# Literature Review on Decision Support Methodologies for Acquisition of Military Equipment

**Maj.Bahtiyar EREN**
Hv.K.K.ligi Lojistik Baskanligi 06100, Bakanliklar-ANKARA-TURKIYE

beren@hvkk.tsk.tr

**Col. Dr. Altan ÖZKİL**
Kara Harp Okulu Savunma Bilimleri Enstitüsü 06100 Bakanliklar-ANKARA-TURKIYE

aozkil@kho.edu.tr / aozkil@yahoo.com

## *ABSTRACT*

*Military Acquisition can be defined as to manage a nation's investments in technologies, programs, and product support necessary to achieve its National Security Strategy and support its Armed Forces. In today's increasingly complex acquisition environment, program managers are faced with the challenge of deftly commanding the skilled resources necessary to run successful programs. In that context, the main objective of military acquisition is to rapidly acquire quality products that satisfy military needs with measurable improvements to mission capability at a fair and reasonable price. Military acquisition makes people consider the product or service for all of its life-cycle. This is a long and complex process. During this process, a lot of criteria must be taken into account, a lot of different perspectives have to be considered and a lot of decisions have to be taken. Because of these reasons, decision support methodologies and tools will play an important role in military acquisition. Decision support activities related to military acquisition can range from identification of needs to the maintaining of the equipment used in the field. In this study, we survey the literature related to decision support method and methodologies that can be used in acquisition of military equipment.*

## 1.0. PROBLEM DEFINITION AND METHODOLOGY

### 1.1. Literature Review Methodology

"Decision Support Methodologies for Acquisition of Military Equipment" theme is decomposed into phrases in order to cover all the aspects. The phrases analyzed in this study can be listed as follows: Decision, decision making, decision support, decision support methodologies, acquisition, military acquisition, equipment, and military equipment. The literature review, which is focused on academic and practical aspects, is carried out with respect to each phrase. Each academic reference included in the literature review is categorized in order to answer what type of problem or issue is analyzed, which methodology is used and what types of decisions are made. Practical aspect of the literature review is focused on the sources found on the internet.

### 1.2. Decision, decision making and decision support

Even though there is no standard definition for the term "decision", it can be stated as "a choice or judgment made about something" [1], [2]. The term "something" refers to "the acquisition of military equipment" in our study. The choices must be defined in such an analytical manner that all the areas related to the acquisition of military equipment must be touched and connected with each other. The only way to do so is to control and manage the decision making process, which is a process of choosing among alternative course of action for the purpose of attaining a goal or goals [3].

# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **OCT 2009** | **N/A** | **-** |

4. TITLE AND SUBTITLE
**Literature Review on Decision Support Methodologies for Acquisition of Military Equipment**

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
**Hv.K.K.ligi Lojistik Baskanligi 06100, Bakanliklar-ANKARA-TURKIYE**

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release, distribution unlimited**

13. SUPPLEMENTARY NOTES
**See also ADA562565. RTO-MP-SAS-080 Decision Support Methodologies for Acquisition of Military Equipment (Methodologies d'aide a la decision pour l'acquisition d' equipements militaires). Meeting Proceedings of Systems Analysis and Studies Panel (SAS) Specialists Meeting held in Brussels, Belgium on 22 and 23 October 2009., The original document contains color images.**

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**Military Acquisition can be defined as to manage a nation's investments in technologies, programs, and product support necessary to achieve its National Security Strategy and support its Armed Forces. In todays increasingly complex acquisition environment, program managers are faced with the challenge of deftly commanding the skilled resources necessary to run successful programs. In that context, the main objective of military acquisition is to rapidly acquire quality products that satisfy military needs with measurable improvements to mission capability at a fair and reasonable price. Military acquisition makes people consider the product or service for all of its life-cycle. This is a long and complex process. During this process, a lot of criteria must be taken into account, a lot of different perspectives have to be considered and a lot of decisions have to be taken. Because of these reasons, decision support methodologies and tools will play an important role in military acquisition. Decision support activities related to military acquisition can range from identification of needs to the maintaining of the equipment used in the field. In this study, we survey the literature related to decision support method and methodologies that can be used in acquisition of military equipment.**

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | |
| **unclassified** | **unclassified** | **unclassified** | **SAR** | **34** | |

Simon's 4 phases of Decision Making, which consist of intelligence, design, choice and implementation phases, is depicted below Figure-1.

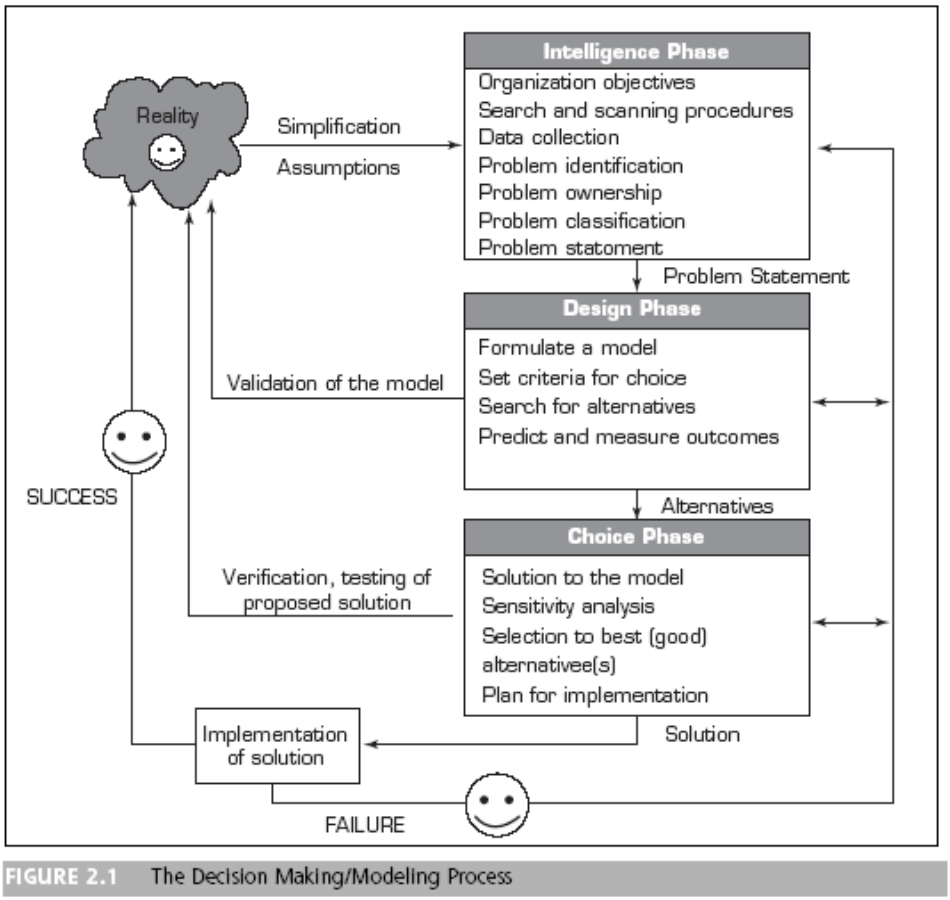


**Figure 1 Simon's 4 phases of Decision Making**

Simon's model is the most concise and yet complete characterization of rational decision-making [3]. It is the reason why Simon's model is used for the study. The explanation of each phase, which is mainly based on Turban textbook, is equipped with the "acquisition of military equipment" issue.

**The intelligence phase** involves scanning the environment, either intermittently or continuously. It includes several activities aimed at identifying situations or opportunities. This phase may also include monitoring the results of the implementation phase of a decision making process. The intelligence phase begins with the identification of organizational goals and objectives related to "acquisition of military equipment". It is not easy task to identify or accept the existence of the problem itself. The problem is identified either by decision makers who detects the difference between what is expected and what is done or by the successive analysis. There are still a lot to do such as data collection, problem classification, problem decomposition etc. Routine and repetitive problems call for standard (programmed) models and decisions whereas such problems as acquisition require nonstandard (nonprogrammed) models. Every acquisition of military equipment may differ in many aspects like available budget, quantity, emergency, readiness of national industrial capability, etc.

**The design phase** involves finding or developing and analyzing possible course of action. These include understanding the problem and testing solutions for feasibility. A model of the decision making problem is constructed, tested, and validated.

