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# JOINT VISION 2010:

# DEVELOPING THE SYSTEM OF SYSTEMS

by

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In response to the changing strategic environment and the declining budgets, the Joint Chiefs of Staff have created a vision to help guide the Department of Defense (DOD) through a transformation that will enable it to meet the challenges it will face in the 21st Century. Now that the Joint Chiefs have articulated this vision, the next and most difficult step is implementing it. This paper explores two fundamental questions. What steps has DOD taken to implement Joint Vision 2010 (JV2010) and are these steps adequate? The DOD has taken significant steps to implement the vision. The DOD has further refined the JV2010 concepts in several key documents. They have also identified a management structure responsible for implementation and a framework for the implementation process. The key question concerning JV2010 is whether or not the implementation process is adequate. Is it capable of performing tough trade-offs and focusing our resources on the right mix of information technologies and traditional capabilities? This paper explores this question by using the systems engineering model to analyze the JV2010 implementation efforts. The analysis concluded the implementation process has many positive aspects. However, if optimal system development is to be achieved the process must take on more of a top down approach capable of evaluating competing alternatives and properly focusing investments on the right technologies and weapon systems required to achieve JV2010 capabilities.

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In response to the changing strategic environment and the declining budgets, the Joint Chiefs of Staff have created a vision to help guide the Department of Defense (DOD) through a transformation that will enable it to meet the challenges it will face in the 21st Century. Now that the Joint Chiefs have articulated this vision, the next and most difficult step is implementing it. This paper explores two fundamental questions. What steps has DOD taken to implement Joint Vision 2010 (JV2010) and are these steps adequate? The DOD has taken significant steps to implement the vision. The DOD has further refined the JV2010 concepts in several key documents. They have also identified a management structure responsible for implementation and a framework for the implementation process. The key question concerning JV2010 is whether or not the implementation process is adequate. Is it capable of performing tough trade-offs and focusing our resources on the right mix of information technologies and traditional capabilities? This paper explores this question by using the systems engineering model to analyze the JV2010 implementation efforts. The analysis concluded the implementation process has many positive aspects. However, if optimal system development is to be achieved the process must take on more of a top down approach capable of evaluating competing alternatives and properly focusing investments on the right technologies and weapon systems required to achieve JV2010 capabilities

# Chapter 1

# Introduction

> *The nature of modern warfare demands that we fight as a joint team. This was important yesterday, it is essential today, and it will be even more imperative tomorrow.*
>
> —General Shalikashvili

"The prospect of a horrific, global war has receded, new threats and dangers—harder to define and more difficult to track—have gathered on the horizon."[1] The changing threat characteristics require the Department of Defense (DOD) take a hard look at the future to ensure that our investments today will lead to the type of capabilities we will require to meet the future threat. The criticality of our investment choices today is further compounded by the shrinking defense budgets. The scarce resources will force the DOD to make difficult choices between competing alternatives. In response to the changing strategic environment and the declining budgets, the Joint Chiefs of Staff have created a vision to help guide DOD through a transformation that will enable it to meet the challenges of the 21st Century. Now that the Joint Chiefs have articulated this vision, the next and most difficult step is implementing it. This paper will explore two fundamental questions: What steps has DOD taken to implement Joint Vision 2010? Are these steps adequate to manage the tough trade-offs that will need to be made to achieve the vision's operational concepts?

The Joint Chiefs of Staff vision, Joint Vision 2010, is an operational framework designed to further increase the effectiveness of joint operations and to guide the evolution of the Armed Forces into the 21st Century.[2] The key to Joint Vision 2010, as described by Secretary of Defense Cohen, "is an integrated *system of systems* that will give them superior battlespace awareness, permitting them to dramatically reduce the fog of war. This *system of systems* will integrate intelligence collection and assessment, command and control, weapons systems, and support elements. It will connect the commanders to the shooters and suppliers and make available the full range of information to both decision makers in the rear and the forces at the point of the spear."[3]

Developing and successfully implementing this "system of systems" is a tremendous undertaking that will require extraordinary leadership and unprecedented cooperation between the services. Implementation of this vision will require significant changes to the way DOD does business. In the Quadrennial Defense Review, Secretary Cohen acknowledges that achieving this vision "is not an easy task and cannot be done in one leap. It is a step-by-step process involving the development of new technologies, investment in new platforms and systems, new concepts, training and doctrine and formation of new organizational structures."[4]

This paper will explore the adequacy of the Joint Vision 2010 implementation process. First, details of the vision will be discussed. Second, implementation status and some of the major concerns about the vision's implementation will be explored. Third, the details of the implementation process will be presented. Lastly, the systems engineering model will be used as a tool to analyze the implementation process. This model provides a framework that can be used to look at the DOD Joint Vision 2010

implementation approach to determine if the key model elements required for a successful system development are present in the DOD implementation strategy. The systems engineering model, as described in Defense Acquisition University, Systems 201 course book, "is a proven disciplined process for development of system solutions."[5] The strength of the system engineering model is that it provides a framework that is very good at managing risk, trade-offs between competing alternatives, and cost. The model is also very good at ensuring compatibility and interoperability among system components and ensuring the developed systems meets the user requirements.[6]

**Notes**

[1] Department of Defense, *Report of the Quadrennial Defense Review,* 1997, iii.
[2] Joint Chiefs of Staff, *Joint Vision 2010*, 1996, 1.
[3] William Cohen, "Report of the Quadrennial Defense Review," *Joint Forces Quarterly,* Summer 97, 11.
[4] Department of Defense, vi.
[5] Defense Acquisition University, *Systems 201 Course Book* (sixth edition, June 1996), 3-5.
[6] Ibid.

# Chapter 2

# Joint Vision 2010

*You got to be careful if you don't know where you're going, because you might not get there.*

—Yogi Berra

## What is Joint Vision 2010?

Joint Vision 2010, as described by the Chairman of the Joint Chiefs of Staff, "is a conceptual template for how America's Armed Forces will channel the vitality and innovation of our people and leverage technological opportunities to achieve new levels of effectiveness in joint warfighting."[1] This new level of effectiveness will provide the joint warfighting team a decisive advantage over its adversaries over the full spectrum of conflict. The heart of this vision is the exploitation of technology to provide the United States with information superiority over its adversary. Information superiority is defined as "the capability to collect, process and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[2] Information superiority would have two very significant benefits. First, the creation of a common battlefield picture and seamless integration of service capabilities will enable the Joint Force Commander to synergistically apply air, land and sea forces to achieve maximum effectiveness and efficiency at a reduced cost in both lives and dollars.

Second, information superiority over an adversary would enable joint forces to operate inside its adversary's decision making cycle, causing the enemy to be "powerless by denying him the time to mentally cope with the rapidly unfolding, and naturally uncertain, circumstances of war."[3]

Joint Vision 2010 espouses four operational concepts that capture the benefits of information superiority. These four concepts are dominant maneuver, precision engagement, full dimensional protection and focused logistics.

