organization. The final report should provide ARA-1, ATS-1, and the ATO design team with timely insights into the creation of the ATO.

In conducting this evaluation, the team:

- Established a baseline of the current requirements process,
- Developed a stakeholder matrix of FAA's current requirements process,
- Identified government and industry best practices and lessons learned related to effective requirements management with a focus on performance-based organizations,
- Analyzed how the Terminal Business Unit (ATB) manages requirements,
- Talked with members of the ATO design team regarding the planned structure of the new ATO, and
- Identified roles and responsibilities at the ATO executive and business unit levels in order to identify the core attributes of an effective requirements process in the new performance-based ATO.

As part of the data collection phase, the evaluation team interviewed a cross section of stakeholders throughout the agency. The list of stakeholders included organizations such as Air Traffic Requirements (ARS), ATB, union representatives, field personnel, and others directly and indirectly involved in requirements generation, documentation, testing and implementation (e.g., AAT, AAF, ARA). Altogether, the team interviewed over sixty stakeholders and then collected and analyzed the information from each interview. The team also collected data from a variety of sources including foreign air traffic organizations and domestic government agencies. All of the data collected during the fieldwork phase were incorporated throughout the report.

Summary of Results

In its current state, the FAA's requirements process has the following characteristics: (a) corporate responsibility for requirements management fragmented between the ARS and ASD organizations, (b) duplication of requirements process activities in ATS organizations, (c) requirements managers coordinating with diverse sets of internal and external customers, and

(d) requirements management activities generally focused at the product/specification level and not at the system/service level.

These attributes of the current requirements management process will need to be augmented and altered to create attributes coinciding with the ATO focus. The transition of ATS and ARA into the ATO is intended to cut administrative costs, improve performance, focus staff on customer service and satisfaction, and realign the agency under common goals, objectives, and strategies. The core attributes of requirements management recommended in this report can be used to support the transition into the ATO structure.

While preparing this report, transition teams had not reached agreement on the structure or high-level work processes of the ATO. In the interim, the interpretation of the evaluation team is that the ATO will embody the following set of characteristics: (1) clearly defined mission and common performance objectives, (2) a flat organization with a commercial-like structure, and (3) business units that will function with significant autonomy. These characteristics provide the general framework of operational philosophy for determining the appropriate elements of effective requirements management.

The ATO's concentration on a small set of common performance objectives will necessitate a shift in the FAA's current requirements development focus from specific products to a system/service-level orientation. The requirements for systems that the ATO develops will have to be derived from its corporate performance goals. Therefore, ATO designers need to strike a balance between the development of National Airspace System (NAS) level requirements at the corporate level and the generation of service and product level requirements in the business units, which will function with autonomy in their service delivery. To meet this challenge, ATO requirements management implementation strategy should embody the following core principles:

- Requirements derived from their performance goals
- Strong coordination and communication (internal and external)
- Clearly defined roles and responsibilities

Using these core principles as a guide, the evaluation team identified attributes of requirements management that should be either perpetuated or instituted in the ATO. Through our conduct of industry best practices analysis and interviews with a wide range of FAA requirements management stakeholders, we identified several trends or the mes that we believe are most applicable to establishing a requirements process in the ATO structure. These are the core attributes of an effective requirements process we advocate for FAA's ATO:

- Top-Down Requirements Management
- Well-Defined Customers
- Correlation of Requirements Interfaces and Conflicts
- Requirements Prioritization
- Service-Oriented Investment and Budget Management
- Periodic Requirements Revalidation
- Trained Requirements Managers
- Process Flexibility

While the development of an ATO requirements management process is a complex task for the design team, the real challenge will likely lie in the evolution of the workforce's mindset. Our

interview results indicated that the majority of requirements process participants are still focused on products and programs rather than service provision.

When designing a requirements process implementation strategy, the ATO design team should review the ACM assessment of the Alaskan Region Corporate Maintenance Philosophy (CMP) Program (<http://www.faa.gov/acm/acm10/reports.htm>) for lessons that are particularly applicable to their organizational transformation challenge. The Alaskan CMP Program is similar to the ATO initiative in that its goal was to institute a more “business-like” approach to airway facilities service provision. Much like the ATO philosophy, the Alaskan Region Airway Facilities (AF) organization established “corporate-level” performance metrics focused on the availability of NAS infrastructure components. While the CMP Program met several of its stated goals, it resulted in the issuance of an unfair labor practice ruling and was ultimately viewed as a failure in implementation. This unsuccessful organizational transformation effort can serve as a valuable case study for the ATO design team.

Recommendation

The evaluation team recommends the ATO design team incorporate the core attributes listed in this report throughout the evolution of the new performance-based organization to establish effective requirements management.

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Introduction

Background

On January 10, 2002, the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) conduct an evaluation on how requirements should be handled under the performance-based Air Traffic Organization (ATO). The final report was to provide ARA-1, ATS-1, and the ATO design team timely insights into the creation of the ATO.

The ATO will become the FAA's performance-based organization (PBO) when fully established in 2002. The ATO will merge ATS and ARA into a performance-based organization, which is defined as a "results driven organization that commits to clear objectives, specific measurable goals, customer service standards, and targets for improved performance."¹ To become a PBO, the ATO must meet several prerequisites. First, the ATO must have a clearly defined mission with established performance metrics. The performance metrics measure the organization's ability to meet its goals and objectives. Second, the head of the organization will be a Chief Operating Officer (COO) whose salary will be partially dependent on meeting the performance metrics that he or she establishes. The relationship between performance and rewards will provide a measure of accountability. Third, the ATO must become service oriented, focusing on customers external to the agency.

The current requirements process, which does not embody all the characteristics of a performance-based organization, has the following characteristics:

- Corporate responsibility for requirements management fragmented between the ARS and ASD organizations,
- Duplication of requirements process activities in ATS organizations,
- Requirements managers coordinating with diverse sets of internal and external customers, and
- Requirements management activities generally focused at the product/specification level and not at the system/service level.

These attributes of the current requirements management process will need to be augmented and altered to create attributes coinciding with the ATO focus. The transition of ATS and ARA into the ATO is intended to cut administrative costs, improve performance, focus staff on customer service and satisfaction, and realign the agency under common goals, objectives, and strategies. The core attributes of requirements management recommended in this report can be used to support the transition into the ATO structure.

¹ Source: Project EASI Archives. <http://easi.ed.gov>

Objective

The objective of this requirements evaluation is to identify the core attributes of an effective requirements process under the performance-based Air Traffic Organization.

Scope/Constraints

FAA management has not yet released the structure of the new performance-based organization. Therefore, the evaluation results are limited to the amount of information provided to the evaluation team during fieldwork. Some information that the evaluation team received during fieldwork regarding the structure of the ATO has not been disseminated as public knowledge. Although this information is not explicitly included in the report, the evaluation team took all data into consideration when developing conclusions and recommendations during the analysis phase.

ACM-10 is currently aware that the ATO will include a number of business units similar to the current Terminal Business Unit (ATB). However, the evaluation team understands that the ATO will not be a replica of the ATB.

The evaluation focused on identifying the core attributes that should either be perpetuated or established under the ATO. The evaluation did not include developing a requirements process or a requirements transition plan for the ATO, nor did it include an evaluation of the current FAA requirements process.

Methodology

The evaluation team began with a data collection phase, in laying out six steps to identify the core attributes of an effective requirements process in the new performance-based ATO. The evaluation steps included:

- Establishing a baseline of the current FAA requirements process (Appendix A),
- Determining the stakeholders in the FAA's current requirements process (Appendix B),
- Identifying government and industry best practices and lessons learned related to effective requirements management, particularly in performance-based organizations (Appendix C),
- Analyzing how requirements are managed in the ATB,
- Analyzing information regarding the planned structure of the new ATO, and
- Identifying requirements roles and responsibilities at the ATO executive and business unit levels.

As part of the data collection phase, the evaluation team interviewed a cross section of stakeholders throughout the agency. The list of stakeholders included organizations such as Air Traffic Requirements (ARS), ATB, union representatives, field personnel, and others directly and indirectly involved in requirements generation, documentation, testing and implementation (e.g., AAT, AAF, ARA). Altogether, the team interviewed over sixty stakeholders and then collected and analyzed the information from each interview. Summaries of the interviews are provided in Appendix D.

In addition to the interviews, the evaluation team examined an array of requirements best practices of domestic and foreign private companies, and government agencies. This analysis of best practices focused primarily on other performance-based organizations and on foreign Air Traffic Control agencies. The evaluation team concentrated on these groups because their lessons learned were highly relevant to the structure and focus of a performance-based organization. Summaries of the best practices are provided in Appendix C. The data from the interviews and the best practices were then incorporated throughout the report.