**The choice phase** is the one in which the actual decision is made and where the commitment to follow a certain course of action is made. The other words; the choice phase includes the search, evaluation, and recommendation of an appropriate solution to the model. The solution to the model yields a recommendable solution to the problem. The problem is considered solved only if the recommended solution is successfully implemented.

**The implementation phase**, which includes the implementation of a proposed solution to a problem, is the initiation of a new order of things or the introduction of change, which must be managed.

### 1.3. Internet Resources about Defence Acquisiton and Decision Support Systems

This section is all about practical aspect of the topic, which is found on the internet by all users.

Military Acquisition manages a nation's investments in technologies, programs, and product support necessary to achieve its National Security Strategy and support its Armed Forces. In that context, its objective is to rapidly acquire quality products that satisfy user needs with measurable improvements to mission capability at a fair and reasonable price [4]. Military equipment can be defined as anything that helps to achieve Natioanl Security and support Armed Forces. In other words; the term "military equipment" covers aircraft, ship, ordonance, ground vehicle, weapon, electronic equipment etc.

There are a lot of reports related to military acquisition carried out by RAND Corporation [5] whose mission is to help improve policy and decisionmaking through research and analysis.

According to the Defence Acquisition Portal [6]; US DoD Decision Support Systems, the detailed information is in the Appendix-B, has three principal decision-making support systems, which are Defense Acquisition System (DAS) [7], Joint Capabilities Integration and Development Systems (JCIDS) [8] and The Planning, Programming, Budgeting, and Execution (PPBE) [9] Process. Together, the systems provide an integrated approach to strategic planning, capabilities needs assessment, systems acquisition, and program and budget development.

Defence Acquistion Guide Book [11] allows you to get information about acquisition in depth.

The National Technical Information Service (NTIS) serves as the largest central resource for government-funded scientific, technical, engineering, and business related information available today [12]. The web page allows you to search 350 topics areas along with the military sciences.

Hemant and et.al.surveyed the decision support tools which are listed in Appendix-C [45]. .

James Swain conducted a survey result, which includes commertial simulation tools, their application areas and vendors contact information, in Appendix-D [46].

### 1.4. Academic Resources about Defence Acquisiton and Decision Support Systems

While doing the literature review, RAND reports are taken as a major resource in the analysis.

## 2.0 ACADEMIC RESOURCES ABOUT DEFENCE ACQUISITON AND DECISION SUPPORT SYSTEMS

RAND [5] web page is searched and findings in the list of "A Bibliography of Selected RAND Publications (1985-1999) and (2000-2005)" are listed in Appendix-A. The list consists of 29 studies which are presented in the order of number, article number, article title, decision issue (the research topic) and

the results came out of the study and decision methods and methodologies used. Key results related to 29 studyies, details in the Appendix-A, can be summarized as follows.

MR-749-AF suggests the exceptional degree of flexibility and responsiveness in decision making and greater delegation of authority to the program office and requiring only a very few performance requirements by contract are the key points.

R-2908/2A suggests accelerate advancement of R&M related avionics technologies, Improve the ability to test avionics equipment, Provide more complete feedback on equipment performance, Institute maturational development, Reorganize avionics engineering resources are the key points.

MR-876-OSD suggests an analytic tool to compare historical trends in the number, duration, and factors affecting.

MR-809-DARPA suggests a streamline program management within functional areas by adopting Integrated Product and Process Development (IPPD), Advanced Concept Technology Demonstration (ACTD) should be carried out to warfighters in an accelerated fashion, cost constraint and acquisition waivers are applied different from the traditional acquisition process, such as reducing the barriers to entry, flexibility in acquisition-specific law and related-regulations are the key points.

MR-899-OSD suggests confident, effective and innovative individuals are critical to the ACTD process, the lead service in the ACTD must ensure proper test and logistics planning, and (3) war fighters should participate into the ACTD from star to finish and being stakeholders in the product. Planning discussions must involve operational users, lead-service peronnel, and acquisition experts who can assess functional areas such as test, logistics, engineering, and affordability. Test lead service organization in the ACTD (1) resolve any misunderstanding of requirement among developers and warfighters, (2) help define quantitative system specification, and (3) facilitate transition of the ACTD to the acquisition process

MR-1030-DARPA suggests the use of a relatively few broad performance goals in describing desired system capabilities, giving full design responsibility to the competing contractor teams (by excluding GFE from the program), using a small joint program office, designating affordability as the only requirement, and putting an emphasis on a small crew, execute the program by focusing on the operational performance of the weapons system instead of demonstrating engineering performance through detailed specifications.

MR-1054-DARPA suggests a mechanism for government intervention to deal with contractor weaknesses--such as a lack of software development expertise--should be incorporated into future government-industry relationships of this type, overcoming the cultural impediment to early user involvement, program risks need to be clearly identified early on and a plan developed to manage them and future programs should go beyond the concept of a unit flyaway price (UFP) as a single goal; once bounded, cost, schedule, and performance should all be stated goals.

R-3333-AF suggests actions are needed that will (1) correct chronic problems in the expression of operational suitability needs and requirements, (2) address the problem of fragmented operational requirements documentation, (3) expand contractual accountability for reliability-and-maintainability and logistics-support characteristics, (4) adjust acquisition policies to enhance T&E's contribution to decisionmaking and to the identification and correction of deficiencies, (5) structure tests to demonstrate new operating concepts and capabilities.

R-3373-AF/RC suggest improving the requirement formulation process, making early development more austere, separating critical subsystem development from platform development, encouraging austere prototyping, improving the transition from full-scale development to production, focusing more attention on upgrading fielded systems, and stimulating plant modernization and production flexibility.

R-3578-ACQ suggest the control methods such as the burden of reporting, support for audits etc. seem likely to incur certain dolar costs, but nt to cause serious delays nor to affect major program decisions and the imposition of shall/shall not constraints make up of bulk regulations, which warrants further analysis.

R-4107-P&L/DAG/JS suggests that tradeoffs must be made between combat effectiveness and transportability from the user perspective. In addition to that, analyses of the relevant tradeoffs must be made more explicitly.

R-3121-AF finds that the military and commercial programs are organized and managed in much the same way and that both produce well-functioning, useful spacecraft. On the other hand; in carefully selected situations, there should be a place for the performance-oriented INTELSAT management practices.

R-3937-ACQ shows that, although there are large variations in the duration of programs in each decade, the time to design and develop programs has apparently lengthened. There is no single, narrowly focused policy option that would reduce the length of the acquisition cycle. Rather, coordination of several different initiatives such as DoD and Congress is necessary. The authors found no strong association among the length of the plan, the factors affecting the plan, and the actual schedule outcome.

N-2209-AF study demonstrates that by far the most important consideration in deciding whether to lease or buy MILSATCOM systems is the cost of risk-bearing, an issue that has largely been ignored in the public debate: under a purchase, risks are borne by taxpayers, whereas under a lease, they are borne by the shareholders of defense contractors.

N-2283/1-AF finds that a single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For all mission types, the equation set uses empty weight and speed as the basic size-performance variable combination.

N-2479-AF study concludes that warranties can have a positive effect on selected acquisition programs. Analysis of pre-law warranties suggests that factors contributing to warranty success include specific, easily measurable objectives; explicit contractor incentives and remedies; explicit government duties; and reasonable prices and expectations. An initial survey of post-law warranties, however, reveals that many warranties do not appear to adequately detail either their objectives or the remedies to be applied if those objectives are not met.

N-2599-ACQ study presents chronologies drawn from the unclassified literature which cover the data of 50 aircraft, 24 helicopters, and 53 missiles developed since the mid-1940s. A limited analysis tenuously supports the idea that the period from the beginning of the demonstration-and-validation phase to the start of fullscale development has been lengthening over the past three decades.

N-2864-P&L Particular emphasis is placed on the description of the models used by the U.S. Army Concepts Analysis Agency to estimate the conventional munitions war reserve resupply requirements, which represent the bulk of the total requirement. The author makes several suggestions for improving the requirements estimation and procurement processes, which should be altered to analyze investment options other than larger stockpiles to respond to the variability and/or uncertainty associated with the wartime demand for munitions. The author also suggests a structure for a measure that stresses the critical early stages of a conflict and allows munitions planners to quantify their preferences for the mix of munitions to be produced.

