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Pathways to Tomorrow:

THE DEVELOPMENT PLANNING PROCESS



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By John M. Griffin, SES, and Victor D. Wiley, 1Lt

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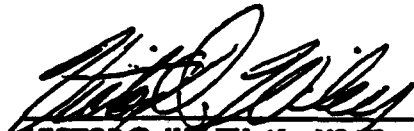
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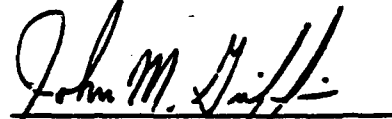
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AIR FORCE MATERIEL COMMAND (AFMC) HAS IMPLEMENTED A NEW, HIGHLY INTEGRATED METHOD FOR PLANNING THE DEVELOPMENT OF FUTURE SYSTEMS KNOWN AS THE DEVELOPMENT PLANNING PROCESS. THIS REPORT DESCRIBES THE DEVELOPMENT PLANNING PROCESS' SYSTEMATIC METHODOLOGY FOR ESTABLISHING AND ACHIEVING THE SHORT AND LONG RANGE GOALS OF ANY ORGANIZATION THROUGH A MULTIPLE CONSTITUENT, ANALYTICALLY BASED PLANNING PROCESS. THE PROCESS PROVIDES DECISION MAKERS WITH MANY ALTERNATIVES FROM WHICH TO CHOOSE AND HELPS TO JUSTIFY THEIR CHOICES.

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Pathways to Tomorrow - The Development Planning Process

INTRODUCTION

How many times have you seen a product advertised that promises something more than it actually delivers? How many times have you bought something that was more trouble putting together than it was worth?

These questions arise from a mindset that has plagued the defense industry and the Department of Defense for decades - the isolation from each other of technologists, engineers, and the customers during the development and design of a product. This separation of constituents has often led to products begging questions such as those above.

This mindset has occurred due to the lack of dedicated, comprehensive, and integrated upfront planning. Despite this insufficiency, the strength of the economy and plentiful defense dollars led to many successes in the past including, most recently, Desert Storm and the end of the Cold War. These successes support the argument that "if it ain't broke, don't fix it." However, this thinking can no longer compete in the face of downsizing and budget cutbacks. Therefore, for an organization to succeed, it must focus its resources to meet its current and future goals.

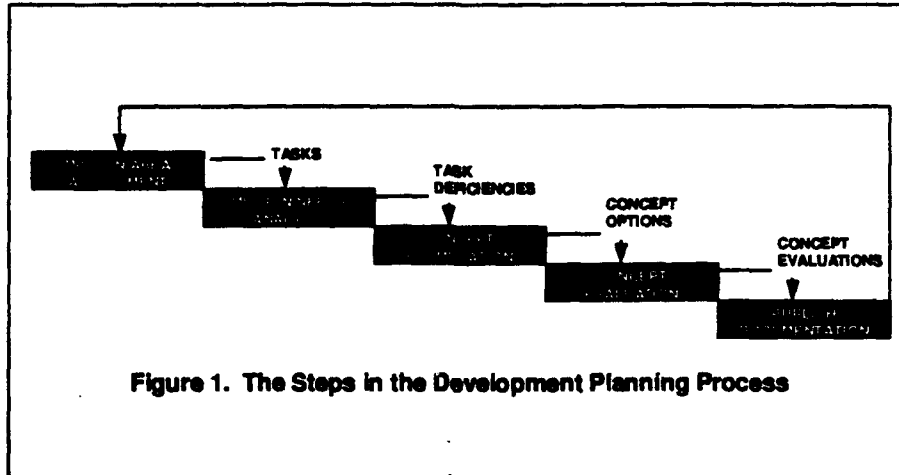
The Japanese, in the 50s, 60s and 70s, focused on the customers' needs through Quality Function Deployment (QFD) to allowing them to produce better products. This strategy allowed them to react faster to the wants of their customers by keeping the customer involved in the improvement of their products. US companies, seeing the Japanese market flourish, have begun to emulate the Japanese and the QFD strategy. Unfortunately, most US companies have only focused on the design to manufacturing part of this strategy (Reference 1); allowing themselves to be reactive to the market based on customer feedback. This served companies well initially; but success in today's world depends on the industries that can be proactive (Reference 2).

The Air Force has taken a step toward this approach by developing, prototyping, and using a process known as the Development Planning Process. This process provides the means to focus an organization's resources, allowing them to maintain their reactive capabilities while reducing the risks associated with being proactive. This report describes a process to systematically break down the planning activities that establish roadmaps for new systems and system upgrades, and enact those plans to deliver superior products.

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OVERVIEW

The Development Planning Process divides the business of planning into an iterative and integrated series of steps. The steps are defined in a logical fashion to ensure succeeding steps are directly traceable to the previous step. This inherently ensures that the results are traceable to the initial inputs (see Figure 1). The Development Planning Process as defined here starts with an



assessment of an organization's goals. From this assessment, the organization establishes strategies for attaining those goals. The next step in the process is to identify the tasks necessary to achieve the strategy. Each task is then analyzed to determine the deficiencies which may prevent the task from being accomplished effectively. The potential concepts to solve each deficiency and/or do a particular task better should be established. These concepts range from purchasing more of an existing system, modifying existing systems using off-the-shelf technologies, Pre-planned Product Improvement type technology programs, to advanced programs. By leveraging modeling, simulation, studies, and analyses capabilities with the existing technology base and industrial capabilities, each potential concept is analyzed to determine how well it solves the deficiency or improves doing the task and how much it would cost to implement. In addition, each concept would identify the types of technologies needed and risk involved in creating and implementing that concept if selected. It is this list of concept alternatives that allows one to select the best path(s) (See Figure 2) to achieve a strategy since resources and the impact of resource constraints can be better understood and managed when the required program events are clearly defined and understood (Reference 3).