The key characteristics of dominant maneuver, as described in Joint Vision 2010, are positional advantage, speed and tempo. These characteristics will enable the application of "decisive force to attack enemy centers of gravity at all levels and compels an adversary to either react from a position of disadvantage or quit."[4] Key characteristics of precision engagement are the ability to locate the target, communicate, generate the desired effect, assess success and reengage if necessary. Precision engagement will enable the US to shape the battlespace from extended ranges and lessen the risk to friendly forces.[5] Full dimensional protection shelters our own forces from the very technologies that Joint Vision 2010 is exploiting. The objective of full dimensional protection will be to control the battlespace and ensure friendly forces freedom of action, maneuver, and engagement, while providing multi-layered defenses for our forces.[6] Focused logistics is the last operational concept. It is described in Joint Vision 2010 as the exploitation of "information, transportation and logistics technologies to provide rapid crisis response, to track and shift assets even while enroute, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical level of operations."[7]

In summary, Joint Vision 2010 is a guide to be used by the services as they develop their unique capabilities into the 21st Century. The vision espouses the exploitation of information superiority to enable the joint force team to dominate its adversary with superior maneuver, speed, tempo, surprise, agility, initiative, and synchronization over the full spectrum of conflict.

## How Are the Operational Concepts Achieved?

How will the DOD achieve JV2010's four operational concepts? This is the billion-dollar question that must be answered to implement the vision. Joint Vision 2010 and the Concept for Future Joint Operations, published by the Joint Chiefs, provides some high levels thoughts on this question. The Advanced Battlespace Information System (ABIS) study also addresses this question in more detail and provides a framework on how the operational concepts can be achieved.

Joint Vision 2010 and the Concept for Future Operations (CFJO) provide a starting point for answering the fundamental question of how to achieve JV2010's operational concepts. Both documents see jointness or "seamless integration of service capabilities"[8] as necessary to achieve the operational concepts. Both documents identify the incorporation of new technologies as the key to achieving the operational concepts of dominant maneuver, precision engagement, full dimensional protection and focused logistics. From the definitions of the operational concepts and the list of advanced technology demonstrations identified in the CFJO, one can intuitively identify several of the key technologies that are important to the implementation of the vision. Such technologies key to developing the battlespace awareness necessary for dominant maneuver and precision engagement would be automatic target identification, data base

management, cross sensor cueing, data filtering, automated image processing, robust navigation, stealth, guidance, command and control, target acquisition, and sensor fusion technologies.[9] Joint Vision 2010 and CFJO documents provide a starting point. However, the question still remains how do you move from the idea of the concepts and an intuitive feel for what the important technologies are to a system that optimally integrates these technologies to achieve the desired increase in warfighting capability.

The ABIS study advances the answer to this question one step further. This study was initiated by Office of Secretary of Defense and joint staff and was conducted by approximately 130 DOD personnel. The "basic purpose of the ABIS Task Force was to better align the science and technology program with the emerging Joint Vision 2010."[10] The task force accomplished this objective by conducting an analysis that focused on the areas of "battlespace management, sensor-to-shooter interoperability and requirements for common supporting information architecture."[11] The ABIS Task force report provided several products that further define how the operational concepts of Joint Vision 2010 could be achieved.

The first product was the identification of a set of operational capabilities that would be required. These capabilities were organized into a framework that has three layers. The three layers are the information grid, battlespace awareness capability and a force employment layer. The information grid layer provides the warfighter the seamless flow of generic information he requires. The battlespace awareness layer provides the warfighter the information he requires to develop a timely understanding of the operational situation and objectives. The force employment layer provides the capability to do predictive planning, integrated force management, and execution of time critical

missions. The second product of the ABIS study was the identification of 32 critical functional capabilities and key technologies needed to support the desired operational capabilities. Lastly and probably most importantly, the ABIS study provides a common set of terms and a common picture that can be used as the starting point for Joint Vision 2010 implementation planning.

In short, the Joint Vision 2010 documents and the ABIS study do a good job of describing the operational concepts, operational capabilities and key technologies that are intuitively required to achieve the desired concepts. However, the question of how will the four operational concepts described in the vision be achieved is still largely unanswered. The key to answering this question is the development of a process that can "impose order on the chaos"[12] and properly blend new information technologies and traditional air, land, sea and space forces into a "system of systems" capable of meeting our national security needs in the 21st Century.

## JV2010 Implementation Responsibility and Process

Implementation of JV2010 will be extremely difficult in our current budget environment. Successful implementation will require a robust process that can rise above service parochialisms and honestly assess competing alternatives and their contribution to increased warfighting capability. Who is responsible for leading the development of the implementation process effort? What is the implementation process? The answers to these questions are contained in the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3101.01, the Concept for Future Joint Operations, and the draft Joint Vision 2010 Implementation Master Plan.

**Implementation Responsibility**

CJCSI 3010.01 is the main document that lays out the implementation structure and responsibilities for implementing Joint Vision 2010 (JV2010). The implementation structure "is established for the purpose of project management and decision making."[13] The structure consists of the Joint Chiefs who will oversee the vision implementation by providing guidance and coordinating with the CINCs.[14] The service operations deputies (OpsDep) "will function as a JV2010 steering committee…they will manage, integrate and synchronize implementation efforts."[15] A Joint Vision Working Group (JVWG) will be formed to "identify and develop issues, provide information, and make recommendations for consideration by the OpsDeps, Joint Chiefs of Staff, Joint Requirements Oversight Council (JROC), and CINCs."[16] The working group will be at the two star level and co-chaired by the Director J-7 and the Commander of the Joint Warfighting Center (JWFC). The JV2010 implementation structure will also provide direction and links to other high-level organizations and processes such as the Joint Strategic Planning System; Planning, Programming and Budgeting System; and Joint Requirements Oversight Council/Joint Warfighting Capabilities Assessments (JROC/JWCA).

CJCSI 3010.01 also identifies specific responsibilities for implementation. The service chiefs are responsible for integrating JV2010 into service programs, processes and systems. They are charged with the responsibility to support implementation by supporting exercises, assessments, doctrine development, etc. The CINCs are also charged with integrating JV2010 into command processes and systems and for supporting JV2010 implementation efforts. Joint Staff, J-7, will serve as the executive agent for JV2010 implementation and system integration and will co-chair the JVWG. The

Commander of the JWFC will serve as the "implementing agent responsible for day-to-day management and concept development, assessment and integration."[17] The JWFC Commander will also co-chair the JVWG. Lastly, CJCSI 3010.01 charges defense agencies to integrate JV2010 into their processes and systems and to support implementation efforts by appointing representatives as appropriate.