N-3136-AF problems are failure of some programs to use a consistent baseline cost estimate, exclusion of some significant elements of cost, exclusion of certain classes of major programs, and constantly changing preparation guidelines. Nevertheless, the author concludes that SAR data are suitable for identifying broad-based trends and temporal patterns across a range of programs.

N-3618-AF study concludes that four factors were important in the assessment and management of risk and thus in the exceptional success of these development programs: (1) the low level of technological risk posed by the derivative developments undertaken, (2) the use of competition to motivate the contractors, (3) the considerable experience of the managers overseeing the developments, and (4) the nature of the contracts.

N-3620-AF study concludes that external oversight can be counterproductive as it raises the likelihood that the system must respond to forces having little to do with performance or management. For example, overselling the program at the beginning can lead to serious difficulties when the inevitable technical problems make system performance and management look poor in relation to the original promises. In addition, formal structures and procedures designed to reduce uncertainty cannot be relied on to counter optimistic estimates of performance, schedule, or cost. Finally, he concludes that concurrent development programs and fixed price contracts are inappropriate for technically risky programs.

RGSD-140 suggest that a multi-method research approach was employed, using both expert interviews and a survey of Army personnel. Using causal modeling techniques (latent variable analysis), it was determined that reform behavior within the Army acquisition work force is determined by: (1) employee attitudes toward the reform, and (2) their perceptions of behavioral control. In addition, multiple regression analysis of these factors revealed that attitudes and control perceptions vary based on the functional perspectives of acquisition employees. Three conclusions emerged: (1) Resistant employees are less likely to believe that the elimination of milspecs and standards will result in positive programmatic outcomes; (2) resistant employees were much more likely to view training and communications efforts as inadequate; and (3) current training efforts are effective in changing underlying attitudes. This study presented two overarching recommendations: (1) Use and improve existing training programs; and (2) target implementation efforts to the resistant elements of the work force, focusing on changing the beliefs and perceptions important in attitude and control perception formation.

P-7169 study illustrates the statistical risk facing both the military purchaser and the contractor from testing less, and conversely, the gains in statistical confidence from testing more. It considers two basically different kinds of reliability: (1) binomial processes, where "success" or "failure" are defined and testing is required to estimate the probability of their occurrence and (2) time-to-failure reliability, where "failure" is defined and the times when failures occur are recorded. The author concludes that both these approaches are likely to require some increase in the size of test programs.

P-7252 study suggest that the key to more supportable avionics lies in an approach to acquisition and support that begins with the equipment's concept exploration stage and follows through the equipment's full life of service. This paper discusses contemporary challenges to avionics supportability and proposes changes to acquisition and support processes that should be beneficial to supportability. It then shows how certain tradeoffs between performance and supportability at the concept formulation stage could enhance the benefits of the proposed changes.

P-7352 study suggest that the traditional measures of effectiveness for major system acquisitions are cost growth, schedule slippage, performance shortfalls, and fielding times. These measures, given our current ability to quantify them, do not tell the whole story about the effectiveness of defense acquisition, but they do give important insights.

P-7359-RGS study discusses what are the the major driving forces in Soviet weapons acquisition and includes evaluations of the aircraft by Western experts and a comparison between the development timelines

P-7417 study maps out the major components of the DoD management system and outlines their relationship to each other and to the acquisition subsystem. The paper then identifies sets of issues related

to each component. The author suggests that future acquisition reform efforts should emphasize other components of the system, rather than the acquisition process itself.

P-7757 study describes an analytic approach to determining how much testing and demonstration are enough and applies it to the B-2 bomber development and flight test program.

**Table 1 A Bibliography of Selected RAND Publications (1985-1999) and (2000-2005)**

| | | | Decision Making/Modelling Process Phases | | | |
|---|---|---|---|---|---|---|
| **No** | **Article Number** | **Article Title** | **Intelligence** | **Design** | **Choice** | **Implementation** |
| 1 | MR-749-AF | App.of F-117 Acq.Strategy to Other Programs in the New Acq. Environment. | | x | x | x |
| 2 | R-2908/2 | A Strategy for Reforming Avionics Acquisition and Support | | x | | |
| 3 | MR-876-OSD | The Use of Baselining in Acquisition Program Management. | x | | | x |
| 4 | MR-809-DARPA | The Global Hawk Unmanned Aerial Vehicle Acquisition Process: A Summary of Phase 1 Experience. | x | | | x |
| 5 | MR-899-OSD | The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process. | | | | x |
| 6 | MR-1030-DARPA | The Arsenal Ship Acquisition Process Experience: Contrasting and Common Impressions from the Contractor Teams and Joint Program Office.. | x | x | x | |
| 7 | MR-1054-DARPA | Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial Vehicle Program: Phase II Experience | x | x | | |
| 8 | R-3121-AF | Commercial and Military Communication Satellite Acquisition Practices. | | | x | x |
| 9 | R-3333-AF | Improving Operational Suitability Through Better Requirements and Testing. | x | | x | |
| 10 | R-3373-AF/RC | Improving the Military Acquisition Process: Lessons from Rand Research. | x | x | x | x |
| 11 | R-3578-ACQ | A Preliminary Perspective on Regulatory Activities and Effects in Weapons Acquisition. | x | | | x |
| 12 | R-3937-ACQ | An Analysis of Weapon System Acquisition Schedules. | x | x | x | x |
| 13 | R-4107-P&L/ DAG/JS | Transportability in the Defense Department Research, Development, and Acquisition Process. | | x | x | |
| 14 | R-4161-ACQ | The Nature and Role of Prototyping in Weapon System Development. | x | x | x | x |

| | | | Decision Making/Modelling Process Phases | | | |
|---|---|---|---|---|---|---|
| **No** | **Article Number** | **Article Title** | **Intelligence** | **Design** | **Choice** | **Implementation** |
| 15 | N-2209-AF | Improving MILSATCOM Acquisition Outcomes: Lease Versus Buy. | | | x | |
| 16 | N-2283/1-AF | Aircraft Airframe Cost Estimating Relationships: All Mission Types. | x | x | | |
| 17 | N-2479-AF | Warranties for Weapons: Theory and Initial Assessment. | | | | x |
| 18 | N-2599-ACQ | Aerospace Weapon System Acquisition Milestones: A Database. | x | x | x | x |
| 19 | N-2864-P&L | The Army's Conventional Munitions Acquisition Process. | x | x | x | x |
| 20 | N-3136-AF | Pitfalls in Calculating Cost Growth from Selected Acquisition Reports. | x | x | x | |
| 21 | N-3618-AF | The Development of the F100-PW-220 and F110-GE-100 Engines: A Case Study of Risk Assessment and Risk Management. | x | | | |
| 22 | N-3620-AF | The Development of the Advanced Medium-Range Air-to-Air Missile: A Case Study of Risk and Reward in Weapon System Acquisition. | | | | x |
| 23 | RGSD-140 | Friend or Foe? Bureaucratic Behavior and Acquisition Reform in the U.S. Army. | | | | x |
| 24 | P-7169 | Estimates of Reliability During the Test and Evaluation Stage: Some Methodological Observations. | | | x | x |
| 25 | P-7252 | Improving Avionics Acquisition and Support from Conceptualization Through Operations | x | x | x | x |
| 26 | P-7352 | Thoughts on Reforming the Military Acquisition Process. | x | x | x | x |
| 27 | P-7359-RGS | MiG-21 Fishbed: A Case Study in Soviet Weapons Acquisition. | x | x | x | x |
| 28 | P-7417 | Killing the Messenger: The Place of Systems Acquisition in the National Security Planning and Management Systems | x | x | x | x |
| 29 | P-7757 | When Should We Start High-Rate Production of the B-2? An Analysis Based on Flight Test Results. | | | x | x |

When the results and methods used in the reports are categorized with respect to Decision Making/ Modelling Process Phases, it is concluded that the reports are almost equally distributed over the phases. In other words, there are enough reports related to almost all of the phases.

The todays the main component of US DoD Acquistion System attributes such as de-centralized, flexible, innovation, and streamlined acquisition processes can be found in the RAND studies.

## 3.0 THE RESULT

It is the fact that the decision support analysis for military equipment requires a lot of efforts carried out many organizations such as decision maker, policy maker, user, military procedures directives.