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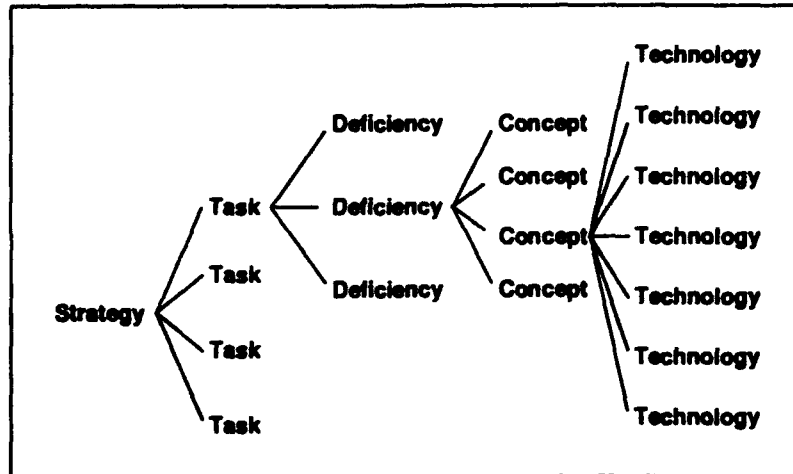


Figure 2. Decision Pathway

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IMPLEMENTATION

In order for this planning process to be successful, it must be a multiple constituent, analytically based process. Multiple constituency means participation, at the right time, by all of the right players involved in the identification, establishment, and achievement of a strategy and its objectives (Reference 3). Participation by all players at the right times ensures that the deficiencies and potential concepts in accomplishing the strategies and tasks are addressed. The involvement of all players in the planning process also provides a sound basis for the proper use and/or development of models, simulations, and analytical techniques for basing recommendations. As long as they are analytically based, these recommendations can be defended through logical arguments. As the number of stakeholders and their level of involvement increases, the complexity of organizing and utilizing all members' ideas and contributions into an effective plan, as well as agreeing on the criteria for analyses, grows. To tackle this problem, Air Force Materiel Command (AFMC) formed a new team structure based on the integrated product development team philosophy (Reference 4, IWSM White Paper) used by F-15, F-16, F-22, B-2 and others.

The structure created by AFMC to manage the Development Planning Process is the Technical Planning Integrated Product Team (TPIPT). This team consists of all the players involved in the Development Planning Process as well as an administrative/facilitative organization. The members provide the knowledge base while the facilitators assure the smooth flow of the process (See Figure 3). The members of the TPIPT can be logically divided into groups based on the amount of support required. The Full-Up TPIPT represents all of the participants in the process, including the users, the customers, the suppliers, the Laboratories, and other activities. Not every member in this group is expected to participate full-time in the

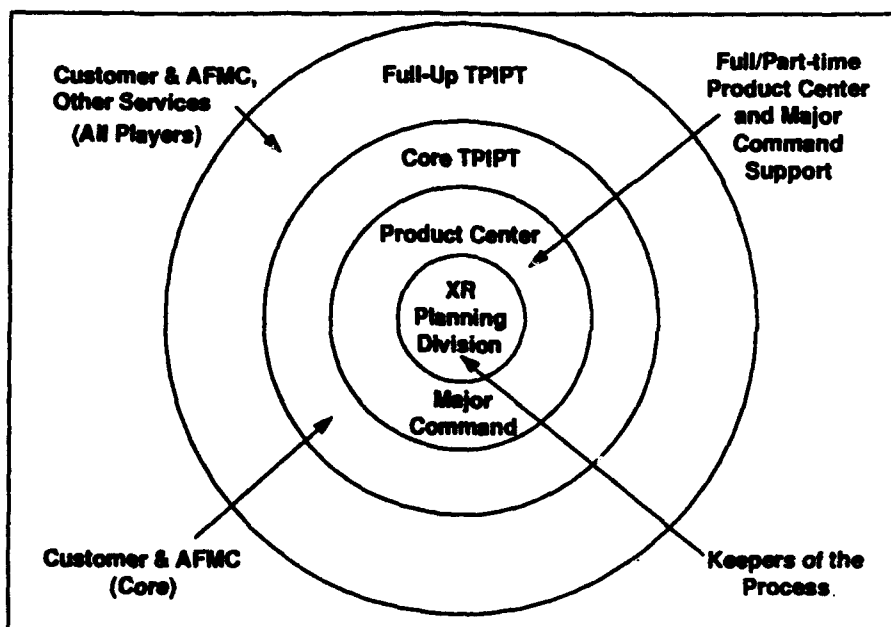


Figure 3. Typical TPIPT Structure

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process, but they are required to provide their expertise when requested. The Core TPIPT group represents the customers and AFMC members that perform most of the activity centered around identifying the deficiencies and developing the concept options for solving the deficiencies. Within AFMC, the planning division of the XR organizations located at each of the product centers (Aeronautical Systems Center (ASC), Electronic Systems Center (ESC), Human Systems Center (HSC), and Space and Missile Center (SMC)) has been assigned the responsibility of providing full-time support to meld the efforts of its constituents into integrated and usable planning documents. These documents should that meet customers', in this case the Air Force Major Commands' (MAJCOMs'), expectations for both the near-term and the far-term.