During the analysis phase of the evaluation, the team assembled all of the relevant data including the requirements process baseline, best practices, lessons learned, and interview summaries. The team combined and analyzed the collected data and mapped the results of the analysis to the ATO philosophy. The team then used the general ATO principles and notional structure as a filter to distinguish the requirements management attributes derived from best practices and lessons-learned that were most relevant to the proposed ATO. This assessment approach allowed the team to focus on the future state of a corporate-level requirements management process under an ATO rather than in the challenges and traits of the current process. After filtering out the findings not relevant to the future state, the evaluation team determined the core attributes of requirements management in the ATO, as well as transition considerations for the design team. Figure 1 illustrates the team’s methodology.

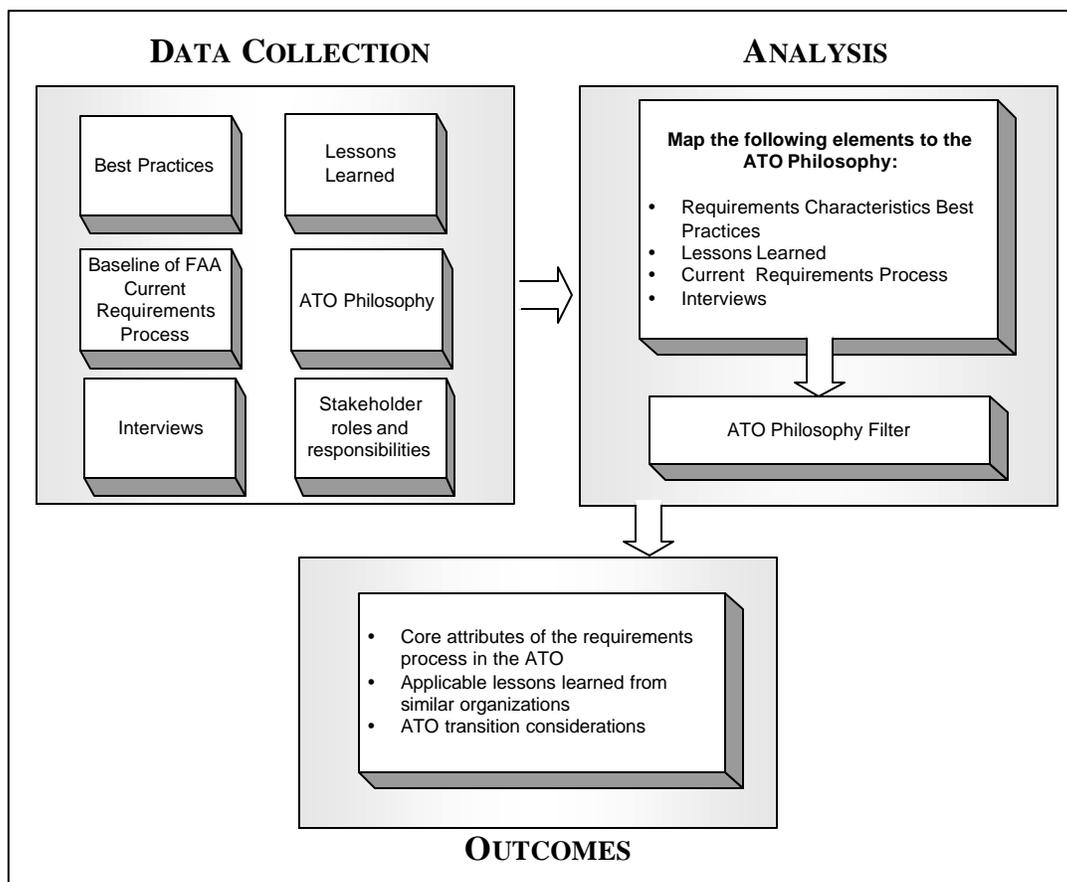


Figure 1 Requirements Evaluation Methodology

Requirements Management in the ATO

A. ATO Environment as it Relates to Requirements

Based on discussions with leaders of the performance metrics and organizational structure transition teams, the evaluation team derived a set of characteristics pertinent to ATO. These characteristics provide the general framework of operational philosophy for determining the appropriate elements of effective requirements management.

- 1. Clearly Defined Mission and Common Performance Objectives** - The ATO will focus all its activities on specific performance goals in the areas of operations (delay, capacity, airport efficiency, etc.), safety, economics, and people. These performance goals will constitute a common set of objectives that will drive all activities and processes in the ATO. The organization will be service-oriented and focused on its external customers, the flying public and users of the National Airspace System (NAS).
- 2. Flat Organization with a Commercial-Like Structure** - A Chief Operating Officer (COO) will lead the ATO which will have a number of business units that are aligned with primary NAS service domains. These business units will report directly to the COO. The ATO design team has not yet completed its definition of the new business units, but it appears that the team's philosophy will be to limit cross cutting organizations and decentralize a majority of overhead functions down to the business unit level.
- 3. Business Units Will Have Significant Autonomy** - We expect the ATO business units to be given wide latitude to determine how they will achieve their performance goals. Because of the limitation of cross cutting organizations, coordination between business units will be done through service level agreements. Business unit performance goals will be derived from ATO-level performance objectives and will consist of both business unit-specific metrics and shared metrics that involve multiple business units. Each business unit will be singularly focused on providing service to external customers in its domain.

Implications for Requirements Development and Management

The ATO's concentration on a small set of common performance objectives will necessitate a shift in the FAA's current requirements development focus from specific products to a system/service-level orientation. The requirements for systems that the ATO develops will have to be derived from its corporate performance goals. Given that ATO designers envision a significant level of autonomy for business units, it appears essential that there be even more rigor

in the traceability of requirements to corporate goals than exists in the agency's current requirements management process. Therefore, ATO designers need to strike a balance between the development of NAS level requirements at the corporate level and the generation of service and product level requirements in the business units.

B. Core Attributes of Requirements Management in the ATO

The ATO design team needs to develop a requirements management implementation strategy that supports both the centralized ATO performance goals and the autonomy envisioned for business unit service delivery. To meet this challenge, ATO requirements management should embody the following core principles:

- Requirements derived from their performance goals
- Strong coordination and communication (internal and external)
- Clearly defined roles and responsibilities

The ATO will be singularly focused on providing air traffic service to its customers. The COO will establish a common set of performance goals to measure the success of each service provision. These goals will include long-term strategic goals and short-term goals. Therefore the development and management of NAS-level requirements must be driven by ATO performance goals. It will be up to ATO business units to deliver air traffic services to the customers. These sub-organizations will have the autonomy to develop the most effective methods for meeting their part of ATO performance goals.

While ATO designers envision that business units will be relatively autonomous, they cannot escape the fact that each business unit is interdependent and operates within one or more domains of a national airspace system. Given this dichotomy, strong, effective coordination and communication will be critical to the success of not only requirements management, but to the ATO implementation as a whole.

The emphasis on business unit autonomy also necessitates the need for comprehensive delineation of requirements management roles and responsibilities. Requirements management at the corporate level should limit its focus to system level requirements derived from corporate performance goals and allocate these requirements to the service level. The development and implementation of detailed service and product level goals, executed within the corporate performance goal framework, should be reserved for the business units. Figure 2 illustrates this concept.

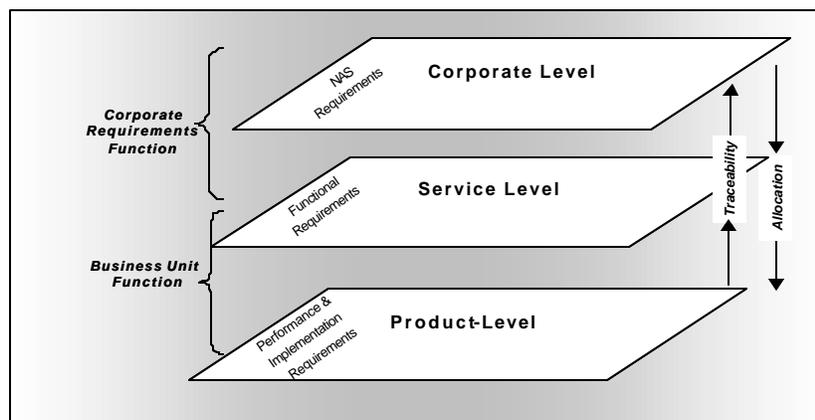


Figure 2 Top-Down Requirements Management Concept

Using these core principles as a guide, we identified attributes of requirements management that should be either perpetuated or instituted in the ATO. The team derived these attributes by conducting industry best practices analysis and interviews with a wide range of FAA requirements management stakeholders. The major trends or themes, presented below, represent the most applicable attributes to establishing a requirements process in the ATO structure.