In this study the internet resources along with the academic resources especially RAND corporation studies are analyzed. The RAND reports are categorized with respect to research topic/question, the methods used and the results got.

It is concluded that RAND reports are one of the main inputs into the US DoD acquisition policy and documentation.

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# Appendix-A – Literature Review on Decision Support Methodologies for Acquisition of Military Equipment

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
|---|---|---|---|---|
| 1 | MR-749-AF | Application of F-117 Acquisition Strategy to Other Programs in the New Acquisition Environment. | To test whether special access or "black" programs accommodate more efficient and effective ways to buy weapon systems than do conventional acquisition programs. | A central aspect of F-117 acquisition was the exceptional degree of flexibility and responsiveness in decision making.<br>Greater delegation of authority to the program office and requiring only a very few performance requirements by contract. |
| 2 | R-2908/2A | Strategy for Reforming Avionics Acquisition and Support . | Assess progress to date as manifested by the performance of fielded equipment and identify areas of needed improvement<br>Define and examine alternative ways of achieving needed improvements. | Accelerate advancement of R&M related avionics technologies<br>Improve the ability to test avionics equipment<br>Provide more complete feedback on equipment performance<br>Institute maturational development<br>Reorganize avionics engineering resources |
| 3 | MR-876-OSD | The Use of Baselining in Acquisition Program Management. | All major weapon system programs establish a program baseline early in the acquisition cycle which sets forth cost, schedule, and performance targets. If the thresholds are exceeded, a review and assessment procedure is initiated in an attempt to understand why the threshold was "breached" and how the program can be brought back on track. | Develop an analytic tool to compare historical trends in the number, duration, and factors affecting<br>Study the relationship between program acquisition life-cycles and the factors affecting deviations from program baselines. |
| 4 | MR-809-DARPA | The Global Hawk Unmanned Aerial Vehicle Acquisition Process: A Summary of Phase 1 Experience. | This study will examine how the various innovations in acquisition management methods affect the program outcomes and how the lessons of these projects might be applied to a wider variety of projects to improve Department of Defense acquisition strategies. | Contractor, in collaboration with the government, institute a streamline program management within functional areas by adopting Integrated Product and Process Development (IPPD)<br>Advanced Concept Technology Demonstration (ACTD), which is program intended to demonstrate mature or maturing technologies to warfighters in an accelerated fashion.<br>There is an upper limit in terms of cost that all contractor should be stayed within limits. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| | | | | Acquisition waivers are applied different from the traditional acquisition process, such as reducing the barriers to entry, flexibility in acquisition-specific law and related-regulations. |
| 5 | MR-899-OSD | The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process. | What were the overarching lessons learned from the Predator Advanced Concept Technology Demonstration (ACTD)?<br><br>Which lessons can be generalized and applied to other ACTD programs? | The predator was one of the first ACTDs to be completed and also to make the transition to the formal acquisition process. It therefore provides a unique opportunity to study the ACTD process for issues and lessons learned.<br><br>Given the necessarily fast pace of the ACTD process, confident, effective and innovative individuals are critical to the success of a program.<br><br>The lead service must be selected early in the ACTD process to ensure that (1) proper test and logistics planning occurs, (2) operational requirements are identified, and (3) war fighters should participate into the ACTD from star to finish and being stakeholders in the product.<br><br>Test lead service organization (1) resolve any misunderstanding of requirement among developers and warfighters, (2) help define quantitative system specification, and (3) facilitate transition of the ACTD to the acquisition process.<br><br>Planning discussions must involve operational users, lead-service peronnel, and acquisition experts who can assess functional areas such as test, logistics, engineering, and affordability. |
| 6 | MR-1030-DARPA | The Arsenal Ship Acquisition Process Experience: Contrasting and Common<br><br>Impressions from the Contractor Teams and Joint Program Office.. | The Arsenal Ship acquisition program was unique in two respects: it represented a new operational concept for Navy weapon systems, and its management structure and process represented a significant departure from traditional military ship-building programs. | The use of a relatively few broad performance goals in describing desired system capabilities<br><br>Giving full design responsibility to the competing contractor teams (by excluding GFE from the program)<br><br>Using a small joint program office<br><br>Designating affordability as the only requirement, and putting an emphasis on a small crew |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| | | | | Execute the program by focusing on the operational performance of the weapons system instead of demonstrating engineering performance through detailed specifications. |
| 7 | MR-1054-DARPA | Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial<br><br>Vehicle Program: Phase II Experience | The program's development phase for the Global Hawk and DarkStar air vehicles is analyzed in this research. | While not applicable to all acquisition programs, the strategy used in the program is an effective alternative to traditional acquisition processes, one that can be enhanced in several ways.<br><br>First, a mechanism for government intervention to deal with contractor weaknesses--such as a lack of software development expertise--should be incorporated into future government-industry relationships of this type.<br><br>Second, to overcome the cultural impediment to early user involvement, the mechanisms for such involvement should be more formalized.<br><br>Third, program risks need to be clearly identified early on and a plan developed to manage them.<br><br>Finally, future programs should go beyond the concept of a unit flyaway price (UFP) as a single goal; once bounded, cost, schedule, and performance should all be stated goals, though the resulting trade space must be large enough to allow credible trade-offs. |
| 8 | R-3121-AF | Commercial and Military Communication Satellite Acquisition Practices. | Examine management practices and program outcomes associated with the acquisition of communication satellites by the Air Force and by the International Telecommunications Satellite Organization (INTELSAT). | The study finds that the military and commercial programs are organized and managed in much the same way and that both produce well-functioning, useful spacecraft.<br><br>It concludes that, in carefully selected situations, there should be a place for the performance-oriented INTELSAT management practices. |
| 9 | R-3333-AF | Improving Operational Suitability Through Better Requirements and Testing. | Identify action that could increase the contribution contribution made by requirements and test-and-evaluation (T&E) aspects of the weapon system acquisition process. | Actions are needed that will<br><br>(1) correct chronic problems in the expression of operational suitability needs and requirements,<br><br>(2) address the problem of fragmented operational requirements documentation, |