Mission Area Assessment (MAA) and Mission Needs Analysis (MNA), in the Development Planning Process (See Figure 1) are primarily the MAJCOMs responsibility. Other TPIPT members are integral parts is assisting the MAJCOMs in these two steps. To accomplish this, the MAJCOMs formed Mission Area Teams (MATs) focused on determining the tasks and deficiencies associated with their particular Mission Areas (Reference 5, Draft AF-OI). These teams provide the constituency needed from the MAJCOMs to perform the MAA and MNA steps as part of the Development Planning process as well as the Air Force Modernization Planning Process (see Figure 4). Once these teams have established the tasks and deficiencies (with other

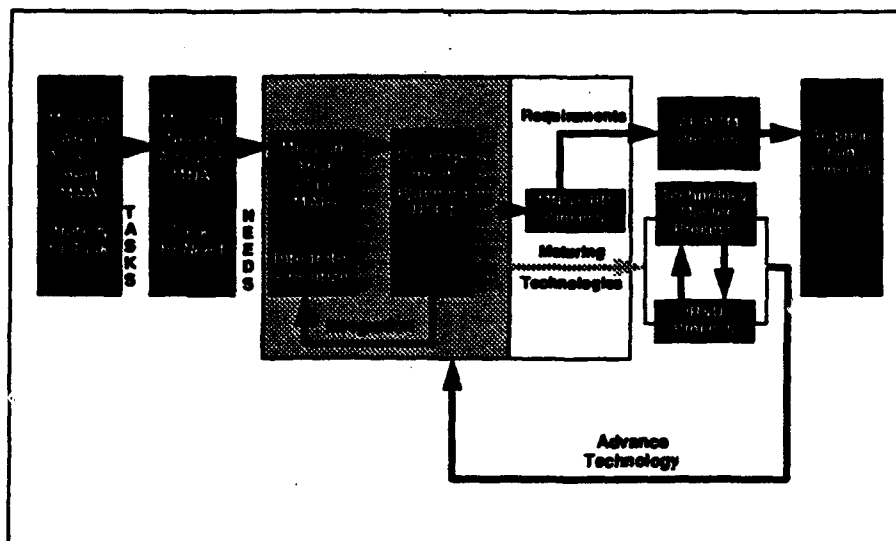


Figure 4. AF Modernization Planning Process

TPIPT members assisting and observing), the TPIPTs then take the deficiencies and conduct "brainstorming" activities to identify concepts to solve the deficiencies. After these concepts have been analyzed, the MAJCOMs then select the promising concepts to include in their Mission Area Plans (MAPs). In this respect, the activities of the Development Planning Process and the Mission Area Planning process are a seamless match. The Development Plan acts as the analytical annex to the MAP. It is this integration of activities (focusing on Mission Area rather than

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product) that makes the Development Planning Process more mature than the planning activities of the past for both the MAJCOM and AFMC (see Figure 5). In the past, the MAJCOMs said "build this." Now the MAJCOMs say, "I have a problem. What solutions will work?"

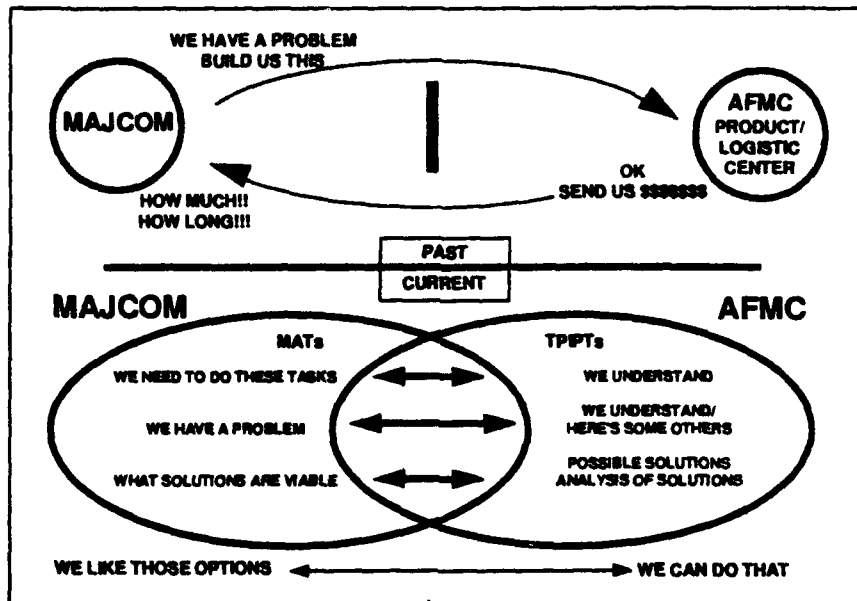


Figure 5. Integration of MATs and TPIPTs

AFMC has 21 TPIPTs currently assigned to the Development Planning process (see Figure 6). Each TPIPT is designed to integrate with the strategic planning being conducted and the Mission Areas existing within the MAJCOMs. An example of the interrelationships between MATs and TPIPTs is shown in Figure 7. The functional Mission Areas (depicted vertically) are areas that do not stand alone, but cut across other Mission Areas (depicted horizontally) as a common activity conducted within each Mission Area. The functional Mission Areas specialize in working the needs and problems associated with their function that are derived from the Mission Areas. These relationships show just a small part of the TPIPT/MAT activity and illustrates the importance of communication between the various groups involved.

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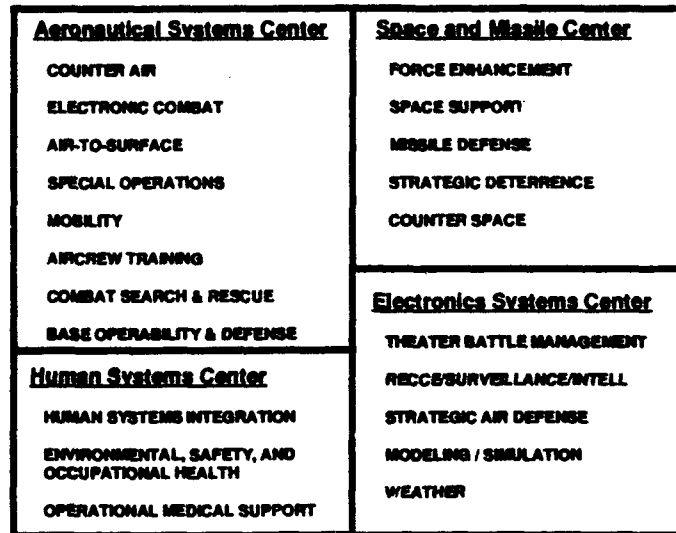