**Implementation Process**

The JV2010 implementation process is currently being developed and refined. However, a solid framework for the process is documented in the Concept for Future Joint Operations (CFJO) and draft version 1.0 of JV2010 Implementation Master Plan. The draft document expands on the implementation framework contained in the CFJO document, providing much more detail of how the implementation process will work. As outlined in the CFJO and the draft implementation plan, the implementation process will consist of a three phase process: concept development, assessment, and integration.

The objective of the concept development phase is to further refine the ideas in JV2010 and to describe future joint warfighting operational capabilities.[18] The joint community, with the assistance of the JWFC, will develop these desired operational capabilities.[19]

The objective of the assessment phase will be to identify the desired operational capabilities needed by the 2010 force. This will be accomplished by determining the operational capabilities that are required to meet the 21st Century challenges identified from National Military Strategy, Joint Strategy Review, CFJO and senior leader seminars.[20] The desired operational capabilities (DOC) will be integrated and prioritized and each one will be assigned to a coordinating authority. The coordinating authority

will guide the validation of their DOCs. CINCs, services and agencies using assessment tools such as joint warfighting experiments, advanced concept technology demonstrations, exercises, wargames and symposia will accomplish validation of the DOCs. The assessment phase will also determine the changes to doctrine, organizations, training, materiel, leadership and people. The results of the various DOC assessments will be combined and forwarded by the JV2010 Working Group for consideration and proposal to the JV2010 integration phase.[21]

The objective of the integration phase is to enter the DOC forwarded from the assessment phase into the JWCA, Joint Requirements Board (JRB), and JROC process. This process will then identify the requirements for the acquisition process and will formally provide inputs into the Chairman's Program Recommendation and Chairman's Program Assessment documents, thereby integrating the DOC into the normal modernization process.[22]

Implementing JV2010 and achieving the desired increase in warfighting capability will be largely dependent on DOD's ability to develop a process that can manage the trade-offs. The process must be robust enough to provide decision makers with reliable assessments of competing alternatives that are accepted by the services and CINCs. Before the robustness of the JV2010 implementation process is analyzed using the system engineering model, it would be useful to first briefly look at some of the issues and concerns the implementation process must be capable of resolving.

## Vision Concerns and Issues

Joint Vision 2010 has been articulated extremely well by the Joint Chiefs of Staff. It has become the new "in phrase" and has been the subject of many articles and briefing.

The main conclusion that can be drawn from reviewing these recent articles and speeches about Joint Vision 2010 is that the majority of the criticism is not of the vision's approach but about how to implement it.

On the surface, it appears the defense community is accepting the fundamental premises of the vision. There has been a general acceptance of the need for improved joint operations effectiveness in light of the changing threat and shrinking budget. Also, there has been general acceptance of the way to achieve the increased effectiveness through taking advantage of our technological edge, primarily by exploiting new information technologies. The operational concepts espoused by the vision seem fundamentally grounded in the principles of war and the services have been quick to point out how their core competencies feed the vision. In recent articles in *Joint Forces Quarterly*, the service chiefs all point out that implementing the operational concepts from JV2010 will increase combat capability. The Chief of Naval Operations, Admiral Johnson, states, "The concepts of JV2010 can multiply our combat capability."[23] Former Air Force Chief of Staff General Fogleman states, "JV2010 provides a compelling operational blueprint for employing the military in tomorrow's conflicts. The Air Force fully embraces this template."[24] General Reimer, Army Chief of Staff, also supports the operational concepts in JV2010. However, he warns that we should not rely on technology alone, and we need to ensure balance between the four different JV2010 operational concepts as we implement the vision if we are to achieve full spectrum dominance.[25] If the service chiefs generally accept the JV2010 concepts then what are the concerns or issues with JV2010?

The concerns about the vision's implementation all seem to stem from two fundamental factors, resources and the nature of the future strategic environment. The limited defense dollars has created an environment where investments made on future information technologies (in the pursuit of information superiority) is at the expense of traditional combat forces (tanks, aircraft, soldiers, ships, marines). This factor sets up two tough trade-offs that must be made. The first trade-off is between technology versus mass and numbers.[26] This trade-off will require us to assess the increase in warfighting capability gained by information superiority so we can determine at what point investment in technology, at the expense of traditional weapons, starts to degrade rather than enhance our combat capability. The second trade-off is between investments to meet our current security needs versus investments in technology and weapons for the next century. This debate is clearly evident in the National Defense Panel (NDP) and Quadrennial Defense Review (QDR) reports. The NDP clearly advocates that we should assume more risk in the near term so we can exploit technology and modernize our forces for the future. The QDR advocates a more conservative approach on this issue. The Marine Corps Commandant, General Krulak, in a speech before Congress on the QDR recognizes this tough choice. However, he does not believe it would be wise to "ignore today's threats" and "move directly to restructuring our forces based upon the next generation of technology."[27]

The second fundamental factor that is causing much debate is what the strategic environment will look like in the next century and what type of weapons will be required to meet the future threat. The NDP sees the future strategic environment presenting very different challenges that will require a force able to "project military power and conduct

combat operations into areas where we may not have forward-deployed forces or bases."[28] The NDP believes many of the capabilities needed in the future are contained in JV2010 and the visions of the services. However, the NDP believes the "procurement budgets of the services are primarily focused on current systems and do not support the central thrust of their visions."[29]

As can be seen from the above discussion, implementation of JV2010 will require the DOD to focus its efforts and make many tough choices. In the opinion of Senator Dan Coats, in a 1997 speech, this has not yet begun to happen. In his speech he asserts that JV2010 has "failed to focus the Pentagon's development efforts" and "the vision is being interpreted to mean all things to all people."[30] Senator Coats' bottom line question is again really an implementation issue of how do we sort out "what will, and will not work on the battlefields of the 21st Century."[31] This question is the underlying theme to most of the issues raised about the implementation of the vision.

The main conclusion that can be drawn from reviewing these recent articles and speeches about Joint Vision 2010 is that the majority of the criticism is not of the vision's operational concepts but with how to implement them. More specifically how will the tough trade-offs between competing alternatives be made and how will we ensure the investments we make now will achieve the capability to dominate the full spectrum of conflicts we will face in the future. These questions can only be answered by putting in place a robust implementation process that is capable of evaluating the combat effectiveness of competing alternatives across the full spectrum of conflict and is supported by the services. To further explore the robustness of the emerging JV2010

implementation process the systems engineering model will be used as a tool to evaluate the process strengths and weaknesses.

**Notes**

[1] Joint Chiefs of Staff, *Joint Vision 2010*, 1996, 1.

[2] Ibid., 10.

[3] David S Fadok, "Air Power's Quest For Strategic Paralysis," Research Report (Maxwell AFB, Ala: School of Advanced Air Power Studies,1995), 14.

[4] Joint Chiefs of Staff, *Joint Vision 2010*, 13.

[5] Ibid., 14.

[6] Ibid., 15.

[7] Ibid., 16.