Top-Down Requirements Management

To strike a balance between the ATO propensity for decentralization and the imposition of common performance goals, the ATO design team should establish a NAS requirements function at the corporate level to lead the development, management and validation of system requirements throughout the system lifecycle. We envision that a corporate level requirements function would maintain the NAS architecture and allocate service-level requirements to the business units for implementation. The establishment of a corporate-level requirements management function would allow the ATO to align its system requirements with performance goals and provide business units with a NAS framework for developing solution implementation alternatives and product-level requirements.

The singular focus on customer service and common, system-wide performance goals necessitates a requirements management function at the ATO corporate level.

This corporate requirements management function would include the following types of activities:

- Coordination and integration between the Business Units and the external RE&D organizations, representing the connection/link between the business unit research activities and the ATO business engineering.
- Development of NAS-level service requirements that align with the NAS Concept of Operations and ATO performance goals through the design and management of the NAS architecture
- Decomposition of NAS-level requirements to the service level via system engineering and allocation to appropriate business units
- Management of the NAS Architecture

The rationale for establishing a corporate level requirements function is twofold. First, it will be very difficult to develop corporate level system requirements in a decentralized business unit environment and maintain consistency and unified focus on ATO performance goals. Secondly, our best practices analysis has shown that decentralization of requirements management has been largely unsuccessful in comparable performance-based organizations.

Both the Internal Revenue Service (IRS) and the United Kingdom's National Air Traffic Service (NATS) allocated requirements management to their lower level business units. Both organizations encountered problems with customer communications, loss of requirements traceability, and inefficient use of resources. Because of these problems, both the IRS and NATS are moving back to corporate level requirements management organizations. Neither the IRS nor NATS manages an infrastructure of equipment and systems as technologically complex as the FAA NAS, but the lessons learned are still applicable.

Well-Defined Customers

We found in our interviews with FAA requirements process participants that identification of and focus on a discrete set of customers is an essential element of requirements management. The philosophy of ATO implementation should support this need for customer definition since its mission will be to concentrate all of the organization's efforts on providing air traffic service to the flying public and measuring its performance accordingly. This concept supports the characteristic of a requirements management process that is unified with ATO performance objectives. In the current FAA system development environment, requirements specialists and acquisition managers must balance the needs of multiple stakeholders who view themselves as customers.

The ATO focus on service to the flying public should allow these stakeholders to evolve their focus from that of a customer to a co-service provider. The corporate level requirements function would provide the primary interface with external customers so that the agency speaks with a unified voice and maintains continuity between ATO performance goals and the service-level requirements developed by the business units. This unity of focus on one customer and a common set of performance goals will also facilitate requirements prioritization.

Correlation of Requirements Interfaces and Conflicts

The simultaneous autonomy and interdependency of business units presents the ATO with significant requirements management challenges. A requirements function would need to have, as a focus area, the responsibility for monitoring requirements shared across multiple business units and resolving requirements conflicts as they relate to NAS integration. In order to monitor requirements shared across business units, the ATO will need to fully document and correlate any system requirements that span multiple NAS domains. This documentation and correlation effort will support efficient communication and logical allocation of these system requirements to the business unit level within the corporate requirements function.

As a tool to support requirements traceability, the ATO should investigate the development of a NAS requirements correlation matrix like the one in use by the Air Force. The Air Force tool documents requirements parameters, thresholds and development rationale. It provides corporate requirements stakeholders with visibility into links, interactions and potential conflicts between strategic level requirements. The current air traffic requirements organization has an automated tool called the Dynamic Object-Oriented Requirements System (DOORS) that may have the ability to support a requirements correlation function in the ATO. However, results from our interview process indicate that the DOORS tool has usability issues.

Requirements Prioritization

Results from our interviews and best practices analysis identified the need for a structured requirements prioritization process. Requirements prioritization in the FAA is particularly challenging because the origins of most of its major system development programs lie in specific aviation safety needs. This is where a corporate level requirements function can provide significant value in an environment of autonomous business units that will have to vie for a limited set of resources. Using customer needs, the ATO performance goals, and NAS architecture as guides, priority arbitration for the COO can be provided within the corporate requirements function.

The Air Force employs a prioritization process that warrants examination by ATO designers. Each Air Force Major Command (analogous to ATO business units) ranks the priority of their requirements and programs by assigning a score of 1, 2 or 3 (with 3 being the highest priority). To maintain focus, the Major Commands can rank no more than one third of their requirements or programs with the highest priority score. The Air Force senior leadership and its Requirements Oversight Council then set priorities for the department as a whole.

A similar standardized prioritization process implemented in the ATO could support the alignment of corporate requirements with performance goals while allowing business units a significant level of autonomy in setting their internal priorities. As with all requirements characteristics, strong, effective communication and coordination are critical to the successful execution of requirements prioritization. A standardized prioritization process would also drive an ATO investment analysis and budgeting process that aligns with corporate performance goals.

Service-Oriented Investment Management

The ATO focus on service to the customer and corporate performance goals will necessitate an evolution from product-oriented investment and budgeting mechanisms to an integrated, service-oriented investment analysis and budgeting process. Service investment management is a trend that we found during our best practices analysis and it aligns with the characteristic of top-down requirements management. We found that IRS, as a performance-based organization, uses service-oriented portfolio management for its information technology (IT) investments and that NATS has returned to a corporate-level investment strategy after attempting to decentralize this function to its internal business units. We also found that the current ATS requirements service is seeking to implement portfolio management and align investments and budgets with NAS service domains. A service-oriented investment management process that is driven by structured requirements prioritization and guided by corporate performance goals would be an essential element of the ATO. While investment management is not truly an element of the requirements process, these two functions are so strongly linked that it warrants consideration during the design of the ATO requirements process.

Periodic Requirements Revalidation

We can expect the NAS architecture and service goals to evolve as new technology is introduced and the aviation market progresses and adapts to an ever-changing environment. In our interviews with FAA requirements process participants, we found consensus that the initial validation and periodic revalidation of requirements needs to be improved in an ATO environment. This revalidation should be done at the corporate level to insure efficient use of resources and alignment with ATO performance goals. The ATO focus on performance measures at the business unit and corporate level should precipitate a more routine revalidation of requirements in light of customer needs. ATO designers can look to NASA's use of *Major Control Gates* as a guide for instituting a structured requirements revalidation process. NASA's control gate process consists of formal reviews at key program milestones, using specific success criteria, to assess whether high-level requirements are being met.

It is through the initial validation and periodic revalidation processes that requirements managers can measure their successes in accordance with ATO performance goals. The ATO emphasis on performance measurement should also generate the need to conduct structured post-implementation validations of products, services, and system-level requirements to ensure that products deployed to the field are actually meeting expectations.

Trained Requirements Managers

In our analysis of best practices and interview results we found agreement that the ATO will need requirements managers with requisite operational and technical expertise to identify and develop clear, measurable requirements. Requirements managers performing corporate functions must possess a detailed understanding of both air traffic operations from a national, system-wide aspect coupled with a systems engineering perspective. These requirements managers will have to interpret the needs of the ATO customer and corporate performance goals to derive NAS-level requirements and allocate them to business units.

At the business unit level, requirements specialists need to have the expertise to decompose service requirements into clear, measurable product requirements and specifications. In our interviews we found that requirements stakeholders believe that current requirements development training is inconsistent. We heard requirements specialists need to have stronger system engineering skills to be successful. The envisioned ATO structure will have a significant effect on requirements specialists in the business units that will necessitate more comprehensive training and professional development. The decentralization of service and product level requirements management among ATO business units may result in a dilution of requirements management expertise. Also, the ATO focus on a single customer (the flying public) will force current internal organizations, such as air traffic and airway facilities, to redefine their roles from internal customers of the system developer to co-service providers. Business unit requirements specialists will need the training necessary to establish technical and operational credibility with "former" customers and guide the development of service-oriented requirements that are tied to corporate performance goals.

Process Flexibility

In our interviews, we found a consistent concern that any requirements management process implemented under the ATO includes flexibility as a key feature of its design. There is a perception that the current ATS requirements process is too rigid. Product teams pursue waivers and exceptions to the current process to expedite their programs. Flexibility in the requirements management process is essential if ATO designers establish business units with a high degree of autonomy. Rigidity in the requirements process could hamper the business unit's ability to develop solutions to meet its service needs.

However, the ATO's focus on serving the customer and measuring success via corporate-level performance goals suggests the need for structure and traceability in the requirements management process. Striking a balance between establishing requirements management structure throughout the ATO and allowing business units a suitable level of independence is particularly difficult. ATO designers need to clearly define roles and responsibilities for requirements management at both the corporate and business unit levels. In our interviews, we found consensus that corporate level requirements managers should concentrate on conducting mission analysis, developing NAS-level service requirements, and setting corporate level priorities based on performance goals. Requirements specialists in the business units should focus on developing and implementing solutions that help to achieve corporate performance goals based on service requirements allocated to them by the corporate requirements function.