Figure 6. AFMC TPIPTs for each Product Center

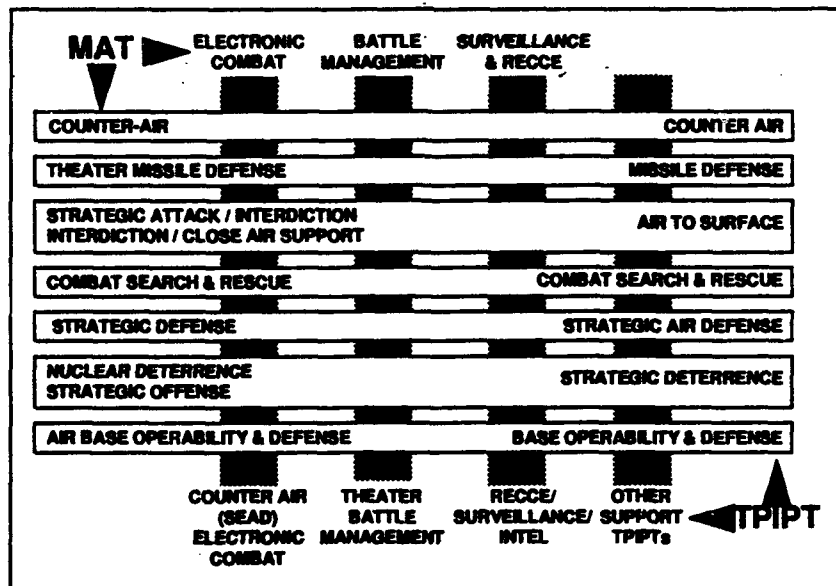


Figure 7. ACC MATs and AFMC TPIPTs interrelationships

Since most of the communication between the various TPIPTs takes place at the action officer level, some of the larger integration issues may be omitted. These issues could involve the overlap of activities between TPIPTs along with the possibility of some non-value added activities taking place. To keep these problems from occurring at the initial level, the TPIPTs are led by a MAJCOM Point of Contact (POC) to ensure that the MAJCOM needs are met. The next level of management oversight involves reviewing the output of the TPIPTs in response to the MAJCOM

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guidance received. This level is comprised of senior management personnel. This group would serve to periodically provide advice and direction on the activities conducted by the TPIPT. Finally, for some select TPIPTs with activities that span a number of Mission Areas, a General Oversight Steering Group would ultimately review the TPIPTs activities and recommendations and provide feedback based on the "big picture" outlook from a top-level perspective (see Example in Figure 8). These advisory groups provide the ability to maintain control of the requirements for TPIPTs and to steer them in the direction that is overall the best for the Air Force.

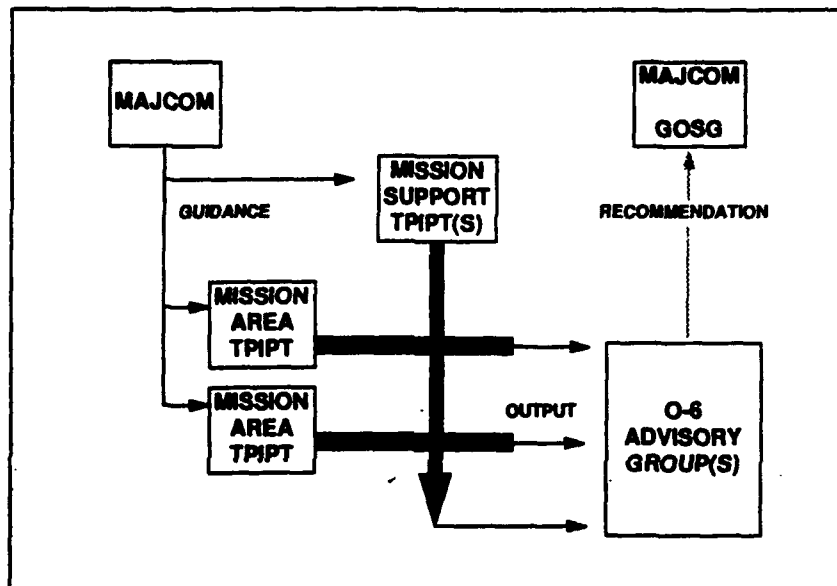


Figure 8. Example of TPIPTs MANAGEMENT OVERSIGHT

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EXECUTION

The Development Planning Process described in Figure 1 begins when the MAJCOM, in coordination with the CINCs, determines the activities that must be performed to win any conflict. For the Air Force these activities will be provided by the Air Staff to the Air Force MAJCOMs as Objectives and Tasks. Once the tasks are determined, the process facilitators request the modeling, simulation, studies and analyses from in-house and industry resources analyze these tasks for their relative value in winning the war (See the Campaign and Mission levels of Figure 9). This analysis provides the relative importance of each task. This relative importance creates the basis for an initial way to determine which area to focus on first.