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| | | | | (3) expand contractual accountability for reliability-and-maintainability and logistics-support characteristics,<br>(4) adjust acquisition policies to enhance T&E's contribution to decisionmaking and to the identification and correction of deficiencies,<br>(5) structure tests to demonstrate new operating concepts and capabilities. These actions could facilitate the consideration of suitability factors in acquisition process activities that address difficult tradeoffs among operational suitability, functional performance, cost, and development time. |
| 10 | R-3373-AF/RC | Improving the Military Acquisition Process: Lessons from Rand Research. | Drawing on more than 30 years of RAND research, evaluates past experience with defense development and production, identifies trends that will affect future acquisition activity, and recommends improvements in the acquisition process to meet future challenges. | Improve the requirementformulation process,<br>Make early development more austere,<br>Separate critical subsystem development from platform development,<br>Encourage austere prototyping,<br>Improve the transition from full-scale development to production,<br>Focus more attention on upgrading fielded systems,<br>Stimulate plant modernization and production flexibility. |
| 11 | R-3578-ACQ | A Preliminary Perspective on Regulatory Activities and Effects in Weapons Acquisition. | This report presents quantitative analyses of the effects of regulations and controls on management practices and overall outcomes of weapons acquisition projects. | The control methods such as the burden of reporting, support for audits etc. seem likely to incur certain dolar costs, but nt to cause serious delays nor to affect major program decisions.<br>The imposition of shall/shall not constraints make up of bulk regulations. These class of regulations warrants further analysis. |
| 12 | R-3937-ACQ | An Analysis of Weapon System Acquisition Schedules. | This study identifies the major factors controlling the pace of typical weapon acquisition programs and suggests reforms that may yield overall benefits through reduction of typical development time. | Results of the analysis show that, although there are large variations in the duration of programs in each decade, the time to design and develop programs has apparently lengthened.<br>There is no single, narrowly focused policy option that would reduce the length of the acquisition cycle. Rather, coordination of several different initiatives such as DoD and Congress is necessary. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| | | | | The authors found no strong association among the length of the plan, the factors affecting the plan, and the actual schedule outcome, suggesting that programs with fairly short plans can, in some circumstances, have successful schedule outcomes. |
| 13 | R-4107-P&L/DAG/JS | Transportability in the Defense Department Research, Development, and Acquisition Process. | This study considers the formal role that transportability plays in the Department of Defense (DoD) research, development, and acquisition (RDA) process. | Tradeoffs must be made between combat effectiveness and transportability.<br><br>The authors recommend asking the tradeoff question from the user perspective, and making analyses of the relevant tradeoffs more explicit. They recommend further that extra transport or lift costs associated with a system in the RDA process be charged against procurement budgets for that system.<br><br>They also suggest that financial incentives be used for creation and comparative evaluation of alternative parameter packages by contractors, the Military Traffic Management Command, and the theater commanders |
| 14 | R-4161-ACQ | The Nature and Role of Prototyping in Weapon System Development. | This report examines the general nature of prototyping, develops an analytical framework for thinking about prototyping in weapon system development, and analyzes past and present prototyping programs within this framework. | This analysis suggests that program-specific characteristics and the characteristics of the acquisition environment vary so widely that no generic criteria are apparent for determining whether or not to prototype or the kind of prototyping strategy to pursue. Thus, it is neither possible nor desirable to develop a set of firm decision rules. In the end, there is no substitute for informed judgment made by experienced managers and engineers. |
| 15 | N-2209-AF | Improving MILSATCOM Acquisition Outcomes: Lease Versus Buy. | Over the next decade, military satellite communication (MILSATCOM) systems will cost taxpayers billions of dollars. The magnitude of these costs and their istribution in the economy will be directly affected by whether public policymakers choose to lease or to buy these systems. | The analysis demonstrates that by far the most important consideration in deciding whether to lease or buy MILSATCOM systems is the cost of risk-bearing, an issue that has largely been ignored in the public debate: under a purchase, risks are borne by taxpayers, whereas under a lease, they are borne by the shareholders of defense contractors. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| 16 | N-2283/1-AF | Aircraft Airframe Cost Estimating Relationships: All Mission Types. | This Note is part of a series that derives a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. | A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For all mission types, the equation set uses empty weight and speed as the basic size-performance variable combination. |
| 17 | N-2479-AF | Warranties for Weapons: Theory and Initial Assessment. | What is the effect of warranties on the major weapons? Warranties have been selectively applied to weapon systems acquisition over several decades. However, in 1983 Congress passed the first law requiring that military contractors provide warranties on all major weapons sold to the Services. Such blanket application raises issues both of tailoring warranties to the wide range of weapons and acquisition environments and of proper implementation policy and procedural guidelines. | This study concludes that warranties can have a positive effect on selected acquisition programs. Analysis of pre-law warranties suggests that factors contributing to warranty success include specific, easily measurable objectives; explicit contractor incentives and remedies; explicit government duties; and reasonable prices and expectations.<br>An initial survey of post-law warranties, however, reveals that many warranties do not appear to adequately detail either their objectives or the remedies to be applied if those objectives are not met. |
| 18 | N-2599-ACQ | Aerospace Weapon System Acquisition Milestones: A Database. | Critics of the weapons acquisition process have often asserted that it takes too long to achieve new operational capabilities. These declarations are seldom accompanied by quantitative evidence. | It presents chronologies drawn from the unclassified literature and supplemented by data collected through direct contacts with project personnel. The data cover 50 aircraft, 24 helicopters, and 53 missiles developed since the mid-1940s. A limited analysis tenuously supports the idea that the period from the beginning of the demonstration-and-validation phase to the start of fullscale development has been lengthening over the past three decades. |
| 19 | N-2864-P&L | The Army's Conventional Munitions | This Note describes the Army's conventional munitions acquisition process from the generation of the | Particular emphasis is placed on the description of the models used by the U.S. Army Concepts Analysis Agency to estimate the conventional munitions war reserve resupply requirements, which represent the bulk of |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| | | Acquisition Process. K. Girardini. 1989. | estimate of the requirements for munitions to the decisions on what mix of munitions will actually be funded. | the total requirement. The author describes the models used to simulate a theater conflict and the methodology used to combine the results of the models. He also makes several suggestions for improving the requirements estimation and procurement processes. The author recommends that the current procurement process be altered to analyze investment options other than larger stockpiles to respond to the variability and/or uncertainty associated with the wartime demand for munitions. He also suggests a structure for a measure that stresses the critical early stages of a conflict and allows munitions planners to quantify their preferences for the mix of munitions to be produced. |
| 20 | N-3136-AF | Pitfalls in Calculating Cost Growth from Selected Acquisition Reports | Both the current estimate and the development estimate are normally taken from the Selected Acquisition Report (SAR), a legally mandated summary report on the status of major acquisition programs.<br><br>This Note identifies and explains the type of cost data found in the SAR and reviews the hisory of the SAR with respect to cost reporting. | Problems are failure of some programs to use a consistent baseline cost estimate, exclusion of some significant elements of cost, exclusion of certain classes of major programs, and constantly changing preparation guidelines. Nevertheless, the author concludes that SAR data are suitable for identifying broad-based trends and temporal patterns across a range of programs. |
| 21 | N-3618-AF | The Development of the F100-PW-220 and F110-GE-100 Engines: A Case Study of Risk<br><br>Assessment and Risk Management. | The "Great Engine War" pitted Pratt and Whitney and General Electric against one another to supply engines for the Air Force's new F-15 and F-16 fighters. This acquisition used "derivative" engines—engines that incorporated small changes in selected parts of existing engines to greatly improve operability, durability, and the operating and support costs of fighter engines. | Camm concludes that four factors were important in the assessment and management of risk and thus in the exceptional success of these development programs: (1) the low level of technological risk posed by the derivative developments undertaken, (2) the use of competition to motivate the contractors, (3) the considerable experience of the managers overseeing the developments, and (4) the nature of the contracts. In the latter, the scopes of work focused on how development was conducted, not on products. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| 22 | N-3620-AF | The Development of the Advanced Medium-Range Air-to-Air Missile: A Case Study of Risk and Reward in Weapon System Acquisition. | In this case study of the AMRAAM program, Mayer examines weapons acquisition as a "political" process<br><br>involving the perceptions and goals of many organizations. Technologically, the missile is a success, despite a development program that involved major schedule slips, substantial cost growth, and several major redesign efforts. | Mayer concludes that external oversight can be counterproductive as it raises the likelihood that the system must respond to forces having little to do with performance or management. For example, overselling the program at the beginning can lead to serious difficulties when the inevitable technical problems make system performance and management look poor in relation to the original promises. In addition, formal structures and procedures designed to reduce uncertainty cannot be relied on to counter optimistic estimates of performance, schedule, or cost. Finally, he concludes that concurrent development programs and fixed price contracts are inappropriate for technically risky programs. |
| 23 | RGSD-140 | Friend or Foe? Bureaucratic Behavior and Acquisition Reform in the U.S. Army. C. | (1) Is military specification and standard reform being implemented successfully by Army acquisition bureaucrats?<br><br>(2) What factors or determinants affect the willingness and ability of Army acquisition employees to implement milspec and standard reform?<br><br>(3) Having assessed implementation to date and understanding better what affects bureaucratic behavior, how can the Army best affect the underlying beliefs and perceptions of its personnel in order to influence behavior in support of milspec and Standard reform? | A multi-method research approach was employed, using both expert interviews and a survey of Army personnel. Using causal modeling techniques (latent variable analysis), it was determined that reform behavior within the Army acquisition work force is determined by: (1) employee attitudes toward the reform, and (2) their perceptions of behavioral control. In addition, multiple regression analysis of these factors revealed that attitudes and control perceptions vary based on the functional perspectives of acquisition employees.<br><br>Three conclusions emerged: (1) Resistant employees are less likely to believe that the elimination of milspecs and standards will result in positive programmatic outcomes; (2) resistant employees were much more likely to view training and communications efforts as inadequate; and (3) current training efforts are effective in changing underlying attitudes. This study presented two overarching recommendations: (1) Use and improve existing training programs; and (2) target implementation efforts to the resistant elements of the work force, focusing on changing the beliefs and perceptions important in attitude and control perception formation. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| 24 | P-7169 | Estimates of Reliability During the Test and<br><br>Evaluation Stage: Some Methodological Observations. | Within the acquisition process, reliability testing is one of the methods the military has used to maintain control of the reliability characteristics of a system being developed. Reliability testing has multiple objectives, including (1) determining compliance with contractual requirements; (2) identifying deficiencies in the system; (3) providing reliability measures for use in operation planning; and (4) measuring the readiness of the system for production and operational use. | this paper illustrates the statistical risk facing both the military purchaser and the contractor from testing less, and conversely, the gains in statistical confidence from testing more. It considers two basically different kinds of reliability: (1) binomial processes, where "success" or "failure" are defined and testing is required to estimate the probability of their occurrence and (2) time-to-failure reliability, where "failure" is defined and the times when failures occur are recorded. The author concludes that both these approaches are likely to require some increase in the size of test programs. |
| 25 | P-7252 | Improving Avionics Acquisition and Support<br><br>from Conceptualization Through Operations | Because avionics require such large investments and such long acquisition times, military services must set high performance requirements to ensure that new equipment will perform effectively against threats that will materialize during what should be a long life of useful service. High requirements, however, force designers to choose advancing technologies and complex integrations among types of equipment | The key to more supportable avionics lies in an approach to acquisition and support that begins with the equipment's concept exploration stage and follows through the equipment's full life of service. This paper discusses contemporary challenges to avionics supportability and proposes changes to acquisition and support processes that should be beneficial to supportability. It then shows how certain tradeoffs between performance and supportability at the concept formulation stage could enhance the benefits of the proposed changes. |
| 26 | P-7352 | Thoughts on Reforming the Military Acquisition Process. | Outlines an approach to reforming the defense acquisition process and describes a prescription for reform based on RAND research results | The traditional measures of effectiveness for major system acquisitions are cost growth, schedule slippage, performance shortfalls, and fielding times. These measures, given our current ability to quantify them, do not tell the whole story about the effectiveness of defense acquisition, but they do give important insights. |