C. ATO Requirements Process Implementation Considerations

While the development of an ATO requirements management process is a complex task for the design team, the real challenge will likely lie in the evolution of the workforce's mindset. The ATO philosophy calls for a significant change in the way requirements managers, system developers, and front-line service providers view their jobs. The ATO will alter the current requirements management culture through its emphasis on services versus products, the consolidation of corporate goals, and its focus on a single set of external customers.

Our interview results indicated that the majority of requirements process participants are still focused on products and programs rather than service provision. This mindset is prevalent even in the ATB organization that has already begun implementation of the performance-based organizational concept. The persistence of a product/program focus among requirements stakeholders indicates that ATO designers need to concentrate on cultural transformation as they prepare for PBO implementation.

When designing a requirements process implementation strategy, the ATO design team should review the ACM assessment of the Alaskan Region Corporate Maintenance Philosophy (CMP) Program for lessons that are particularly applicable to their organizational transformation challenge. The Alaskan CMP Program is similar to the ATO initiative in that its goal was to institute a more "business-like" approach to Airway Facilities service provision. Specifically, the CMP was designed to reduce the frequency of periodic maintenance and certification necessary in the FAA's Alaskan Region. Much like the ATO philosophy, the Alaskan Region Airway Facilities (AF) organization established "corporate-level" performance metrics focused on the provision of NAS infrastructure services to aviation users. While the CMP Program met several of its stated goals, it resulted in the issuance of an unfair labor practice ruling and was ultimately viewed as a failure in implementation. The United States General Accounting Office (GAO) audited the CMP program and issued the November 30, 2001 report number GAO-02-127R entitled "*National Airspace System: Incomplete Transition Back to National Maintenance and Certification Standards in the Federal Aviation Administration's Alaskan Region.*" According to the GAO report, "the Federal Labor Relations Authority ruled that FAA must revert back to the national maintenance and certification standards in the Alaskan Region because it had not negotiated an extension of the pilot program with its unions." FAA officials stated the transition back to the national standards would be completed by January 1, 2002. This unsuccessful organizational transformation effort can serve as a valuable case study for the ATO design team.

In its initial implementation, the CMP Program had strong foundations upon which it could build. These positive elements included:

- Strong support and sponsorship from both the national and regional AF management levels,
- Consensus among middle management, first line supervisors, and the AF workforce that they had to improve their way of doing business, and
- Support from union leadership and their active participation in work process redesign.

Even with these building blocks in place, the transformation of the Alaskan Region AF group into a performance-based organization was ultimately unsuccessful. There were several factors

applicable to the requirements management environment that contributed to the CMP program's failure, including:

- The Alaskan region AF workforce was accustomed to a highly structured, compliance-focused work environment.
- CMP Program leaders did not adequately prepare its workforce for a more autonomous, responsibility-oriented environment.
- There was severe degradation of communication and trust in the Alaskan Region's AF work environment.
- Management believed that they could have done a better job of communicating with the workforce during the CMP Pilot Program.
- The feedback mechanism did not work as envisioned. Negative criticism of the CMP program was discounted by the core team and management, which caused a shutdown of the feedback loop.
- Workforce interpretations and perceptions became reality.
- Management did not effectively communicate the objectives of CMP and the rationale for their actions.
- There was a significant turnover of managers and supervisors under CMP contributing to employees having considerable fear of retaliation if they did not support CMP.

There was also significant pressure for AF managers to demonstrate immediate results. This emphasis on immediate results exacerbated the problems they encountered with cultural transformation and communication up and down the organizational chain.

While the scope of the CMP program is limited in comparison to the ATO, its lessons are still applicable. The CMP program failed in spite of strong management sponsorship and initial support from union leadership and the general workforce. Our interview results indicate a reluctance to address the complexity of the cultural transformation component in the ATO restructuring effort. The Alaskan CMP Program provides a vivid illustration of the consequences the ATO design team can expect if cultural transition considerations are not adequately addressed in its implementation strategy.

Evaluation Results Summary

In its current state, the FAA's requirements process has the following characteristics:

(a) corporate responsibility for requirements management fragmented between the ARS and ASD organizations, (b) duplication of requirements process activities in ATS organizations such as ARS, ATP, and AAF, (c) requirements managers coordinating with diverse sets of internal and external customers, and (d) requirements management activities generally focused at the product/specification level and not at the system/service level.

These attributes of the current requirements management process will need to be augmented and altered to create attributes coinciding with the ATO focus. The transition of ATS and ARA into the ATO is intended to cut administrative costs, improve performance, focus staff on customer service and satisfaction, and realign the agency under common goals, objectives, and strategies. The core attributes of requirements management recommended in this report can be used to support the transition into the ATO structure.

During the preparation of this report, transition teams had not reached agreement on the structure or high-level work processes of the ATO. The evaluation team interviewed key members of the ATO design team to gain a general understanding of the ATO implementation approach. The interpretation of the evaluation team is the ATO will embody the following set of characteristics:

- Clearly defined mission and common performance objectives,
- Flat organization with a commercial-like structure, and
- Business units that will function with significant autonomy.

These characteristics provide the general framework of an operational philosophy for identifying appropriate elements of effective requirements management.

The ATO's concentration on a small set of common performance objectives will necessitate a shift in the FAA's current requirements development focus from specific products to a system/service-level orientation. The requirements for systems that the ATO develops will have to be derived from its corporate performance goals. Therefore, ATO designers need to strike a balance between the development of NAS level requirements at the corporate level and the generation of service and product level requirements in the business units, which will be functioning with envisioned autonomy in their service delivery. To meet this challenge, ATO requirements management implementation strategy should embody the following principles:

- Requirements derived from their performance goals
- Strong coordination and communication (internal and external)
- Clearly defined roles and responsibilities

Using these core principles as a guide, we identified attributes of requirements management that should be either perpetuated or instituted in the ATO. Through our conduct of industry best practices analysis and interviews with a wide range of FAA requirements management stakeholders, we identified several trends or themes that we believe are most applicable to establishing a requirements process in the ATO structure.

These are the core attributes of an effective requirements process the evaluation team advocates for FAA's ATO:

- Top-Down Requirements Management
- Well-Defined Customers
- Correlation of Requirements Interfaces and Conflicts
- Requirements Prioritization
- Service-Oriented Investment Management
- Periodic Requirements Revalidation
- Trained Requirements Managers
- Process Flexibility

While the development of an ATO requirements management process is a complex task for the design team, the real challenge will likely lie in the evolution of the workforce's mindset. Our interview results indicated that the majority of requirements process participants are still focused on products and programs rather than service provision.

When designing a requirements process implementation strategy, the ATO design team should review the ACM assessment of the Alaskan Region Corporate Maintenance Philosophy (CMP) Program (<http://www.faa.gov/acm/acm10/reports.htm>) for lessons that are particularly applicable to their organizational transformation challenge. The Alaskan CMP Program is similar to the ATO initiative in that its goal was to institute a more "business-like" approach to airway facilities service provision. Much like the ATO philosophy, the Alaskan Region Airway Facilities (AF) organization established "corporate-level" performance metrics focused on the availability of NAS infrastructure components. While the CMP Program met several of its stated goals, it resulted in the issuance of an unfair labor practice ruling and was ultimately not accepted as a permanent change in the way they did business. This unsuccessful organizational transformation effort can serve as a valuable case study for the ATO design team.