[8] Ibid., 6.

[9] James R. Blaker, "Understanding the Revolution in Military Affairs," (National Security Report, May 1997), 11.

[10] ABIS Task Force, "ABIS Final Report: Major Results", on-line, Internet, 4 March 1998, available from http://www.dtic.dla.mil/dstp/DSTP/abis/volume/abis1.htm.

[11] ABIS Task Force, "ABIS Final Report: Executive Summary", on-line, Internet, 4 March 1998, available from http://www.dtic.dla.mil/dstp/DSTP/abis/volume/abis1.htm.

[12] Air Command & Staff College, War Theory class notes, Maxwell AFB, 1997.

[13]Joint Chiefs of Staff, *CJCSI 3010.01 Chairman's Joint Vision 2010 Implementation Policy*, 1997, 3.

[14] Ibid.

[15] Ibid.

[16] Ibid., 4.

[17] Ibid., 6.

[18]Joint Chiefs of Staff, *CJCSI 3010.02 Chairman's Joint Vision 2010 Implementation Plan Draft Version 1.0*, 1998, 5.

[19] Ibid.

[20] Ibid., 11.

[21] Ibid., 5.

[22] Ibid., 6.

[23] Jay L. Johnson, "The Navy in 2010: A Joint Vision," *Joint Forces Quarterly*, Winter 96/97, 19.

[24] Ronald R. Fogleman, "The Air Force and Joint Vision 2010," *Joint Forces Quarterly*, Winter 96/97, 25.

[25] Dennis J. Reimer, "Dominant Maneuver and Precision Engagement," *Joint Forces Quarterly*, Winter 96/97, 13-16.

[26] James R. Blaker, 3.

[27] Charles C. Krulak, "Quadrennial Defense Review," Statement, On-line, 4 March 1998, available at http//www.fas.org/man/congress/1997h970522k.htm.

[28] National Defense Panel, *Transforming Defense: National Security in the 21st Century*, 1997, ii.

[29] Ibid., iii.

## Notes

[30] Senator Dan Coats, “Joint Experimentation: Unlocking the Promise of Future Capabilities,” Speech, Institute for Foreign Policy Analysis conference, Washington DC 1997,1.

[31] Ibid.

# Chapter 3

# The Systems Engineering Model

*Model (mod'l) n. 1.A tentative ideational structure used as a testing device. 2. An example to be emulated.*

—American Heritage Dictionary

## Why Use It?

There are two primary reasons why it is logical to use the system engineering model as a tool to analyze Joint Vision 2010 implementation policy. First, development of a "system of systems" will require the extensive integration of intelligence, command and control, and weapons systems from all DOD agencies. This integration will be an extremely challenging task. It will require the Defense Department to make many tough trade-offs between mass and numbers vs technology;[1] capabilities aimed at high intensity conflict vs low intensity conflict, trade-offs between space/air/land/sea capabilities, types of technology investments and types of experiments. The system engineering model is very good at managing tough trade-offs and therefore, provides a good framework that can be used to evaluate the JV2010 implementation process.

Second, the system engineering model "is a proven disciplined process for development of system solutions."[2] This process results in a total system solution that meets customer needs and optimizes performance and cost trade-offs over the entire life

of the systems. The system engineering approach ensures operational needs are properly transformed into an integrated system. This approach also ensures subsystem components are compatible, interoperable, and optimally integrated.[3] Therefore, it is logical to use the system engineering model as a tool to determine if the implementation process contains the necessary parts to adequately manage the trade-offs necessary to achieve JV2010 capabilities.

## What is the Systems Engineering Model?

Now that we have covered the purpose of the system engineering model and its applicability to the analysis, we will look at the steps and parts that make up the process. The system engineering model, as described in Defense Acquisition University Coursebook, consists of five main parts and three feedback loops.[4] The five main parts are process inputs, requirements analysis, functional analysis/allocation, synthesis, and systems analysis & control. The feed back loops are the requirements, design and verification loops.

The process input block contains the information needed to start the development of a system. Key process inputs required are user requirements, technology base and program decision requirements. User requirements are one of the most important parts of the process. These requirements specify the missions, environments, capabilities and measures of effectiveness (MOE) the system must satisfy. The technology base forms the foundation on which the new system will be built. Development of a sound technology base requires long term investment in research and development. This investment is essential to mature new technologies and reduces the risk associated with a new system development. Due to its long term nature, failure to properly invest in the

technology base is not easily corrected. Decision requirements are also a key element of the process inputs. Decision requirements identify the conditions that must be satisfied before moving to the next phase of development.

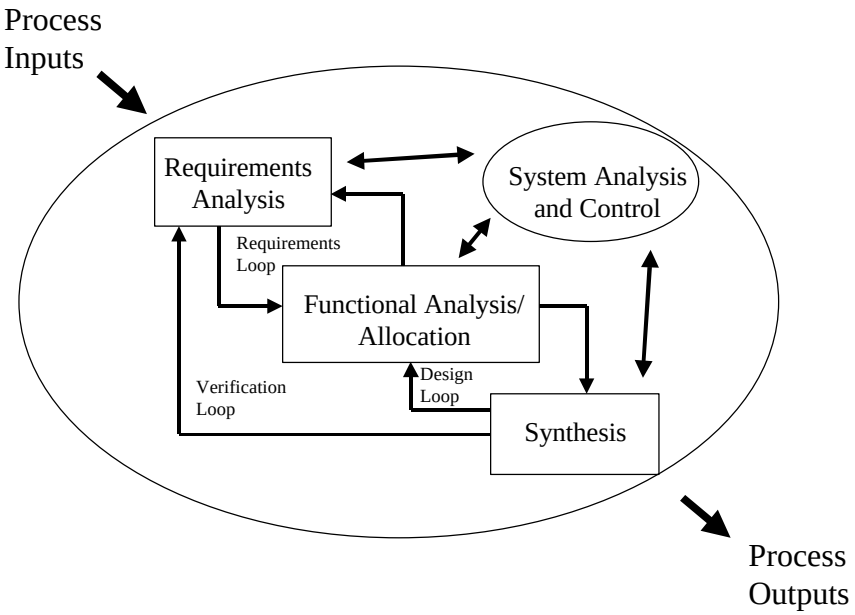


**Figure 1. Systems Engineering Process[5]**

The requirements analysis block is where system functional and performance requirements are developed. In this block tools such as modeling and simulation and analysis and testing are used to perform trade-offs to evaluate how well different approaches can achieve the system capabilities. The key to this block is using the assessment tools to develop measures of performance (MOP) from the MOEs developed in the process input phase. MOPs relate key system performance measures to operational capabilities or battle outcomes. For example, an MOE for precision engagement may be the number of target kills per sortie. Using the analysis tools different approaches can be evaluated. Furthermore, MOPs can be determined. Such MOPs in this case could be

how good the resolution of a targeting system needs to be, how fast targeting information needs to be passed from sensors to shooters, how accurate precision guided munitions (PGM) need to be, etc. The development of MOEs and relating them to MOPs is critical to performing the trade-offs required to build a cost effective system that meets user requirements.