| No | Article Number | Title | Decision Issue | Result, Methods&Methodology |
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| 27 | P-7359-RGS | MiG-21 Fishbed: A Case Study in Soviet Weapons Acquisition. | In order to consider the advantages and limitations of evolutionary weapons development and to get a better understanding of the Soviet weapons acquisition system and its products, this paper presents a case study of the MiG-21 aircraft, NATO codename "Fishbed." | As background, the author discusses the major driving forces in Soviet weapons acquisition and includes evaluations of the aircraft by Western experts and a comparison between the development timelines |
| 28 | P-7417 | Killing the Messenger: The Place of Systems<br><br>Acquisition in the National Security Planning and<br><br>Management Systems | Past efforts to reform the systems acquisition process in the Department of Defense (DoD) have failed to view acquisition as part of a complex government planning and management system. This paper considers whether the acquisition process can be reformed without changes in other elements of DoD management systems. | It maps out the major components of the DoD management system and outlines their relationship to each other and to the acquisition subsystem. The paper then identifies sets of issues related to each component. The author suggests that future acquisition reform efforts should emphasize other components of the system, rather than the acquisition process itself. |
| 29 | P-7757 | When Should We Start High-Rate Production of the B-2? An Analysis Based on Flight Test Results. | Over the past decade, government commissions and Congress have urged the Department of Defense to devote more attention to testing activities during the weapons acquisition process. | This paper, the text of a statement made before the United States Senate on July 26, 1991, describes an analytic approach to determining how much testing and demonstration are enough and applies it to the B-2 bomber development and flight test program. |

# Appendix-B – US DoD Decision Support System

According to the Defence Acquisition Portal [6]; US DoD Decision Support Systems has three principal decision-making support systems. Together, the systems provide an integrated approach to strategic planning, capabilities needs assessment, systems acquisition, and program and budget development.

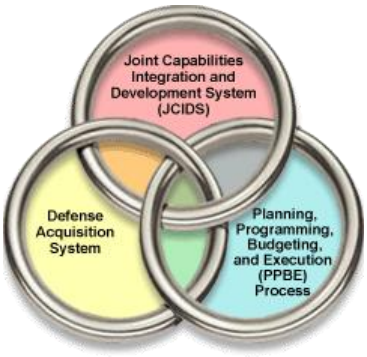


**Figure 2 US DoD Decision Support Systems**

DoD uses the **Defense Acquisition System** to manage the acquisition of weapon systems and AIS. Although based on centralized policies and principles, the system allows for de-centralized and streamlined acquisition. The system is flexible and encourages innovation, while maintaining strict discipline and accountability. The Defense Acquisition System, the management process that guides all DoD acquisition programs, can be found in detail on the Defense Acquisition Guidebook Homepage [11].

The Joint Chiefs of Staff established **Joint Capabilities Integration and Development Systms** (**JCIDS)** to assess and resolve gaps in military joint warfighting capabilities. To effectively integrate capabilities identification and acquisition, the JCIDS guidance (CJCSI 3170.01G and JCIDS Manual) was developed in close coordination with acquisition regulations (DoD 5000 series). The JCIDS process supports the acquisition process by identifying and assessing capability needs and associated performance criteria to be used as a basis for acquiring the right capabilities, including the right systems. These capability needs then serve as the basis for the development and production of systems to fill those needs. Additionally, it provides the PPBE process with affordability advice by assessing the development and production lifecycle cost. The detail information can be found on the JCIDS web page [8].

**The Planning, Programming, Budgeting, and Execution (PPBE) Process** is DoD's strategic planning, program development, and resource determination process. DoD uses PPBE to craft plans and programs that satisfy National Security Strategy demands within resource constraints. PPBE process is how the Department of Defense (DoD) allocates its resources, which is found in detail on the PPBE web page [9].

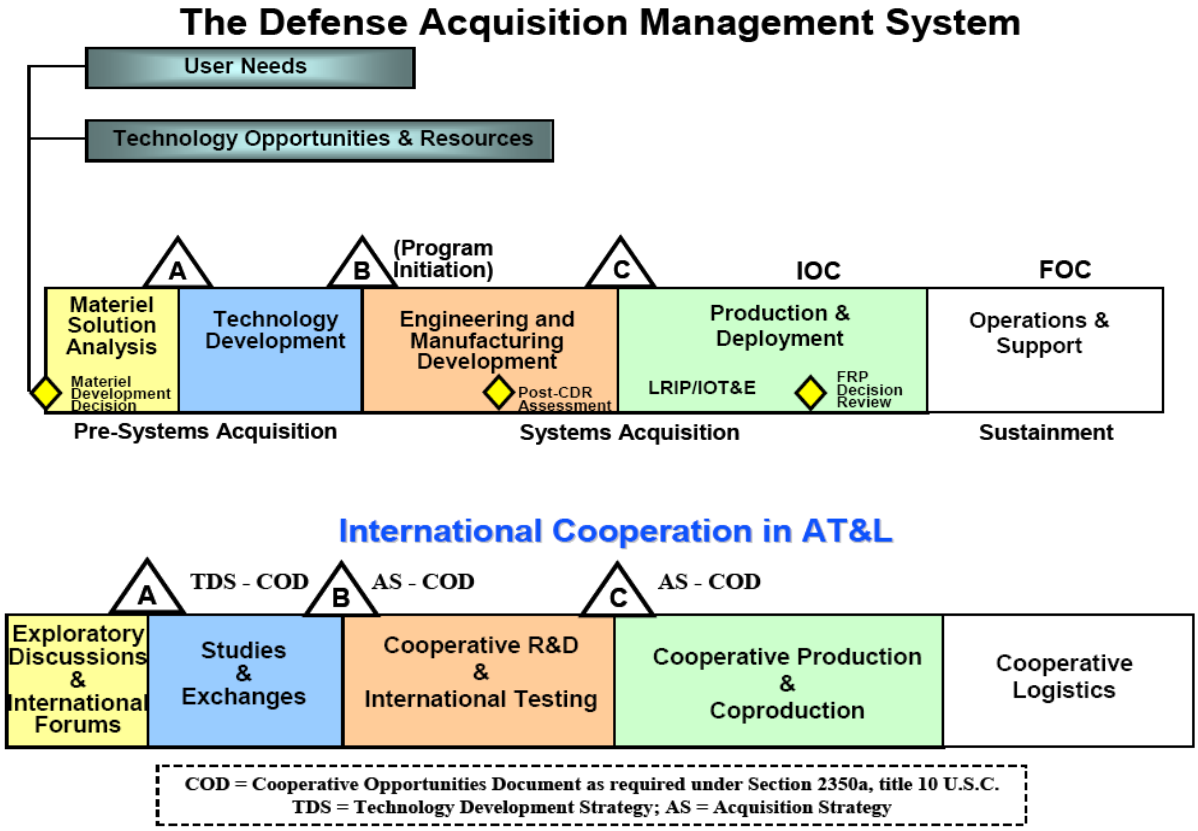


**Figure 3 US Defense Acquisition Management System**

**Determination of User Needs & Exploring Technology Opportunities (Early Technology Projects).** The efforts needed to identify cooperative development opportunities before entering into a formal acquisition program are often challenging, but such activities capitalize on high payoffs in cost savings and interoperability when successful. Formulation of cooperative development programs involves resolution of issues in the areas of requirements harmonization, cost sharing, work sharing, technology transfer, intellectual property rights, and many others. While multinational force compatibility may increase system acquisition cost, it can provide more cost-effective defense for the whole force through increased interoperability and reduced life-cycle costs. Cooperative opportunities identification and formulation should be pursued during the earliest stages of the pre-systems acquisition research and development process to maximize the chance for success [10].