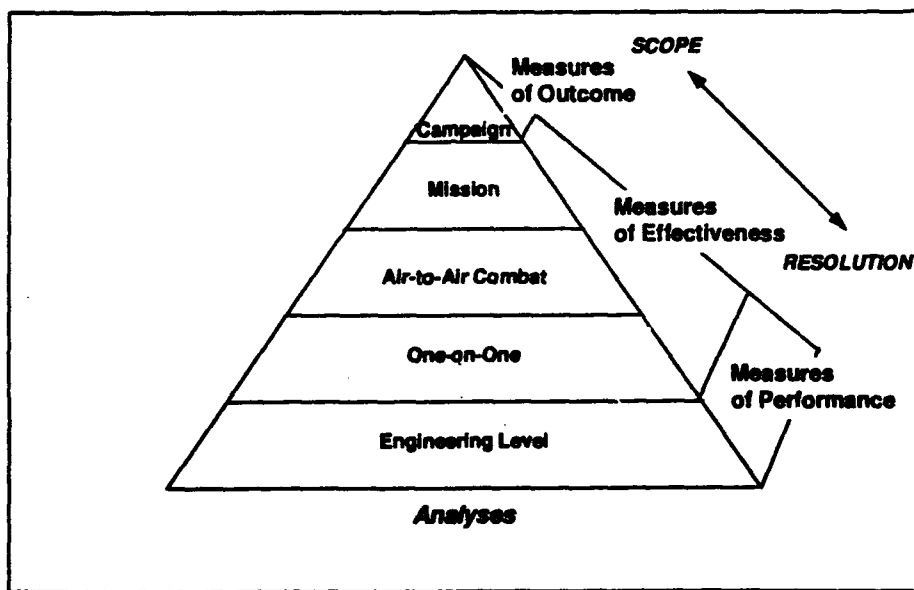


Figure 9. ASC Analytical Models and Their Hierarchical Structure

In the Mission Needs Analysis step, the deficiencies in performing the tasks are identified. These deficiencies represent deployability, employability, and supportability problems as defined by the MAJCOM and the System Program Directorates as well as force-on-force level deficiencies that are discovered through campaign analyses. The baseline for determining the deficiencies are the systems we currently possess versus the current and projected threat. Once the deficiencies are identified, they are studied to determine which have more impact on the outcome of a conflict. This is partly based on the importance of the task that the deficiency is related to and partly based on the number of tasks the deficiency affects. This analysis would provide a second means of determining which area to focus on seeking concept solutions for first.

With the MNA step complete and deficiencies in hand, the Concept Formulation step of the Development Planning process can occur (Reference 6). The formulation of concepts requires the broadest level of participation from the members of the TPIPT as well as industry (See Appendix A, A Systems Engineering Approach). Every player brings forth concept ideas on how the identified deficiencies can be solved while the laboratories identify technologies that may

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support these concept ideas within the next 10 years. For promising ideas that go beyond the purview of current laboratory programs, guidance to begin technology work in these areas is given for solutions to be available within 25 years. This "brainstorming-like" step generates a lot of ideas. As a way of correlating the volumes of information and showing the connectivity and interrelationships of the concepts and the deficiencies they address, the XR organizations decided to use a matrix structure (see Figure 10). The matrix structure represented a concise way of presenting information while still providing enough detail to be useful.

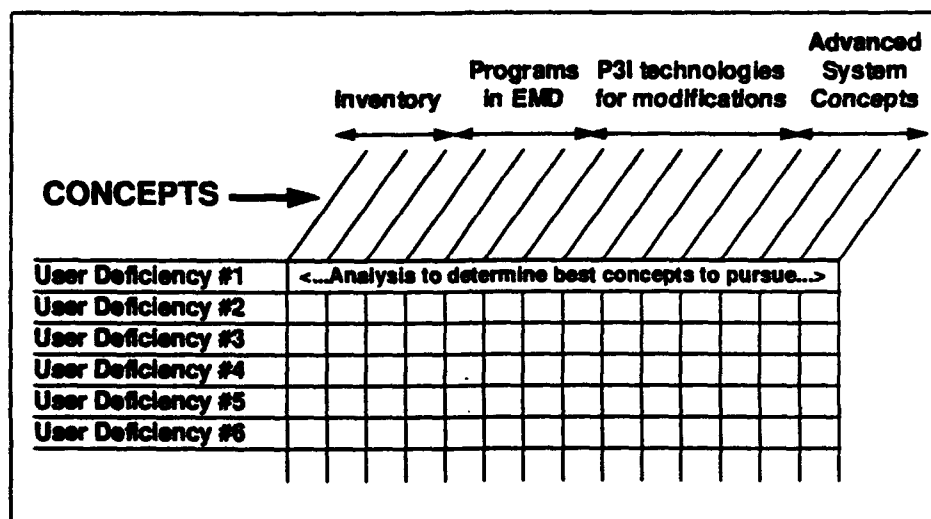


Figure 10. The Summary Matrix

The left column in the figure lists the deficiencies as identified by the MAJCOM and as rank ordered (highest at the top) by analysis. The top row of the matrix lists all of the concepts that were identified as a means to solve one or more of the deficiencies. This row would first list the current inventory items that could be used against the deficiencies. Next, the programs in Engineering and Manufacturing Development (EMD) would be listed to show the new capabilities they would bring to the MAJCOMs. Depending on the status of an existing EMD program, the MAJCOM may expect to realize the system's capability anywhere from the 1-5 year time frame. New EMD programs spawned from the Development Planning Process that are approved in the Program Objective Memorandum (POM) may enter into the MAJCOM's inventory in the 5-8 year time frame. The next set of concepts would contain SPO or laboratory technology programs identified as possible future Pre-Planned Product Improvement (P3I) technologies for modifications of existing systems. The impact time frame for these concepts varies anywhere from 1-15 year time frame, depending on the maturity of the technology and the magnitude of the change to the inventory or EMD system. An example of this may be the GBU-28, developed in several months during Desert Storm to penetrate buried bunkers. Infra-red search and track sensors are an example of a much more complex set of technologies, many of which require

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continued technology maturation, engineering validation, and extensive engineering development before production. Finally, the concepts that involve new systems or technologies that are not currently being worked within the laboratories would be listed to cover the 16-25 year out time frame.