The functional analysis/allocation block is where performance requirements are allocated to the subsystems. For example, in the precision engagement case, subsystem requirements obtained in the requirements analysis phase are flowed down to the subsystems, such as sensor requirements, command and control requirements, weapon platform requirements, weapon requirements, bomb damage assessment capability, target identification, information processing requirements. These requirements can also be used to drive technology investment in the areas that need to be further developed.

The synthesis block is where the physical architecture is defined and each subsystem developed. In the case of JV2010's "system of systems" the subsystems would be the items normally managed by separate system program offices (SPO), such as PGMs, unmanned aerial vehicles, weapon platforms, etc. Each subsystem would be designed to meet the functional requirements defined in the previous block ensuring optimal total system performance and integration.

The systems analysis and control block is probably the most important system engineering block because it has major effects on all phases of the process. This is the block that controls the process by performing trade-studies and effectiveness analysis. This block is also where risk and cost are controlled and interoperability and progress monitored.

The system engineering model also contains three feedback loops. The main purpose of the requirements loop is to verify that each requirement can be traced to a system function. The purpose of the design loop is to ensure all the functions can be traced to physical system elements. Lastly, the purpose of the verification loop is to verify the physical system built meets the system requirements.

Together the design loops and five system engineering blocks provide a systematic approach to the development of complex systems that ensures the end product is optimally designed and meets the user's requirements. In the next chapter the system engineering model will be used as a testing device to analyze the DOD JV2010 implementation approach.

**Notes**

[1] James R. Blaker, "Understanding the Revolution in Military Affairs," (National Security Report), May 1997, 3.

[2] Defense Acquisition University, *Systems 201 Coursebook* (sixth edition, June 1996), 3-5.

[3] Ibid., 3-4.

[4] System Engineering process information described in this chapter is derived from Defense Acquisition University, Systems 201 Course and Coursebook.

[5] Defense Acquisition University, *Systems 201 Coursebook*, 1996, Figure redrawn from figure on 3-7.

# Chapter 4

# Analysis of DOD Joint Vision 2010 Approach

> *At the most general level, it is an argument that favors a higher priority on getting power, i.e., tanks, aircraft and ships, to work together more effectively and efficiently, than on buying better, more advanced and capable versions of these instruments that cannot work together well.*
>
> —James R. Blaker

The previous chapter described the details of the systems engineering model. The details of the various pieces necessary for successful system development were identified. This chapter will use the system engineering model as a tool in which to evaluate the JV2010 implementation process. The JV2010 implementation is a complex undertaking. Therefore, the implementation process should exhibit, in some fashion, the mechanisms (process inputs, requirements analysis, functional analysis/allocation, synthesis and system analysis and control) necessary to manage a complex system development.

## Process Inputs

The systems engineering model identifies several key process inputs required to initiate a successful system development. As discussed previously the inputs are user requirements (mission, environment, capabilities, MOEs), and technology base. JV2010 and the Concept for Future Joint Operations (CFJO) are the main documents that identify these inputs.

The CFJO and the JV2010 documents do a good job of specifying what mission, environment and capabilities are desired of the 2010 "system of systems." The mission or objective identified is to "achieve new levels of effectiveness in joint warfighting" and to "achieve dominance across the range of military operations."[1] JV2010 also identifies the major capabilities of the "system of systems" that would be required to achieve full spectrum dominance. As discussed earlier the vision captures the desired capabilities in four concepts: dominant maneuver, precision engagement, focused logistics and full dimensional protection. The CFJO expands on these concepts and identifies specific capabilities. The major capabilities identified are the ability to "position and employ widely dispersed joint air, land and sea forces,"[2] the capability to "locate the target, generate the desired effect, assess our level of success and retain the flexibility to reengage,"[3] and the ability to "track and shift assets even while enroute, and to deliver tailored logistics packages."[4] The ABIS study further defines required capabilities and provides detailed information on capabilities required to achieve the JV2010 operational concepts.

The JV2010 documents do a really good job of providing the system objective and desired operational capabilities. However, another key user requirement input that is not adequately addressed is the identification of measures of effectiveness (MOE). MOEs are a measure of operational capabilities in terms of engagement or battle outcomes. MOEs are a critical input because that is what is used to determine the increase or decrease in combat effectiveness different concepts and technologies provide. Typical MOEs are attrition numbers and number of targets killed per sortie. In the case of JV2010, the key is developing a systematic approach to determine how the selected

MOEs are affected over the full spectrum of conflict by improved battlespace awareness, weapon precision, logistics and force protection. Failure to identify a robust set of MOEs will result in the inability to focus assessment experiments and to make the tough trade-offs between competing alternatives and technologies.

Proper development of the technology base required to support system development is also a critical system input. The JV2010 document recognizes this fact and provides a good start for focusing technology base investment. The CFJO identifies Defense Technology Objectives (DTO) for each operational concept. Each DTO identifies a "specific technology advancement that will be developed or demonstrated."[5] A detailed list of the DTOs is contained in Defense Technology Objectives of the Joint Warfighting Science and Technology Plan and the Defense Technology Area Plan.[6] These plans are key documents that are used to focus technology base investments.

## Requirements Analysis

The JV2010 implementation process currently does not adequately address requirements analysis. The assessment phase of the JV2010 implementation process contains many of the tools, such as experiments and demonstrations required to perform requirements analysis. The focus of the assessment phase is "identifying the warfighting capabilities required by the 2010 force."[7] The draft implementation plan proposes accomplishing this objective by having the joint community propose desired operational capabilities, criteria for measurement and an assessment strategy. An example given in the draft plan is the "capability to integrate US/non-US agencies into contingency planning."[8] Sample measurement criteria for this capability is given as number of days to produce a coordinated plan. The assessment strategy is through unified exercises.

From just one example given in the plan it is difficult to draw any conclusions. However, from this example, this approach really doesn't seem to capture the purpose of requirements analysis. The purpose of requirements analysis is to determine key subsystem performance measures required to achieve the total desired system performance. The assessment phase example doesn't tie the impact of achieving better coordination back to any system level combat capability measure of effectiveness. Without knowing the increase in combat capability that would result from this operational capability it would be difficult to prioritize its importance and to determine how much resources should be devoted to its implementation. The assessment phase as it is evolving contains many of the key tools to perform requirements analysis. Hopefully further evolution will take it from what appears to be the identification and assessment of separate capabilities to a process that takes a more total system view.

## Functional Analysis/Allocation and Synthesis

The next two steps in the systems engineering model are functional analysis/allocation and synthesis. The functional analysis/allocation block of the system engineering model is where performance requirements are allocated to the subsystems. The synthesis block is the phase where the subsystem physical design is accomplished.