**Exploratory Discussions.** Before entering into an international project, many forms of dialogue can take place with potential partners. These informal discussions are usually called exploratory discussions or technical discussions--they are NOT called “negotiations,” which requires a legal authority and formal permission from the Office of the Secretary of Defense. The avoidance of any binding commitments on the part of the U.S. Government, and the absence of any draft, international agreements characterize exploratory discussions.

**International Forums.** There are many international forums dedicated to discussing mutual armaments needs and early technology projects. These forums include the Conference of National Armaments Directors (CNAD), whose U.S. representative is the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)). The CNAD's subsidiaries are the "Main Armaments Groups,"

particularly the NATO Army Armaments Group, NATO Navy Armaments Group, and the NATO Air Force Armaments Group. The NATO Research and Technology Organization conducts and promotes cooperative research and information exchange in NATO. The Technical Cooperation Program with Australia, Canada, New Zealand, and the United Kingdom is another multilateral forum dedicated to cooperation in conventional military technology development. In addition there are about 30 bilateral forums, such as the U.S.-Japan Systems and Technology Forum and the U.S./Canadian Armaments Cooperation Management Committee, that have a similar purpose.

**Studies.** It is normal for the DoD and potential partners to conduct studies before entering into a cooperative acquisition project. These studies can be conducted years before the project starts, and are often called feasibility studies, or pre-feasibility studies. Industry, government agencies, or a combination of both generally conduct the feasibility studies, with the objective of providing a technical appraisal of the feasibility of developing and producing equipment.

**International Exchanges of Information and Personnel.** A common source for cooperative program opportunity identification is the Defense Research, Development, Test and Evaluation Information Exchange Program (IEP), which provides a standardized way of conducting bilateral science and technology information exchange (formerly called data exchange). The IEP has proven extremely useful as a means of cooperative opportunities formulation. Another source for identifying cooperative opportunities is the Defense Personnel Exchange Program, especially the Engineer and Scientist Exchange Program (ESEP).

**Pre-Systems Acquisition.** Decisions made during the Materiel Solution Analysis and Technology Development phases of Pre-Systems Acquisition generally define the nature of the entire program. Once the program enters the Engineering and Manufacturing Development phase, it is difficult to adopt major changes without significant schedule or cost adjustments. Consequently, the decision to include international partners needs to be addressed as early as possible, preferably during development of the Initial Capabilities Document, but no later than during the Materiel Solution Analysis phase.

**The Technology Development Strategy** prepared for Milestone A or the **Acquisition Strategy** for Milestones B and C must address the following areas:

a) Is a similar project in development or production by NATO, a NATO organization, a member nation of NATO, a major non-NATO ally, or friendly foreign country?

b) If so, then the Technology Development Strategy or initial acquisition strategy must provide an assessment of that project as to whether or not it could satisfy or be modified to satisfy U.S. military requirements, and

c) An assessment of the advantages and disadvantages with regard to program timing, developmental and life-cycle costs, technology sharing, and Rationalization, Standardization, Interoperability of a cooperative development program.

d) The USD(AT&L) provides a recommendation whether or not the feasibility and desirability of a cooperative development program should be explored.

e) What alternate forms of cooperation could be appropriate for the project?

**Engineering and Manufacturing Development.** After program initiation, during Engineering and Manufacturing Development, key elements of the system design are defined, and system/subsystem development begins. Major changes often present schedule delays that program managers are unwilling to accept; however, there have been numerous examples of successful subsystem cooperative development partnerships that have been formed during the Engineering and Manufacturing Development Phase.

**Foreign Comparative Testing.** A viable alternative to development is the acquisition of commercial items. While individual acquisition programs can conduct evaluations with their own resources, the Foreign Comparative Testing Program offers a structured and funded means for program offices to evaluate the suitability of a foreign developed item for purchase in lieu of developing a similar U.S. item.

**International Test Operations Procedures.** The International Test Operations Procedures (ITOP) program provides for international agreements that document state-of-the-art test techniques for technical testing of military material and allows the exchange of test data to avoid redundant testing when foreign equipment is purchased.

**Production and Deployment Phase.** There are three basic mechanisms for transfer of U.S. produced defense articles and associated production capability to other nations: sales, co-production and cooperative production.

**Operations & Support Phase.** Cooperative logistics refers to cooperation between the U.S. and allied or friendly nations or international organizations in the logistical support of defense systems and equipment. Cooperative logistics is part of the acquisition process, but as a substantial part of military operations, much of the implementation process involves Security Assistance processes and procedures.

# Appendix-C – Web Pages for Simulation Tools

Hemant and et.al, surveyed the decision support tools in Tablo-2 below.

| Site name | Uniform Resource Locator |
|---|---|
| Aliah | http://www.decisioncoaches.com/home.html |
| BizLand | http://www.bizland.com/bizland/index.bml |
| Cognos | http://www.cognos.com |
| Cow Culling | http://ag.arizona.edu/AREC/cull/culling.html |
| Databeacon | http://www.storydata.com |
| DataWarehousing Online | http://www.datawarehousingonline.com |
| Decision Analysis Society (DAS) | http://faculty.fuqua.duke.edu/daweb/ |
| Decisioneering | http://www.decisioneering.com/ |
| Dimensional Insight | http://www.dimensionalinsight.com/ |
| DSSResources.com | http://www.DSSResources.com |
| e-optimization.com | http://www.e-optimization.com/ |
| Expert Choice | http://www.expertchoice.com/ |
| Frontline Systems | http://solver.com/ |
| Grazing Systems | http://www.grazingsystems.co.nz/model.cfm |
| Health Decision Strategies (HDS) | http://www.healthstrategy.com/objectiv.htm |
| Hyperion | http://www.hyperion.com/ |
| IBM OSS COIN | http://oss.software.ibm.com/developerworks/opensource/coin |
| iLog | http://www.ilog.com/ |
| InfoHarvest | http://www.infoharvest.com/ihroot/index.asp |
| Lumina | http://www.lumina.com/adedemo/index.htm |
| MicroStrategy | http://www.microstrategy.com |
| Personalogic | http://personalogic.com |
| Salesforce.com | http://salesforce.com |
| Teradata | http://teradata.com |
| Teradata University Network | http://www.teradatauniversitynetwork.com |
| The OLAP Report | http://www.olapreport.com/index.htm |
| TreeAge | http://www.treeage.com/ |
| Web-HIPRE | http://www.hipre.hut.fi/WebHipre/ |