Once concepts have been identified from the Concept Formulation step, each concept would be evaluated during the Concept Evaluation phase. Every concept would have a top-level Cost versus Operational Effectiveness Analysis (COEA) estimate conducted as part of the systems engineering process that transforms stated needs into a life cycle balanced set of product and process descriptions (Reference 7). The result of this COEA would be High, Medium, or Low payoff assessment of the concept against the specific deficiency being addressed. For promising concepts (High and some medium payoffs), more in-depth studies would be conducted. Since the bulk of analyses' capabilities are resident within industry and since some of the concepts (especially the advanced concepts) would have been identified by industry, the TPIPT would rely heavily on the participation of industry in this step. In addition to the relative payoff assessment, these promising concepts would then be evaluated by the TPIPT on two other criteria. The first criterion assesses the developmental risk involved in transitioning the technology needed into a usable system. This assessment is rated as Red, Yellow, or Green depending on the level of risk involved. The second criterion determines the technological risk involved in maturing/producing a technology to be transitioned to the development stage. The assessment of this risk is shown as Red, Yellow, or Green based on the maturity of the technology and how well-studied the technology subject (a twist on an old technology or a new technology entirely. This three-fold evaluation technique utilized by ASC/XRS for a concept versus a deficiency is shown in Figure 11.

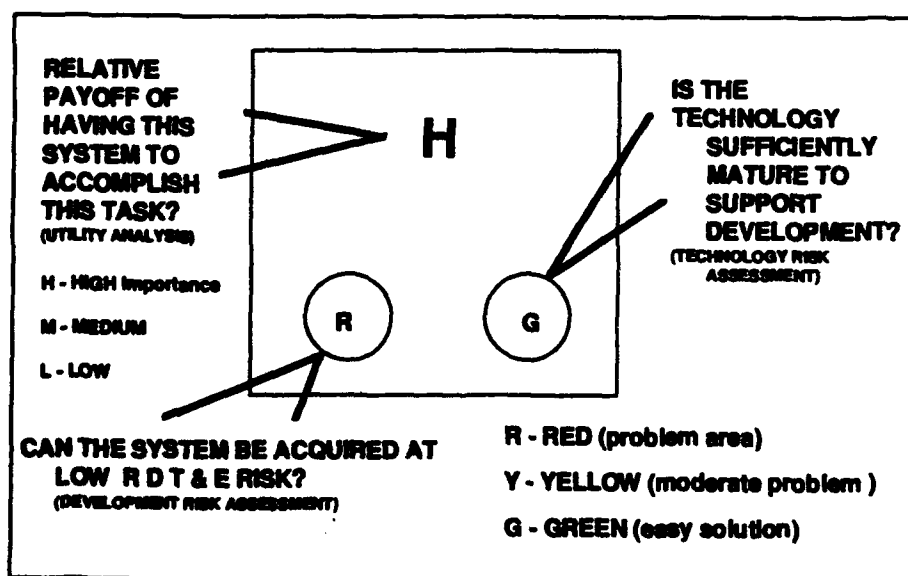


Figure 11. Evaluation Criteria Format

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Through continuous iterations of the first four steps of this process, convergence of system requirements from mission area studies is achieved. Technology efforts are modified, in time, through technology maturation and engineering validation to better focus against a specific MAJCOM deficiency by reflecting a better understanding of changes in needs, capabilities, and costs. System design progresses from conceptual trade-offs that examine concepts and determine the contributions of technologies through concept selection to preliminary design and classical system risk reduction activities such as wind tunnel and structural element testing. The process is complete when all the information needed is available for an informed acquisition option selection.

The final step of the process is to compile all of the analyses results into a readable understandable document(s). The document(s) would be published annually as a snapshot in time to reflect the current analyses of the Development Planning Process. The document(s) should be published and disseminated to every organization that participated in the process as well as to the people who make the decisions on where resources are allocated.

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DOCUMENTATION

The results of the Development Planning Process currently produce two important documents, a Development Plan from each TPIPT and a Technology Investment Recommendation Report from each of the Product Centers.

The Development Plan documents the activities that took place during the process cycle and acts as an audit trail for the conclusions made. The Development Plan lists the Strategies, Objectives, and Tasks that the Mission Area Assessment produced with a complete description of what each task included in Section II. Section III contains the task deficiencies identified from Mission Needs Analysis with a detailed description of each deficiency (Note: these two sections, in essence, are the same information as placed in the MAP; they are provided here in the Development Plan as a convenience). The deficiency list then correlates to the left-most column of the Summary Matrix (See Figure 12). Once the tasks and deficiencies are understood by all,

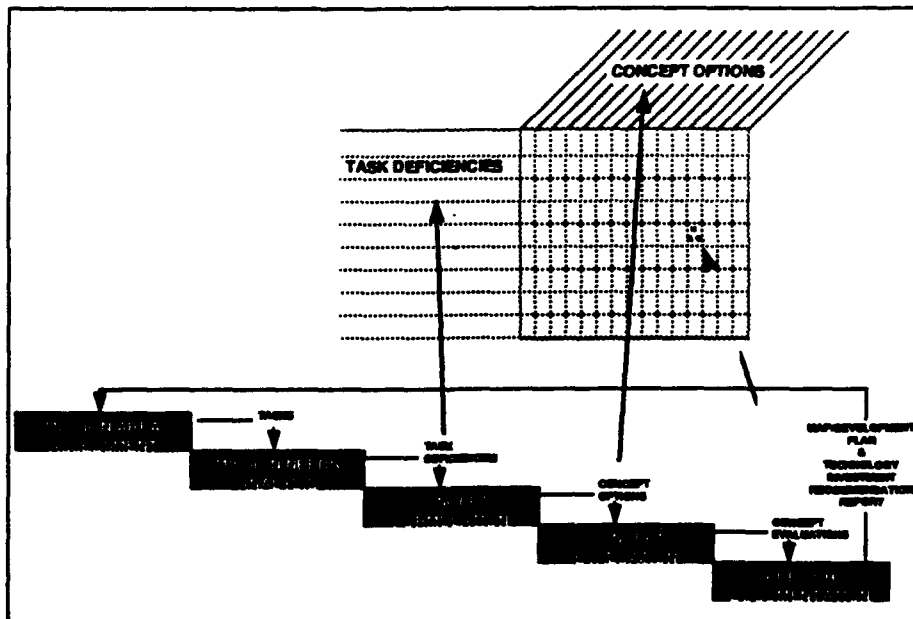


Figure 12. The Development Planning Process and the Summary Matrix

the concept options to solve the deficiencies are identified and placed in Section IV (The Development Plan would list all of the possible concepts while the MAP would contain the concepts supported by the MAJCOM). Each concept in this section would contain a description of what it involves and the types of technologies necessary to make it happen (Reference 8). These concept options would be organized as in Figure 10. After the concepts are generated, a placeholder would be used to mark where analysis of the concept against a deficiency needs to take place. Once a concept is analyzed, the results of the analysis are placed in the appropriate cell of the matrix (see Figure 11). With each cell, a background information package located in Section V would document the analysis behind the conclusions and recommendations made for each concept solution. Thus, at the executive level, a large amount of information would be