Recommendation

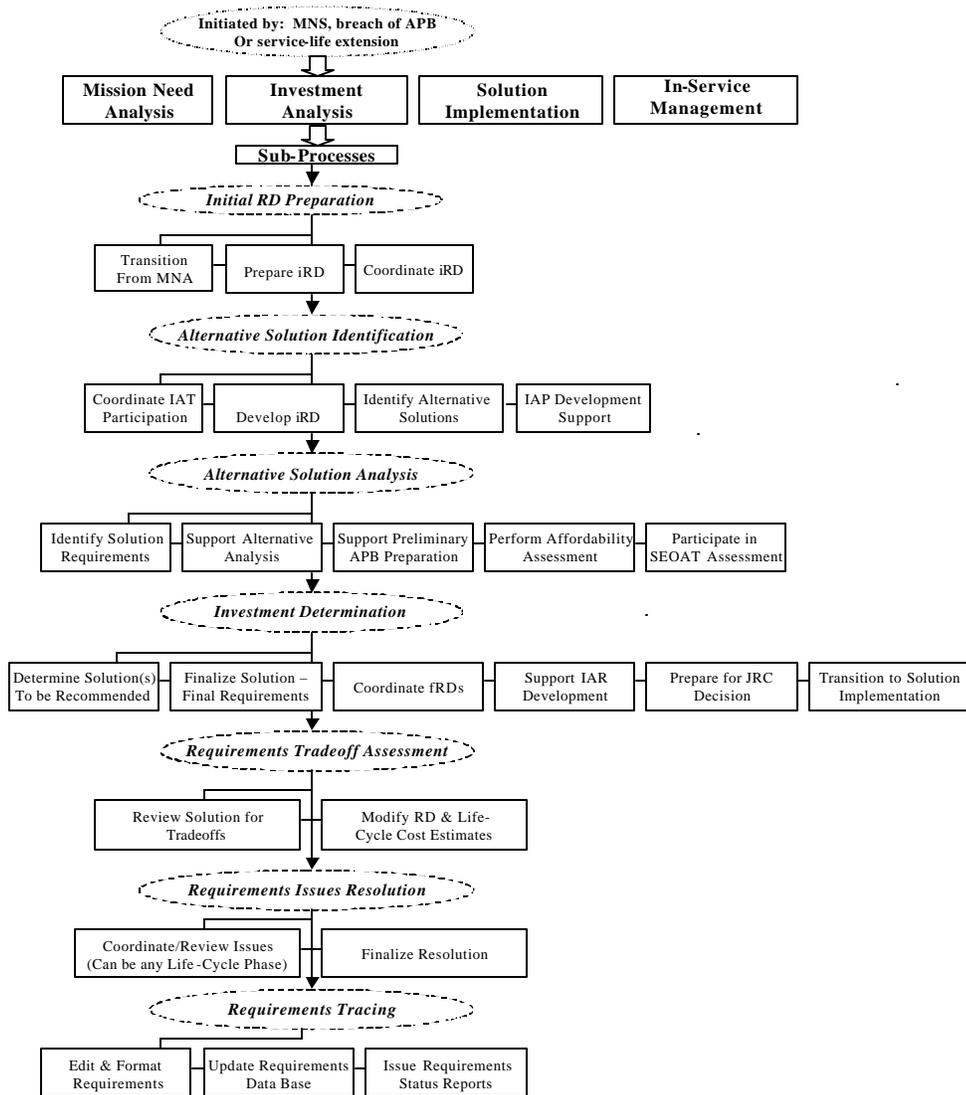
The evaluation team recommends the ATO design team incorporate the core attributes listed in this report throughout the evolution of the new performance based organization to establish effective requirements management.

Specifically, the core attributes recommended for incorporation into an effective requirements process are:

1. Top-Down Requirements Management,
2. Well-Defined Customers,
3. Correlation of Requirements Interfaces and Conflicts,
4. Requirements Prioritization,
5. Service-Oriented Investment Management,
6. Periodic Requirements Revalidation,
7. Trained Requirements Managers, and
8. Process Flexibility.

Appendix A: Current FAA Requirements Process

As part of the data collection phase, the evaluation team documented the FAA requirements process as provided under the Air Traffic Systems Requirements (ARS) organization. Organizations across the FAA, including Air Traffic (AAT) and Airway Facilities (AAF) use the requirements process to document, validate, translate and promote their requirements in the development of new capabilities. The process depicted below is a baseline of the current FAA requirements process, as provided by ARS. Stakeholders throughout the organization have reviewed this graphical depiction for the purpose of accuracy.



Appendix B: Stakeholders Matrix

The information used to create this matrix of stakeholders and their primary functions within the FAA Requirements Process was obtained from the In-Service Review Checklist (ISR Checklist). Stakeholders are defined as individuals or organizations interested in the success of a product or service. ACM-10 has focused on documenting the primary areas of responsibility and concern for the stakeholders listed in the ISR Checklist. The checklist is meant to be an all-inclusive list of all possible situations. This list of stakeholders and functions may be tailored for individual products or systems to only identify the applicable organizations or factors that will be considered and validated.

Functions	External Stakeholders								Internal Stakeholders																
	Airlines	Unions	Associations	General Aviation	Manufacturers	Other Federal Agencies	State/Local Government	Flying Public	OSHA	ATS										API					
										AAF	AOP	ASR	AFZ	AOS	ANI	AAT	ATP	ATX	ARS	ATQ	ACM	API	AEE		
Operational Concept	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Technical Performance Requirements	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Physical Integration	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Functional Integration	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Human Integration	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Security	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
In Service Support	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Test and Evaluation	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Implementation and Transition	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Quality Assurance	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Configuration Management	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
In Service Management	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Systems Safety Management	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Stakeholders Matrix (continued)

Functions	Internal Stakeholders																							
	ARA					AVR																		
	ARA	ASD	ASU	IPT	AAR	Technical Center	AVR	AFS	AVN	ARM	AIR	ACS	APA	AIO	AML - Logistics Center	AXX - Regional Organization	CAMI (MMAC)	ARP	AHR	ASY	Regions	Key Site		
Operational Concept	■	■		■		■													■					
Technical Performance Requirements	■	■		■		■																		
Physical Integration	■		■	■		■								■	■		■					■		
Functional Integration	■	■		■		■	■	■	■	■												■		
Human Integration	■			■	■	■								■		■						■		
Security	■		■	■							■		■		■							■	■	
In Service Support	■		■	■		■								■	■							■	■	
Test and Evaluation	■			■		■																	■	
Implementation and Transition	■		■	■		■	■	■				■	■		■				■			■		
Quality Assurance	■		■	■		■							■	■										
Configuration Management	■			■										■								■		
In Service Management	■			■										■								■	■	
Systems Safety Management	■			■																■			■	

Appendix C: Best Practices

The evaluation team contacted the following domestic and foreign organizations for information regarding their requirements processes. The objective of this data collection was to determine how other organizations conduct requirements and to document the relevant results as best practices and lessons learned. Although not all of the organizations listed below are performance-based, all have traits that are applicable to the FAA and the ATO.

The organizations whose names are italicized do not have a formal requirements process. Therefore, no requirements best practices or lessons learned were drawn from their organization. The Department of Education and the US Patent and Trademark Office (USPTO) are PBO's. However, because both organizations do not develop requirements for large-scale, high-value capabilities, the evaluation team did not draw best practices from their requirements processes.

Domestic Organizations	Foreign Organizations	Performance Based Organizations
<ul style="list-style-type: none">▪ Department of Defense - Air Force (USAF)▪ National Air and Space Administration (NASA)▪ <i>Nuclear Regulatory Commission</i>▪ <i>U.S. Coast Guard</i>	<ul style="list-style-type: none">▪ NATS▪ Air Services Australia▪ <i>Civil Aviation Security Administration (Australia)</i>▪ <i>DFS</i>▪ <i>NAV Canada</i>▪ Praxis (UK)	<ul style="list-style-type: none">▪ IRS▪ USPTO▪ Department of Education

The following is a list of the core attributes and their corresponding best practices taken from domestic and foreign organizations and agencies. A brief description of each best practice follows this matrix. The evaluation team considered a number of best practices and lessons learned from the organizations listed above. However, only the best practices and lessons learned that are directly applicable to one or more of the core attributes are provided in this appendix.