JV2010 implementation process is in its early stages and as probably should not be expected to address functional analysis and synthesis specifically. However, it is important to once again emphasize the importance of trying to link subsystem performance through MOPs back to MOEs. This is the only way to develop an understanding of how combat capability is affected by subsystem performance. This

understanding is critical to focusing investments and properly accomplishing functional allocation.

Once functional allocation is accomplished, you are ready to move into the synthesis phase where each subsystem can be developed. In the case of JV2010's "system of systems" these subsystems would be the items managed by separate system program offices (SPO), such as weapon platforms, munitions, and unmanned aerial vehicles. The unique challenge that we face in implementing JV2010 is that most of the systems that we will have in 2010 (Global Information Network, F-22, Joint Strike Fighter, unmanned aerial vehicles, V-22, *Nimitz*-class carriers, theater ballistic missile defense, digitized army) are currently under development. Therefore, as time passes, the ability to influence the design and modify requirements necessary to achieve JV2010 capabilities at a reasonable cost decreases.

## System Analysis and Control

System analysis and control is probably the most important function in the systems engineering model. This block controls the system development and risks with analysis and trade-off studies. The JV2010 implementation process is beginning to put a framework together to accomplish this function. The draft implementation plan identifies a management structure and organizational responsibilities for managing JV2010 system development and implementation. The key organizations charged with system development control are the JVWG, JRB, OPSDEPS, JROC/JWCA, JWFC and the J-7.

The JV2010 "system analysis and control" structure outlined in the JV2010 implementation plan is a blend of the new JV2010 process (concept development, assessment, integration phases) and the current JROC/JWCA, Planning Programming and

Budgeting System and Joint Strategic Planning System processes. As discussed earlier, the draft JV2010 Implementation plan identifies J-7, JWFC and JVWG as the primary agencies responsible for managing the JV2010 implementation process. The desired operational capabilities (DOC) recommendations from J-7, JWFC and JVWG are input into the current JRB, JROC/JWCA process. "Entry into the JWCA, JRB/JROC processes provide the JROC oversight function and identify requirements for the acquisition process. It also serves to provide input into the Chairman's Program Review and Chairman's Program Assessment."[9]

As can be seen from the above discussion, the JV2010 implementation plan provides a detailed framework to perform the systems analysis and control function required for successful system development. However, the key question is whether this management structure will be capable of making the tough trade-off necessary to control the "system of systems" development.

Is this management structure capable of making the tough trade-offs is a difficult question to answer this early in the implementation process development. The management structure has several positive aspects. The management structure is at the highest levels of the Defense Department with the authority, resources and mechanisms necessary to implement the changes required to achieve JV2010 capabilities. The process provides for representation from all the services, the joint staff and the CINCs. The most positive aspect of the process is it provides links to the current modernization process necessary to initiate changes, through the JROC/JWCA process. The JROC has become "the chief mechanism through which the Chairman prepares his advice."[10] It has become the body that is trying to make the tough trade-offs between competing

programs, reducing redundancies and developing strategies dealing with "recapitalization and the revolution in military affairs."[11] The JROC's ability to make cross-service trade-offs and its influence in the modernization system is an essential piece without which JV2010 cannot be implemented. Another positive trend that will be a great benefit to JV2010 implementation is the maturation of the JWCA process. The JWCA process has added the required analysis and detailed assessments required by the JROC to make tough capabilities/requirements trade-offs.

However, there is one aspect of the implementation management structure that is troublesome. It appears to be somewhat of a bottoms-up process as opposed to the system engineering approach, which is top-down. The concept development phase appears to rely on concepts being "bubbled up" by the joint community for consideration and assessment. The JWFC JV2010 internet page contains an example of a one page form that will be used by commands to submit their desired operational capabilities. The idea of soliciting desired operational capabilities before developing a consensus on the type of threat and strategic environment we want to be prepared for in the next century seems fundamentally wrong. This approach runs the risk of ending up with a series of disjointed initiatives that are not focused on preparing for the strategic environment of the 21st Century. The assessment phase must identify MOEs and the type of threats we want to be prepared for so that the increase in combat capability resulting from a desired operational capability can be assessed.

A more desirable approach from a system engineering prospective is implementing a top-down approach. A top-down approach, consistent with the system engineering model, would start by identifying key MOEs that could be used during simulations, war

games and joint warfighting experiments to measure the four JV2010 operational concepts in terms of battle outcomes. This top-down approach would also identify various test cases or scenarios that are representative of the operational environments we expect in the next century. This approach would utilize the MOEs, scenarios, and assessment tools (experiments, modeling and simulation, advanced concept technology demonstrations) to provide several key outputs that are necessary to make tough trade-off decisions. First, it would enable the determination of our current weapon system capability baseline in terms of the MOEs. Second, it would enable the determination of the increase or decrease in warfighting capabilities over the baseline provided by future concepts and technology. Third, sensitivity analysis could be performed to determine the optimal subsystem measures of performance required to maximize performance and minimize cost.

Analysis of the DOD implementation approach has shown that it contains many positive aspects. Analysis has also pointed out several weak areas that should be improved. The most notable area requiring improvement is the incorporation of a more top-down approach that will allow for trade-off decisions being made on the basis of increases or decreases in warfighting capability. The next chapter will provide a brief summary of the other analysis results.

**Notes**

[1] Joint Chiefs of Staff, *Joint Vision 2010*, 1.
[2] Joint Chiefs of Staff, *Concept for Future Joint Operations*, 1997, 2.
[3] Ibid.
[4] Ibid., 3.
[5] Ibid., 28.
[6] Ibid.
[7] Joint Chiefs of Staff, *CJCSI 3010.02 Chairman's Joint Vision 2010 Implementation Plan Draft Version 1.0*,11.

## Notes

[8] Ibid., 18.
[9] Ibid., 6.
[10] William A. Owens, and James R. Blacker, "Overseeing Cross-Service Trade-offs." *Joint Forces Quarterly,* Winter 96/97, 37.
[11] Ibid., 39.

# Chapter 5

# Conclusions

> *To achieve cross-service trade-offs means developing ways to surmount the bureaucratic stovepipes that characterize most interservice staff undertakings.*
>
> —Adm William A. Owens

In response to the changing strategic environment and the declining budgets, the Joint Chiefs of Staff have created a vision to help guide DOD through a transformation that will enable it to meet the challenges it will face in the 21st Century. Now that the Joint Chiefs have articulated this vision, the next and most difficult step is implementing it. This paper explores two fundamental questions: What steps has DOD taken to implement Joint Vision 2010 and are these steps adequate?