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presented in a single, condensed format allowing for comparisons of solutions. The engineering and analysis level data providing the detail would be available in the background information package. For a brief example, see Figure 13.

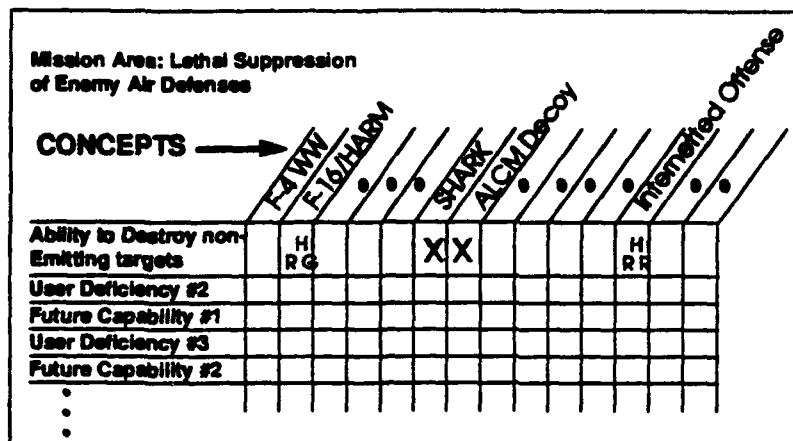


Figure 13. Example Use of The Summary Matrix

Although the concept options resulting from the Development Planning process identify the types of technologies needed for successful implementation of the concept options, these technology needs are limited to the views of the particular TPIPT that produced the concept. To get a "big picture" view of the types of technologies needing to be pursued, the technology needs of each TPIPT located at a Product Center are combined into one document. This document, the Technology Investment Recommendation Report, provides resource allocation guidance to the Laboratories for the types of technology programs the Laboratories should be pursuing. By blending the inputs from each of the Development Plans produced by that Product Center's TPIPTs, the Technology Investment Recommendation Report shows the overall importance of a technology program to the success of a Mission Area. The Laboratories, in response, produce technology roadmaps known as Technology Area Plans (TAPs) that summarize their programs as related to the needs identified in the Technology Investment Recommendation Report.

Together, these documents are powerful tools for decision makers and budget advocates. The Development Plan provides analytically based alternatives for solving problems to the MAJCOMs, the Technology Investment Recommendation Report gives suggestions to the Laboratories as to what types of technology programs will support the alternatives, and the Technology Area Plan summarizes the technology programs the Laboratories are conducting in response to the alternatives. These documents provide justification for why a decision maker may choose a particular concept(s). Most tools are valuable only if they are used, so it is important that these documents are sent to the right people (see Figure 14). Currently ASC/XR has published 2 Development Plans. Each of the 8 TPIPTs located at ASC are scheduled to publish a

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Development Plan by 1 September 1994. All of the Product Centers have published a Technology Investment Recommendation Report with an update scheduled for 1 October 1994.

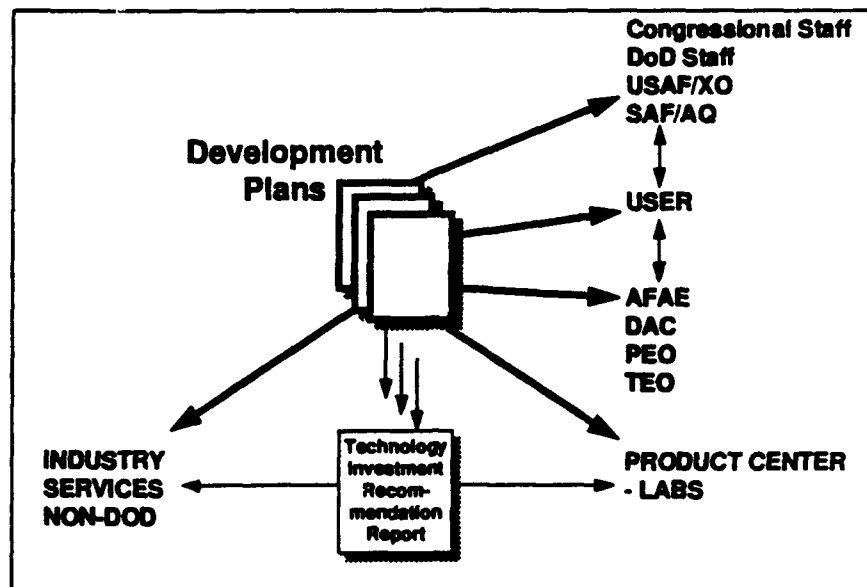


Figure 14. The Development Planning Process Documents and their Recipients

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SUMMARY

The need for a more mature planning process is driven by the fact that we can not afford to start programs and then not finish them. This Development Planning Process provides a systematic methodology for establishing and achieving the short and long range goals of any organization through a multiple constituent, analytically based planning process. The people involved in every facet of achieving these goals must be included, at some level of participation, in this process. People dedicated to process success are needed at each step to ensure that the necessary actions are taken. The steps begin with identifying the strategy being employed and determining the tasks necessary in achieving the strategy. Each task is evaluated for deficiencies that prevent it from being performed effectively. Concept options are developed to solve the deficiencies and analysis is performed on each concept to provide a relative comparison that will facilitate prioritization. The results are documented and presented as a decision tool to decision makers. The process provides decision makers with many alternatives from which to choose and helps to justify their choices. If we can get the entire DoD, or even just the Air Force to speak with one voice to advocate future technologies and systems, this new Development Planning Process will have been worth the effort. Remember, the future is in our hands.