Core Attributes	Source	Best Practice/Lesson Learned
Top-Down Requirements Development	USAF	<ul style="list-style-type: none"> • <u>Requirements Oversight Council</u> provides requirements expertise, approves documentation, and provides a corporate perspective • <u>High Performance Teams</u> (HPTs) assemble strategic requirements that are passed along to the commands • <u>Shortfall lists</u> (strategic level) are created to determine the most critical needs • <u>Modernization Planning Process</u> is a process used to establish strategic goals for the Air Force
	NATS	<ul style="list-style-type: none"> • After placing requirements staff in business units, NATS decided to return to a <u>Corporate-Level Requirements Management Organization</u> and created SDI, a requirements controlling group for the organization
	IRS	<ul style="list-style-type: none"> • IRS placed requirements developers in business units but returned to a <u>Corporate-Level Requirements Management Organization</u>
Well-Defined Customers	NATS	<ul style="list-style-type: none"> • <u>SDI</u> was created to define customers at a corporate level for business units
	FAA Interviews	<ul style="list-style-type: none"> • ATO Philosophy states that the central customer is Flying public, a change from internal stakeholders being the customers • Numerous interviews stated that customers need to be well defined in order to provide the service they need and expect
Correlation of Requirement Interfaces and Conflicts	USAF	<ul style="list-style-type: none"> • The Air Force implemented a Requirements Correlation Matrix to document thresholds, objectives, and rationale for requirements, as well as document requirements changes • <u>Comment Resolution</u> provides stakeholders with an opportunity to address requirements concerns and resolve potential conflicts
	Praxis	<ul style="list-style-type: none"> • Praxis developed an approach to <u>conflict management</u>, detailed in their REVEAL methodology
	FAA-ARS	<ul style="list-style-type: none"> • <u>NDT</u> is a tool that provides requirements correlation and configuration management
Requirements Prioritization	USAF	<ul style="list-style-type: none"> • <u>Prioritization scoring</u> is when stakeholders rank and prioritize requirements based on their needs
	FAA Interviews	<ul style="list-style-type: none"> • Interview results revealed that <u>stakeholders need to prioritize requirements</u> so that the most essential user needs are included, if feasible, in the final product
Service-Oriented Portfolio Management	NATS,	<ul style="list-style-type: none"> • When NATS returned to corporate level requirements management, they began to evaluate capabilities based on <u>portfolio management</u>
	FAA ARS	<ul style="list-style-type: none"> • The FAA is creating <u>portfolio management</u> to align investment analysis with performance goals
Periodic Requirements Re-Validation	USAF	<ul style="list-style-type: none"> • The <u>Requirements Oversight Council</u> performs validation • The <u>Comments Resolution Process</u> is used to define comment timelines
	NASA	<ul style="list-style-type: none"> • <u>Major Control Gates</u> provide NASA with a system of checks to re-validate requirements throughout the system engineering and acquisition process
Trained Requirements Managers	NATS	<ul style="list-style-type: none"> • <u>Trained requirements engineers</u> become the intelligent customer for business units, understanding customer needs with both a technical and operational perspective
	FAA ARS	<ul style="list-style-type: none"> • ARS recognized the need to have managers with requisite operational and technical expertise trained to write requirements that are measurable and can be implemented
	USAF	<ul style="list-style-type: none"> • <u>Key Personnel Lists</u> are used to document trained requirements personnel and subject matter experts
Process Flexibility	USAF	<ul style="list-style-type: none"> • <u>Evolutionary Acquisition</u> provides requirements process flexibility and reduces the length of time to complete the process • <u>Rapid Requirements Process</u> is used for approved projects when a capability needs to be developed quickly
	Praxis	<ul style="list-style-type: none"> • <u>Prototyping</u> allows programs determine the feasibility of requirements up-front
	ASA	<ul style="list-style-type: none"> • ASA uses contractors for requirements development
	NATS	<ul style="list-style-type: none"> • NATS shares development costs with external organizations

Descriptions of the Best Practices and Lessons Learned

Best Practice: Air Force Requirements Oversight Council (AFROC)

Core Attribute: Top-Down Requirements Development

Document: Air Force Requirements Instructional Guide

Description:

- AFROC assesses AF requirements for all programs. The group is given specific responsibilities under the requirements process to provide comments, review work at the milestones, and play an active independent role in the requirements process. AFROC reviews the MNS, ORD, CRD, and other documentation.

Best Practice: High Performance Teams (HPTs)

Core Attribute: Top-Down Requirements Development

Document: Interview

Description:

- The Air Force recently created High Performance Teams (HPTs). The teams are assembled at the outset of a mission need to develop the high level requirements for the program/capability. The team consists of stakeholders, independent subject matter experts (SMEs), and others personnel who can add insight into the capability or have an interest in the program's success. The team spends a couple of weeks developing the high level requirements. Once the high-level requirements are complete, the team disassembles. The information generated from the team is provided to the core team, which the HPT identifies before the domain and product-level requirements identification begins.

Best Practice: Shortfall List

Core Attribute: Top-Down Requirements Development

Document: Air Force Requirements Instructional Guide

Description:

- MAJCOMs determine the capabilities that they will need, both short-term and long-term, to meet their goals and increase efficiency. These needs are placed on a shortfall list, which is used to determine the future needs of the Air Force as an organization. The output of the shortfall list is a set of mission needs that must be approved before moving into the requirements process. The shortfall list feeds the entire requirements generation process and acquisition process. The MAJCOM needs are assessed at the corporate level to determine the most pressing future capabilities.

Best Practice: Modernization Planning Process

Core Attribute: Top Down Requirements Development

Document: Air Force Requirements Instructional Guide

Description:

- Air Force requirements typically originate from the Modernization Planning Process (MPP), which details Air Force requirements responsibilities and procedures. MPP is the foundation for requirements generation. It involves the extensive analysis of Air Force strategic plans and high-level requirements. From the plans and requirements, the Air Force ranks deficiencies and prioritizes the most essential capabilities. This method ensures that commands assess the most critical needs, as well as the costs and benefits of undertaking the program.

Lesson Learned: Corporate Level Requirements Management Organization

Core Attributes: Top-Down Requirements Development, Well Defined Customers

Interview: NATS (UK), IRS

Description:

- Both NATS and IRS allocated requirements personnel to business units. Both faced requirements problems after allocating requirements staff to the business units. Those problems included customer disconnect, a lack of transparency in the process, different SOPs, an inefficient use of resources, groups purchasing similar systems, and a lack of integration.
- NATS and the IRS are moving back to a central organization for requirements. NATS has created SDI (Service Development and Investment), which is the intelligent customer for its business units, allowing the business units to have a cross-functional and enterprise-wide view of the customer needs and capabilities.

Best Practice: Requirements Correlation Matrix (RCM)

Core Attribute: Correlation of Requirements Interfaces and Conflicts

Document: Air Force Requirements Instructional Guide

Description:

- Air Force programs use a RCM, which is a matrix used to display and track essential user needs and requirements as they evolve. The programs use the RCM to look at cost-performance tradeoffs. RCM requires documented rationale for each requirement and need. Broken into three parts, Part I consists of a list of parameters for logistics, maintenance, and operational requirements. Part I provides the thresholds and objectives for each requirement. Part II explains how thresholds, objectives, and other requirements were derived citing case studies, research, models, and prototypes. Part III explains the rationale for changes to the requirements.

Best Practice: Comment Resolution

Core Attributes: Correlation of Requirement Interfaces and Conflicts, Periodic Requirements Revalidation

Document: Air Force Requirements Instructional Guide

Description:

- Once an Operational Requirements Document (ORD) is written and coordinated, the document goes through a period where various commands are able to comment on the ORD. The commands have a defined timeline from which they must submit their comments for comment resolution. If a command fails to submit comments within the given time period, then the command's comments and concerns are not included.
- The requirements team develops a comments matrix, and any critical comments are required to be resolved within 24 hours. If changes to the ORD cannot be agreed upon, then the XOR Chief works with the O-6 at the command to resolve the comments. Any problems that cannot be solved under the XOR Chief move up the chain of command. The requirements team updates the ORD based on these discussions.

Best Practice: Conflict Management

Core Attribute: Correlation of Requirement Interfaces and Conflicts

Document: REVEAL Methodology, Praxis (UK)

Description:

- REVEAL uses a distinct conflict management approach to resolve issues that arise when identifying and confirming requirements. REVEAL states that there are two different types of conflicts – superficial (design disagreements) and fundamental (underlying conflict about the requirement). There are also intrinsic (logical contradictions) and extrinsic (only removed by future developments) conflicts. Requirements processes need to establish trade-offs to deal with these conflicts. A trade-off matrix would assist requirements engineers in doing so.

Best Practice: Prioritization Scoring

Core Attribute: Requirements Prioritization

Document: Air Force Requirements Instructional Guide

Description:

- Each Major Command (MAJCOM) prioritizes the requirements listed in the Operational Requirements Document (ORD). This information provides direction to the ESC (Acquisition Community) on which requirements are most important to the commands. In doing so, the ESC first looks for solutions to meet the top-ranked requirements. Once the ESC has identified a set of potential solutions, they perform cost/risk assessments and coordinate with the Spiral Development Incremental Plan (SDIP). MAJCOMs prioritize the requirements using a numbering system. In the numbering system, requirements are ranked with a 1, 2 or 3. A three equals the highest priority for a MAJCOM. Only 1/3 of the ranked requirements can be a three. The MAJCOMs are also allowed to choose the top 6 requirements of all of those that are ranked.

Best Practice: Major Control Gates

Core Attribute: Periodic Requirements Revalidation

Document: NASA Systems Engineering Handbook

Description:

- NASA Systems Engineering has developed a series of major control gates during the lifecycle. The major control gates provide guidance to project managers and ensure that programs have all the documentation necessary to move to the next stage. Each Review consists of a list of criteria for successful completion. That list must be finalized before the next step begins. Reviews involving requirements include the Mission Definition Review, System Definition Review, Preliminary Design Review, and Critical Design Review. These control gates look similar to the ISR checklist, but they act as more of a step-by-step guide to what needs completed, laying out distinct questions that must be addressed at each stage of requirements development.