The DOD has taken significant steps to implement the vision. In a 1997 article the Commander of JWFC stated "if JV2010 remains just an idea, it may well die a slow death from misuse and ambiguity."[1] The vision has begun to emerge out of "just the idea" phase. The DOD has further refined the JV2010 concepts in the ABIS study and CFJO document. CJCSI 3010.01 has created a management structure to manage the implementation of the vision. This management structure, led by J-7 and JWFC, is currently developing the details of an implementation process that will be used to transform our current military into one that possesses the operational concepts espoused in JV2010.

DOD has done an excellent job of articulating the vision. It appears the defense community is accepting the fundamental premises of the vision. There has been a general acceptance of the need for improved joint operations effectiveness in light of the changing threat and shrinking budget. Also, there has been general acceptance of the way to achieve the increased effectiveness through taking advantage of our technological edge, primarily by exploiting new information technologies.

The DOD recognizes that the transformation will be a difficult and challenging undertaking that will require many tough choices. The most fundamental choices are getting the balance of traditional capabilities (tanks, aircraft, ships, munitions etc) versus information technologies right and properly balancing investments to meet near term versus far term security needs

The key question concerning JV2010 is whether or not the implementation process is adequate. Is it capable of performing these tough trade-offs and focusing our resources on the right mix of information technologies and traditional capabilities to provide the full spectrum dominance that is desired? This paper explored this question by using the systems engineering model to analyze the JV2010 implementation efforts to determine if they contained the key mechanisms necessary for optimal system development.

Analysis of the JV2010 implementation process revealed several findings. First, the implementation process has done an excellent job of articulating the vision and further defining the desired operational concepts espoused by the vision. Second, the implementation process started the difficult task of focusing the technology base investment on the key enabling technologies required for vision implementation. Third, the vision implementation process comes up short on linking combat capability to

subsystem performance by not identifying key MOEs and MOPs. This is a significant shortcoming because it is very difficult to perform the trade-offs and focus investments without this link. Fourth, the JV2010 implementation process has identified a management structure to control the system development and this structure has many positive aspects. The main one is its links to the JROC/JWCA process. However, one troubling aspect is its lack of top-down approach that is necessary to control optimal system development.

The DOD has undertaken an extremely difficult and challenging task of implementing Joint Vision 2010. They have taken significant steps to start this process and appear to be very serious about achieving the vision. The implementation process has many positive aspects. However, if optimal system development is to be achieved the process must take on more of a top-down approach capable of evaluating competing alternatives and properly focusing investments on the right technologies and weapon systems required to achieve JV2010 capabilities.

## Notes

[1] Joseph J. Redden, "Joint Doctrine: The Way Ahead," *Joint Forces Quarterly*, Winter 96/97, 11.

# Chapter 6

# Recommendation

> *We may find the key to future capabilities is not in the planes, tanks, and ships—but in communications, intelligence, and other enablers. If so, then we need to have both the joint process to inform us of the programs which should be slowed or terminated, as well as the joint courage to shift budgets to accelerate those true advances in warfighting capability.*
>
> —Senator Dan Coats

This chapter will provide a recommendation on how the implementation process can be strengthened to provide the top-down approach that is so critical in system development. One way to strengthen the top-down approach is to create a team that can manage the linking of MOEs to MOPs required to properly perform requirements analysis and system control. If you really want to develop a "system of systems" then you need a "SPO of SPOs" to manage the development. What would be the primary functions of this organization, what would this organization look like, where would it fit in the current JV2010 implementation framework and what are its benefits?

The primary functions of this organization would be to work on requirements analysis by linking combat capability to subsystem performance requirements. The requirements definition pyramid, shown in Figure 2, is a key tool to help accomplish this task.

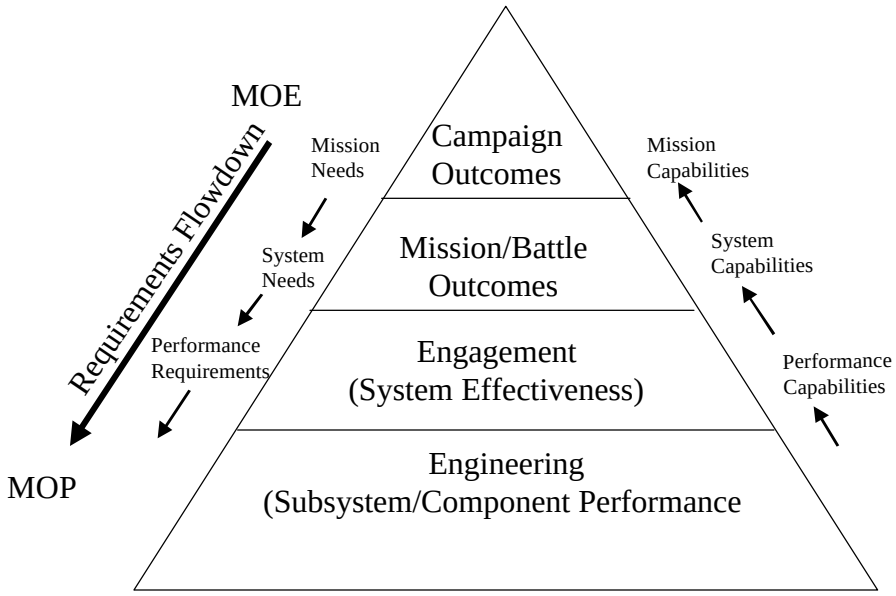


**Figure 2. Requirements Definition Pyramid[1]**

The requirements definition pyramid depicts how subsystem performance should be linked to combat capability measures. The pyramid consists of four different levels or layers of analysis and simulation. Each layer is built on the higher fidelity models in the layer below. The top two levels are the campaign and mission layers. These layers are relatively low fidelity simulations or experiments that determine the impact on combat capability resulting from various alternatives. In the case of JV2010, this analysis would identify a realistic scenario and model the key parameters of the major subsystems (such as command and control, intelligence, surveillance, reconnaissance , aircraft, tanks, ships, munitions) to develop the relationship between warfighting capability measures (attrition, targets killed) and subsystem performance measures (accuracy of PGM). The third layer is a higher fidelity analysis aimed at determining the effectiveness of individual weapons under various conditions. For example, this might be detailed analysis, simulation or test

of how a PGM might perform in various electronic warfare environments. The data from this layer is an input to the models contained in the top two layers of the pyramid. The last layer contains very detailed engineering models, which are used to analyze subsystem or component level performance under different conditions. For example, how well aircraft radar performs at identifying a target in clutter. The data from this layer is an input to the weapon system models contained in layer three of the pyramid.