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The Development Planning Process**

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APPENDIX A SYSTEMS ENGINEERING APPROACH

The Air Force is implementing a disciplined Strategy-to-Technology (STT) process to obtain validated decision data. In support of this commitment, a robust systems engineering effort is required. First, to define system: An integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective; and second to define Systems Engineering: An interdisciplinary approach encompassing the entire technical effort to evolve and verify an integrated and life-cycle balanced set of system people, product, and process solutions that satisfy customer needs. Systems engineering encompasses: (a) The technical efforts related to the development, manufacturing, verification, deployment, operations, support, disposal of, and user training for, system products and processes; (b) the definition and management of the system configuration; (c) the translation of the system definition into work breakdown structures; and (d) development of information for management decision making.

For example, an aircraft working in cooperation with AWACS and/or JOINT STARS can execute a strike mission utilizing a radar with less detection range than an autonomous system. Interdependence means a less complex radar - a more affordable radar option, but less capable when operating independently. The superior performance of a system over a collection of independent subsystems or components results from the cooperative interaction among the multiple system resources that connect them.

The systems engineering process looks at the entire suite of technologies necessary to solve a need and guides maturing of the technologies for a system solution as opposed to a specific stand-alone capability.

The essence of a system can be described in terms of several characteristics or descriptors. A system is composed of two or more sub-elements; each of which is composed of two or more subordinate elements; and so on down through a hierarchical system. This decomposition process stops when all of the system elements (functional packages) have been identified at a low enough level and in sufficient detail to yield a detailed design by a single specialized engineering organization or procured from a single supplier. These things, which make up the system, are organized into a hierarchical tree structure like that illustrated in Figure 15. The complete set of things that comprise a system organized in this manner is referred to as the system architecture.

The parts of the system must interface in useful ways in order for the elements to qualify as system. Interfaces are a second fundamental descriptor. Architectural elements interface with each other and with the system environment (which may include other competing or cooperating systems) to achieve the system goal. The environment is a third descriptor, even though it is not a part of the system. A system is intended to satisfy predefined goals or functions, which form the fourth fundamental descriptor. The highest level function is the war fighters' need. This need is also the ultimate system requirement. Finally, a system should have a prescribed process for operation of the system and this operational process is a fifth system descriptor.

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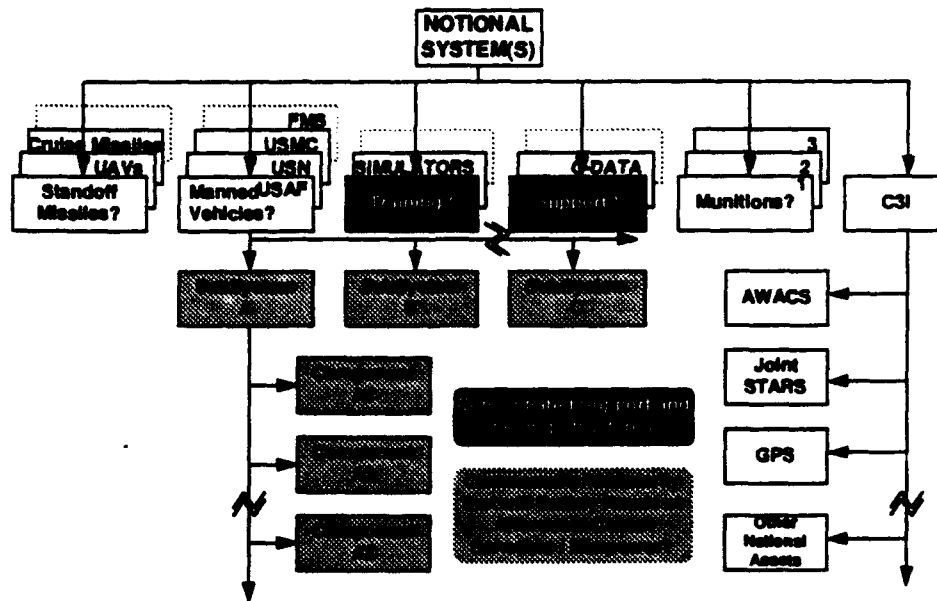


Figure 15. Potential Architecture Elements for Solution Alternatives

War at Sea and War over Land represent significantly different operational environments for manned aircraft. A pitching and rolling aircraft carrier deck of limited physical dimensions in contrast to a stable runway of relatively generous dimensions forces pilots to change their interaction with the aircraft. The pilot becomes one of the interfaces between the environment and the vehicle (an architectural element of the weapon system). The environment forces differences in the operational process of landing the aircraft (a common function). A carrier airplane flies to a specific touchdown point on a pitching deck, so it lands at a higher sink rate than a land based airplane. This results in high induced landing loads, driving robust design requirements for landing gear, tailhook, and keel beam on the keel beam structure. The pilot of a land based airplane does not have to worry about a short pitching runway and can flare the airplane for a smooth touchdown. Thus, induced landing loads are much less than for carrier based operations. We now have a set of common architectural subelements with potentially conflicting design requirements. These subelements provide different functions as a result of differences in operational environment. The primary systems are development, manufacturing, verification, deployment, operations, support, training, and disposal.

The program team will need to see and understand the interaction of the architectural elements with themselves, and the system environment via interfaces in accordance with defined operational and support processes to achieve the total system goals or function.