Lesson Learned: Trained Requirements Engineers

Core Attribute: Trained Requirements Managers

Interview: NATS

Description:

- Requirements at NATS were first generated using a 'wish list.' Customers did not fully understand how to identify their requirements.
- SDI was created to aid users in understanding their needs. SDI was named the intelligent customer, providing all business units with the requirements information they needed to develop capabilities that customers would buy into. SDI has to understand each customer, as well as the strategic and financial goals of the company when creating requirements for new capabilities.

Best Practice: Key Personnel Lists

Core Attribute: Trained Requirements Managers

Document: NASA Procedures and Guidelines

Description:

- NASA program and project managers are able to view a list of key personnel and functional contacts within NASA for subject matter expertise. Programs can use these personnel to aid in requirements development, ensuring that independent experts and key stakeholders are included when developing requirements documentation.

Best Practice: Evolutionary Acquisition (EA)

Core Attribute: Process Flexibility

Document: Air Force Requirements Instructional Guide

Description:

- Because acquisitions can require extensive amounts of time and because technology is often out-of-date by production/implementation, the Air Force uses evolutionary acquisition. In EA, each subsequent phase may be covered by the documentation from the previous phases, with updates listed in an annex. The initial ORD describes the capability and need, and the requirements are simply updated in subsequent iterations.

Best Practice: Rapid Requirements Process (RRP)

Core Attribute: Process Flexibility

Document: Air Force Requirements Instructional Guide

Description:

- There are times when a capability needs to be fielded quickly and the existing process is too lengthy to produce the capability in a timely fashion. In situations such as this, Air Force programs use a RRP to expedite acquisitions. Specific standards and processes are used to provide a fast, fieldable system.

Best Practice: Prototyping

Core Attribute: Process Flexibility

Document: REVEAL Methodology, Praxis (UK)

Description:

- Prototyping is used to validate of requirements after they have been collected and analyzed. REVEAL uses prototyping, modeling and simulation, and the playback of consequences to determine whether the requirements are validated. The FAA validates its requirements during the creation of the iRD; however, prototyping or modeling and simulation can assist stakeholders in understanding the feasibility of their requests. This should become a more standard process, as it is used in REVEAL.

Lesson Learned: Using contractors for requirements development

Core Attribute: Process Flexibility

Interview: Air Services Australia

Description:

- ASA no longer writes extensive requirements. A multi-disciplinary team assembles high-level specifications and creates an RFP. ASA receives detailed proposals from industry. Those proposals are later short-listed down to two or three companies. ASA works with all the short-listed companies to develop the capability. One of the short-listed companies is chosen as the final contractor. The contractor already has the requirements documentation, and ASA acts as a manager in the process.

Lesson Learned: Sharing development costs with other organizations

Core Attribute: Process Flexibility

Interview: NATS

Description:

- SDI has realized that certain systems can be shared across organizations for different projects. This is especially relevant in Europe where the ATC is much smaller, but the needed capabilities are expensive.
- NATS is moving to share information on technology within the UK and throughout Europe.

Appendix D: Interview Summary Results

The evaluation team interviewed a number of individuals from several organizations to better understand the requirements process and its related issues, to gather data on what areas within the current process are working well, to acquire suggestions on how to improve the process, and to gain ideas as to how the process should be structured under the ATO. The evaluation team summarized the interviews and used them throughout the analysis phase to establish a broader context in the development of recommendations. The evaluation team randomly selected and contacted a wide selection of requirements stakeholders in an effort to gain numerous perspectives.

Organizations Interviewed for the FAA Requirements Evaluation	
AAF	Office of Airway Facilities
AAT	Office of Air Traffic
ACM	NAS Configuration Management and Program Evaluation
AIO	Office of Information Services
AND	Office of Communication, Navigation, and Surveillance Systems
AOP	NAS Operations Program Directorate
ARN	Communication, Navigation, Surveillance (Requirements)
ARQ	Requirements Development
ARS	Air Traffic System Requirements
ASD	Office of System Architecture and Investment Analysis
ATB	Terminal Business Service
ATP	Air Traffic Planning and Procedures
ATQ	Independent Operational Test and Evaluation
ATS	Office of the Administrator for Air Traffic Services
ATX	Resource Management Office
AUA	Office of Air Traffic System Development
AXX	Field Representatives from 400 & 510
IPT	Integrated Product Team
NAATS	National Association of Air Traffic Specialists
NATCA	National Air Traffic Controllers Association
PASS	Professional Airways Systems Specialists

The following is a summary of the key comments and trends produced from the interviews the evaluation team conducted with requirements stakeholders. The organizations interviewed are listed above. This summary does not include all of the comments made by individuals in each group. However, it does capture the trends that were observed across the majority of individuals within the identified groups. The group entitled ‘other requirements stakeholders’ consists of the following organizations: ASD, AAF, AAT, ATP, AOP, IPTs, and AND.

Question 1: What is working well in the current requirements process?	
ATB Management	<ul style="list-style-type: none"> • Decisions are more streamlined because the organization is focusing on present needs • There is less contention surrounding the requirements process because the requirements process is within the organization rather than outside of ATB.
ATB Staff	<ul style="list-style-type: none"> • Requirements staff understand their roles, allowing for a good division of responsibilities within the teams • The ability to understand the requirement and how it relates to the field is consistently being addressed
Union Representation	<ul style="list-style-type: none"> • Collaboration between management and the union is working well • The requirements process is more predictable due to requirements staff following AMS during requirements identification and documentation • Programs accept union input, allowing for a concentrated team effort
ARS Management	<ul style="list-style-type: none"> • Requirements are well documented under the current process • The requirements process is centralized, disciplined, and consistently applied to programs (predictable) • Constant improvements are made on the process • Requirements engineers are dedicated to doing requirements thanks to quality training
ARS Staff	<ul style="list-style-type: none"> • Requirements engineers are knowledgeable • The front end of the process works well from mission need to investment analysis, as a whole • Validation of the iRD has improved the process as requirements personnel are brought to the field
Field	<ul style="list-style-type: none"> • Inter-Disciplinary Teams, which collaboratively resolve agency-wide field level requirements issues, are an asset • The working relationship between the facilities and the field have provided communication, coordination, and validation • The regions have a requirements database of validated projects, which eliminated the yearly resubmission of unfounded projects • There are established procedures for requesting F&E projects
Other Requirements Stakeholders	<ul style="list-style-type: none"> • The process and requirements engineers are working well, which aids in establishing relationships with other organizations • The role that ARS plays as a combiner of AT and AF requirements is effective • The development of requirements documents is based on the concept of operations • ASD cooperates well with ARS in the requirements process

Question 2: What is not working well in the current requirements process?	
ATB Management	<ul style="list-style-type: none"> • Strategic planning is not being evaluated when identifying and writing requirements • There is a lack of defined roles and responsibilities, as well as a lack of training • The requirements process takes too long • There needs to be improved communication with the field • Many pieces of requirements are not working well in ATB; requirements functioned more efficiently in the old organizations.
ATB Staff	<ul style="list-style-type: none"> • Funding is a major issue due the ‘salami slicing’ that occurs among programs, adversely affecting requirements • Requirements personnel are not speaking up or pushing back on requirements that the users do not need • There is no metric to determine whether the product met the system-level requirements • Roles and responsibilities are not clear, inhibiting effective communication
Union Representation	<ul style="list-style-type: none"> • Funding is the major issue plaguing requirements. There is not enough funding, and the funding that the program initially receives is typically reduced during the lifecycle • Communication is a problem • Stakeholders need to be more involved in all areas of requirements identification and development • The stakeholders need to resolve conflicts early in the process
ARS Management	<ul style="list-style-type: none"> • Stakeholders need to be more involved in requirements • Organizations are often duplicating the job of ARS • There is inconsistency in the requirements leads, which makes it difficult for programs to move through the process in an efficient manner • The process takes too long
ARS Staff	<ul style="list-style-type: none"> • The process takes too long • The JRC does not say ‘no’ to any programs that do not meet their baselines or provide full documentation • IRT participation is sporadic • ARS suffers from a lack of credibility • There is no professional development or formal training for requirements management
Field	<ul style="list-style-type: none"> • There is insufficient funding to meet all of the requirements for the life of the program • There is not enough communication and too much bureaucracy • The creation of ATB has caused confusion in roles and responsibilities • Organizations fail to operate inefficiently due to differing visions • The requirements process has not been incorporated by all of the necessary HQ organizations
Other Requirements Stakeholders	<ul style="list-style-type: none"> • There is no overarching group or function that approves NAS requirements and validates requirements • A systems engineering perspective is lacking from requirements • There is no traceability • The process itself is appropriate for the organization, but the process is carried out in an inefficient manner • Executives throughout the agency circumvent the requirements process • ARS is not consistently following their requirements process