Our current organizational structure does a poor job of linking the campaign/mission models at the top of the pyramid with the detailed engineering models at the bottom of the pyramid. This is probably due to two major factors. First, subsystems (aircraft, tanks) are typically managed by one SPO and normally have one prime contractor. This structure is therefore very good at developing detailed engineering level analysis, simulation and testing to verify that the subsystem meets the measures of performance specified. Where the SPO organizational structure does poorly is at the campaign or mission level analysis that is key to accomplish the trade-offs necessary for JV2010 implementation. Analysis at this level is difficult because it requires numerous SPOs and contractors to share data and information. Also, linking changes in subsystem performance to battle outcomes or MOEs is often viewed as out of the scope or responsibility of the SPO. For example, it has not been uncommon in the past for an aircraft SPO to make changes to the aircraft that may or may not impact the accuracy of a PGM dropped from that aircraft without assessing the overall platform/munitions system performance.

The second main reason for the poor job of linking analysis at the top and bottom of the pyramids is the modeling done at the campaign and mission level is primarily focused

at supporting the operational community in planning and in the development of doctrine and tactics. For example, the JWFC is currently developing the Joint Simulation System (JSIMS). JSIMS will "provide an integrated representation of the battlespace domain. In addition to integrating land, maritime, air/space domains, JSIMS will encompass other linked capabilities such as transportation, logistics, intelligence, command and control, special operations and information operations."[2] From this excerpt from the JSIMS concept document published by the JWFC, it seems that JSIMS would be a key tool used in JV2010 implementation to assess competing alternatives. However, JSIMS is not mentioned in the JV2010 implementation documents. Further examination of the JSIMS documents reveals that JSIMS is primarily focused on the support of "joint, service and other agency training, education, doctrine development and mission rehearsal"[3] as opposed to acquisition requirements.

The JV2010 implementation challenge is to create an organization or SPO of SPOs that can overcome the above factors and link campaign/mission models at the top of the pyramid with the detailed engineering models at the bottom of the pyramid. This organization would thereby connect subsystem performance to mission outcomes and provide the data required by the JROC to make sound investment choices between competing alternatives.

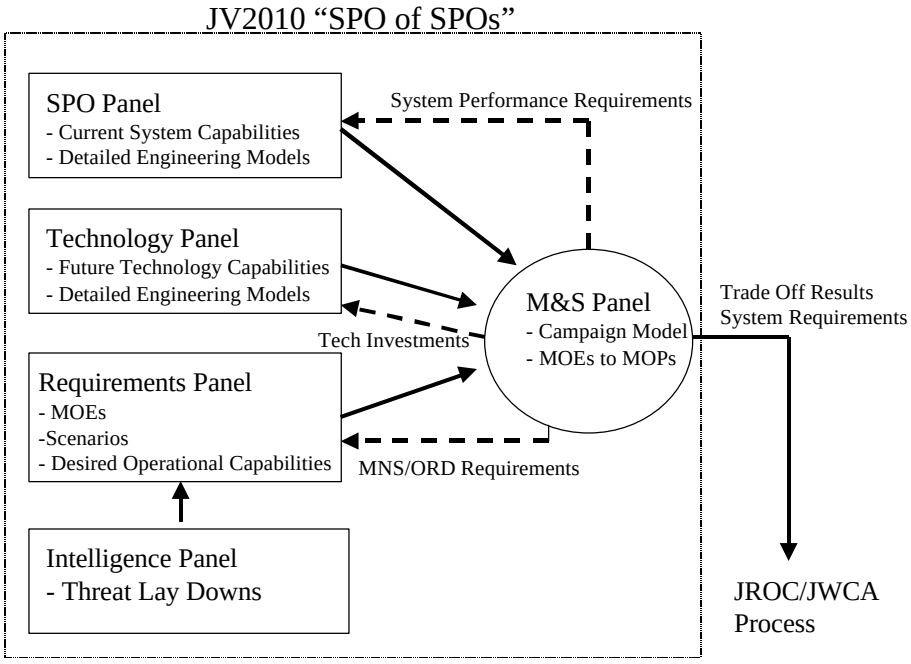


**Figure 3. Joint Vision 2010 "SPO of SPOs"**

The organizational structure of the "SPO of SPOs" could be very similar to the organization of the Global Positioning System (GPS) Joint Program Office set up to determine the combat effectiveness of our current weapon systems with or without GPS. The Navigation Warfare Evaluation Team (NET) organizational structure worked remarkably well. It was able to bridge the gap between engineering and campaign level models by bringing together users, intelligence experts, technologists, weapon system mangers, and modeling & simulation experts. Each group brought their piece of the puzzle enabling detailed requirements analysis study to be performed without "reinventing the wheel" by developing new models and experiments. An organization similar to the NET (Figure 3) could fill the void that appears to be taking shape in the JV2010 implementation process.

This organization could fit very nicely into the current JV2010 implementation process. The JWFC is already a key player in the assessment phase and is also highly involved in campaign model development with Joint Simulation System. They would be an ideal organization to organize and run the "SPO of SPOs" or evaluation team. This team would draw its members from the service program offices, laboratories, intelligence and operational communities. The team's focus would be on connecting the subsystem analysis and assessment work being conducted in the SPOs and labs to the campaign level modeling being performed at the JWFC to determine the combat value of competing alternatives.

The benefits of this approach are many. It would ensure the proper flow of requirements, as depicted in Figure 2, necessary for optimal system development. It would create a structure that could tie together the other assessment tools. The advanced concept technology demonstrations could provide vital performance data on new technologies required by the higher level mission models. The joint warfighting experiments and exercises would be used to validate mission level modeling to ensuring the validity of its results. This integrated assessment approach would provide a systematic cost effective way of managing the "system of systems" development trade-offs. It would break down the stovepipes and perform the trade-off between current capabilities and technology General Reimer was concerned about. Most importantly it would answer Senator Coats' fundamental question of "what will, and will not work on the battlefields of the 21st Century."

## Notes

[1] Figure reproduced from Defense Acquisition University *Systems 201 Coursebook*, 7-9.

## Notes

[2] Joint Warfighting Center, *JSIM Concept of Operations version 1.0*, (Fort Monroe, Virginia, 1997), 3.

[3] Ibid., 1.

## *Glossary*

| | |
|---|---|
| ABIS | Advanced Battlespace Information System |
| CFJO | Concept for Future Joint Operations |
| CJCSI | Chairman of the Joint Chiefs of Staff Instruction |
| DOC | Desired Operational Capability |
| DOD | Department of Defense |
| DTO | Defense Technology Objective |
| GPS | Global Positioning System |
| JRB | Joint Requirements Board |
| JROC | Joint Requirements Oversight Council |
| JSIMS | Joint Simulation System |
| JVWG | Joint Vision Working Group |
| JV2010 | Joint Vision 2010 |
| JWCA | Joint Warfighting Capabilities Assessment |
| JWFC | Joint Warfighting Center |
| MOE | Measure of Effectiveness |
| MOP | Measure of Performance |
| NDP | National Defense Panel |
| NET | Navigation Warfare Evaluation Team |
| OpsDeps | Operations Deputies |
| PGM | Precision Guided Munition |
| QDR | Quadrennial Defense Review |
| SPO | System Program Office |

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