	<ul style="list-style-type: none"> • Requirements personnel are not the champion of the product or capability, making requirements identification and documentation more difficult • The process takes too long to complete • Stable requirements drive the investment analysis. Incomplete requirements pose problems for Alternatives Analysis within the IA, and they can force programs to restart the IA process.
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Question 3: How do you address redundancies and overlaps with other stakeholders in the requirements process?	
ATB Management	<ul style="list-style-type: none"> • Redundancies and overlaps are dealt with on a case-by-case basis
ATB Staff	<ul style="list-style-type: none"> • Commit to working relationships across the Lines of Business (LOB's) • Conduct periodic stakeholder meetings
Union Representation	<ul style="list-style-type: none"> • Meet with workgroups to sort out redundancies and overlaps • Product teams and stakeholders should use safeguards and create rules to deal with any redundancies and overlaps
ARS Management	<ul style="list-style-type: none"> • Portfolio management should help to eliminate redundancies and overlaps, which are a product of other organizations doing ARS's job
ARS Staff	<ul style="list-style-type: none"> • Interdependencies are addressed on an individual basis • Operations and acquisition personnel need to work together to resolve redundancies and trade-offs
Field	<ul style="list-style-type: none"> • The field uses Inter-Disciplinary Teams, which collaboratively resolves agency-wide, field level requirements issues, to eliminate redundancies and overlaps • The field uses budget prioritization meetings to jointly prioritize all project needs
Other Requirements Stakeholders	<ul style="list-style-type: none"> • Overlaps and redundancies will be reduced when the roles are divided by domain • Stakeholders provide input to the AFSMT, which provides a corporate perspective and helps to reduce redundancies and overlaps • Workgroups are one method to deal with redundancies and overlaps

Question 4: How is the impact of cost and benefits handled in the requirements process?	
ATB Management	<ul style="list-style-type: none"> • ATB handles tradeoffs through business cases which include alternative analysis
ATB Staff	<ul style="list-style-type: none"> • There are not enough trade-offs and risk assessment handled to evaluate the cost and benefit of requirements • Program teams conduct impact analysis to determine the shortfalls and tradeoffs based on input from users
Union Representation	<ul style="list-style-type: none"> • Program team addresses the cost and benefits of products • Union representatives are usually not involved in cost v. benefits tradeoffs • Unions need to be included in the cost benefits evaluations and program processes
ARS Management	<ul style="list-style-type: none"> • Cost v. benefits tradeoffs are normally handled during alternatives analysis under investment analysis or during the solution implementation phase
ARS Staff	<ul style="list-style-type: none"> • ARS handles the cost and benefits of any requirements changes • Cost and benefits need to be evaluated after the operational change
Field	<ul style="list-style-type: none"> • Staff studies are developed for large projects where the estimated cost for the project is developed and the benefits are identified

	<ul style="list-style-type: none"> • Smaller projects use cost and benefits decisions after the estimated costs from associated organizations are collected • Utilize meetings to discuss the cost/benefits of projects' impact to service
Other Requirements Stakeholders	<ul style="list-style-type: none"> • ARS and ATB conduct cost and benefits tradeoffs and analysis, which is usually handled in the IRT • Cost and benefits for requirements are not very important, as most organizations want to know how much the program costs, not how much a requirement costs • There is little opportunity to influence requirements based on economic analysis. Requirements are not challenged until the proposed solution is deemed unaffordable

Question 5: How do you think the requirements process can be improved?	
ATB Management	<ul style="list-style-type: none"> • Requirements definition needs to be separated from requirements approval • ATB requirements personnel need field input and need to have the ability to work with facilities • The requirements process should increase its flexibility to meet new requirements in innovative ways
ATB Staff	<ul style="list-style-type: none"> • Allocation of requirements is the key to developing system-level requirements and then passing down domain and product level requirements • Systems engineering needs to be included in the requirements process • Requirements must be traceable and repeatable • Roles and responsibilities within the requirements process need to be provided to all staff
Union Representation	<ul style="list-style-type: none"> • Improve funding to make it a more consistent process • Conduct prototyping during the early stages of requirements • There needs to be a method in which stakeholders can respond to tactical needs throughout the acquisition process
ARS Management	<ul style="list-style-type: none"> • Reduce the time and resources necessary to conduct requirements engineering and management • Incorporate system engineering • Create a large, centralized body that has the vision to create corporate requirements • The requirements process and teams should incorporate requirements prioritization with stakeholders
ARS Staff	<ul style="list-style-type: none"> • Make the requirements process less bureaucratic • Create a central management for requirements with a strategic perspective • Evaluate the efficiency and effectiveness of the portfolio management process • Establish a stable requirements baseline with an understanding of existing performance of fielded systems
Field	<ul style="list-style-type: none"> • Conduct early and consistent collaboration with stakeholders • Create stable funding streams to support systems throughout the lifecycle • Establish an effective and consistent communication process • Reduce the time it takes to complete requirements • Create accountability through education
Other Requirements Stakeholders	<ul style="list-style-type: none"> • Increase the consistency of the requirements process and personnel • Train all requirements personnel • Stakeholders need to start following the requirements process rather than circumventing it for a shorter process • Conduct cost and benefit analysis from the start of the program

	<ul style="list-style-type: none"> • Create a high-level requirements identification (strategic) and validation function • Use rapid prototyping • Involve stakeholders • Identify requirements prior to the IA
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Question 6: What do you think are the key attributes needed in the requirements process for the new Air Traffic Organization?	
ATB Management	<ul style="list-style-type: none"> • Communication and feedback from stakeholders • Tie the requirements process to metrics at all levels of requirements identification and validation • Prioritize requirements
ATB Staff	<ul style="list-style-type: none"> • Involve stakeholders • Training for all requirements personnel • Tie the requirements process to metrics at all levels of requirements identification and validation • Necessary to have a cross-cutting requirements function above the business units to develop requirements
Union Representation	<ul style="list-style-type: none"> • Collaborative decision-making and communication are the keys to requirements • Firm funding streams are necessary • Stakeholder involvement • Training for all requirements personnel
ARS Management	<ul style="list-style-type: none"> • Involve stakeholders • Tie the requirements process to metrics at all levels of requirements identification and validation • System-wide requirements needs to be connected with systems engineering functions • Training is needed for all requirements personnel • Necessary to have a cross-cutting requirements function above the business units to develop requirements
ARS Staff	<ul style="list-style-type: none"> • Create strategic requirements and relate them to the strategic goals of the agency • Create a cross-cutting requirements function above the business units to develop requirements • Requirements traceability • BU's should not own the requirements process
Field	<ul style="list-style-type: none"> • Shortened process or reduced time to conduct the process • Stable funding • Accountability • Requirements traceability • Recruit talented individuals with knowledge in the causes the contributions to delays and the FAA infrastructure
Other Requirements Stakeholders	<ul style="list-style-type: none"> • Requirements must be measurable • Automated tools • Consistent process across all programs • Involve stakeholders • Necessary to have a cross-cutting requirements function above the business units to develop requirements • Documented requirements process with timelines

	<ul style="list-style-type: none">• Good tradeoffs and testing• Hands-on determination of requirements that gives users and develops an opportunity to better understand the most effective alternative
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Appendix E: Acronyms

ACM	NAS Configuration Management and Program Evaluation
AIO	Office of Information Services
AIS	Automated Information System
AND	Office of Communication, Navigation, and Surveillance Systems
AOP	NAS Operations Program Directorate
ARA	Associate Administrator for Research and Acquisitions
ARN	Communication, Navigation, Surveillance
ARQ	Requirements Development
ARS	Air Traffic Requirements Service
ASA	Air Services Australia
ASD	Office of System Architecture and Investment Analysis
ATB	Terminal Business Unit
ATC	Air Traffic Control
ATO	Air Traffic Organization
ATP	Air Traffic Planning and Procedures
ATS	Associate Administrator for Air Traffic Services
ATX	Resource Management Office
AUA	Office of Air Traffic System Development
COO	Chief Operating Officer
DFS	Deutsche Flugsicherung (ATC, Germany)
DOORS	Dynamic Object-Oriented Requirements System
EA	Evolutionary Acquisition
ESC	Acquisition Community
FAA	Federal Aviation Administration
IPT	Integrated Product Team
IRS	Internal Revenue Service
IT	Information Technology
USPTO	U.S. Patent and Trademark Office
MAJCOM	Major Command
MN	Mission Need
IA	Investment Analysis
BU	Business Unit
MPP	Modernization Planning Process
NAATS	National Association of Air Traffic Specialists
NAS	National Airspace System
NASA	National Air and Space Administration
NATCA	National Air Traffic Controllers Association
NATS	National Air Traffic Service (United Kingdom)
ORD	Operational Requirements Document
PASS	Professional Airways Systems Specialists
RRP	Rapid Requirements Process
SDI	Service Development and Investment
SDIP	Spiral Development Incremental Plan