| Software | Vendor | Typical Applications of the software | Primary Markets for which the software is applied | RAM | Operating Systems |
|---|---|---|---|---|---|
| @RISK | Palisade Corporation | Risk analysis for Microsoft Excel spreadsheets using Monte Carlo simulation | Finance; Insurance; Oil/Gas/Energy; Pharmaceuticals; Manufacturing | | Windows |
| @RISK 5.5 | Palisade Corporation | @RISK performs risk analysis using Monte Carlo simulation to show you many possible outcomes in Excel | Finance/Banking, Energy & Utilities, Manufacturing, Insurance/Reinsurance, Healthcare Six Sigma , Academic | 512 | Windows XP, Vista |
| Analytica 4.2 | Lumina Decision Systems, Inc | Investment, risk, decision, portfolio network flow analysis;systems dynamics; resource, R&D planning; organization simulation | Business, financial, public policy, energy, environmental, healthcare, defense, manufacturing, education, telecommunication | 128 | Windows 98, 2000, NT, XP, MP, Vista |
| AnyLogic | XJ Technologies | Flexible general purpose simulation tool. Discrete Event, Agent Based and System Dynamics modeling | Healthcare, Logistics, Supply Chains, Manufacturing, Defense, IT, Pharmaceuticals, Marketing, Finance, Energy, Education | 2GB | MS Windows Vista or XP, Apple Mac OS, Linux |
| Blues Simulation System (Bluesss) | Stanislaw Raczynski | General purpose, discrete and continuous models | Education, research | | Windows XP, Vista |
| Clinical Trials Simulator | ProModel Corporation | Automated simulation analysis and mathematical optimization of multiple clinical trial site and patient recruitment scenarios | Pharmaceutical Clinical Trials | 1 GB min; Recommend 2 GB | Windows XP, Vista, Windows 7 |
| CSIM for Java | Mesquite Software, Inc. | Models of processes and systems of processes | Education | depends on model | Any system with Java |
| CSIM20 | Mesquite Software, Inc. | Modeling large, complex systems | Computer systems, networks, education | depends on model | Windows, Linux, Solairs86, Solaris, MacOSx |
| DecisionTools Suite | Palisade Corporation | Integrated risk, decision, and data analysis in Excel combining Monte Carlo simulation, decision trees, optimization, & more. | Finance; insurance; oil/gas/energy; pharmaceuticals; manufacturing; six sigma | | Windows |
| Emergency Department Simulator | ProModel Corporation | Emergency Department throughput, staffing, patient flow, and efficiency analysis. | Emergency Department Performance Improvement | 128MB min, 512MB recommended | Windows 2000, XP |
| Enterprise Portfolio Simulator | ProModel Corporation | Web-based simulation analysis of multiple, simultaneous project/product plans across one or more portfolios of projects | Project and Portfolio Planning, Strategic Resource Capacity Planning; New Product Development, R&D, Scheduling | 2GB min; Recommend 4GB | For Server: Windows Server 2003, 2008 For Client: Mac or PC or anything that runs a browser |
| ExtendSim AT | Imagine That Inc. | Rate-based modeling functionality for manufacturers operating in a mixed-mode environment: batch process and discrete event. | Any industry that operates in a high-speed or high-volume arena: packaging lines, chemical processes, network traffic, etc. | 512 MB | Windows Vista, XP, 2000, 2003 Server, or better; Macintosh OS X 10.4 or better |

| Software | Vendor | Typical Applications of the software | Primary Markets for which the software is applied | RAM | Operating Systems |
|---|---|---|---|---|---|
| ExtendSim OR | Imagine That Inc. | Message-based discrete event architecture to model processes involving physical or logical objects moving through systems. | Manufacturing and business modeling; communication systems, healthcare, six sigma, transportation, service, education, etc. | 512 MB | Windows Vista, XP, 2000, 2003 Server, or better; Macintosh OS X 10.4 or better |
| ExtendSim Suite | Imagine That Inc. | Professional 3D modeling of continuous, discrete event, and discrete rate processes. | When impressive presentations count. 3D modeling of manufacturing, logistics, business, government, eductation, engineering. | 512 MB | Windows Vista, XP, 2000, 2003 Server, or better; Macintosh OS X 10.4 or better |
| Flexsim | Flexsim Software Products, Inc. | Process improvement, process optimization, capital investment justification, lean implementations | manufacturing, warehousing, distribution, supply chain, and mining | 256 MB | Windows Vista, Windows XP |
| Flexsim CT | Flexsim Software Products, Inc. | Container shipping terminal applications, yard stacking segregation strategies, quay crane allocation, dispatching | Container terminals | 256 MB | W0 |
| Flexsim HC | Flexsim Software Products, Inc. | Hospital ER and related healthcare/patient flow applications | Healthcare, emergency rooms, patient flow, patient services, lab, staff balancing | 256 MB | Windows Vista, Windows XP |
| ForeTell-DSS | DecisionPath, Inc. | „Test drive‰ decisions e.g., managing risks from terrorist threats, org.change, competitive mktg strategy, M&A transactions | Government (e.g. homeland security, DOD, civil sector policy), Pharma/Life Sciences, Financial Services | 512 MB | Windows, Mac OS, Linux (written in Java) |
| GoldSim | GoldSim Technology Group | Engineering risk analysis, including water resource management, mining, waste management, and aerospace mission risk analysis | Mining, Energy, Water Resource Management, Aerospace and Defense, Engineering Consulting, Radioactive Waste Managment | 512 MB | Windows XP, Servero 2003, Vista, 7 |
| Integrated Performance Modelling Environment (IPME) | Alion Science and Technology MA&D Operation | human performance modeling, manning analysis, human workload evaluation, product design | government, defense, manufacturing, staffing | 512 MB | Mandrake 10X, RedHat Enterprise, Windows 2000, Windows XP |
| MedModel Optimization Suite | ProModel Corporation | Design, plan, evaluate and improve processes of hospitals, clinics, and other healthcare systems to optmize performance | Hospitals, Clinics, Healthcare Systems, Medical Device Manufacturing and Sales | 512MB min; Recommend 2 GB | Windows XP, Vista, Windows 7 |
| Micro Saint Sharp | Alion Science and Technology, MA&D Operation | human performance modeling,manufacturing,healthcare,service industry,military,business process reengineering,supply chains | human performance modeling,manufacturing,healthcare,supply chains | 256MB | Microsoft Windows Server 2003, Windows Server 2008, Windows XP, Windows Vista (Operating systems must support the Microsoft .NET Framework 3.5) |
| Portfolio Simulator | ProModel Corporation | Simulation and optimization analysis of multiple,simultaneous project/product plans across one or more portfolios of projects | Project and Portfolio Planning, Strategic Resource Capacity Planning; New Product Development, R&D, Scheduling | 1 GB min; Recommend 4 GB | XP, Vista, Windows 7 |

| Software | Vendor | Typical Applications of the software | Primary Markets for which the software is applied | RAM | Operating Systems |
|---|---|---|---|---|---|
| Process Simulator | ProModel Corporation | Lean, SixSigma, value stream mapping, process mapping, flow chart simulation, continuous process improvement | All | 512MB min; Recommend 2 GB | Windows XP, Vista, Windows 7; Also needs MS Visio 2003 or 2007 or 2010 |
| Project Simulator | ProModel Corporation | Enables project managers to more accurately predict outcomes of their project plans | Anyone who uses Microsoft Project | 1GB min; Recommend 2 GB | Windows XP, Vista, Windows 7; Also needs MS Project 2007, 2010 |
| ProModel Optimization Suite | ProModel Corporation | Lean, SixSigma, capacity planning, cost analysis, process modeling, cycle time reduction, throughput optimization and more | Manufacturing and logistics, pharmaceutical, defense | 512MB min; Recommend 2 GB | Windows XP, Vista, Windows 7 |
| Proof 3D | Wolverine Software Corporation | Provides 3D animation capabilities for use in discrete event simulation | Air Traffic control, transportation, manufacturing | | Windows XP/Vista/7 |
| Proof 5 | Wolverine Software Corporation | Provides 2D animation capabilities for use in discrete event simulation | Air Traffic control, transportation, manufacturing | | Windows XP/Vista/7 |
| PSM++ | Stanislaw Raczynski | General purpose, sicrete and continuous models | Education, Delphi users | | Winfows XP, Vista |
| QMS | QuantMethods | Pedigogical tool for teaching quantitative methods, including simulation. | Higher education | N/A | N/A - Browser access |
| REACT | MJC2 | Real-time scheduling and simulation | All large logistics and transport operations. | varies | many including Windows, UNIX and Linux |
| Renque | Renque Corporation | General purpose discrete event simulation software | Transport, Communications, Engineering & Design, Business modelling | | Microsoft Windows Vista, Microsoft Windows XP, Microsoft Windows 2000 |
| Risk Solver | Frontline Systems Inc. | Risk analysis and risk budgeting, Monte Carlo simulation | Academic, Oil & Gas, Pharmaceuticals, Insurance | 2GB | Windows 7, Vista or XP |
| Risk Solver Platform | Frontline Systems Inc. | Monte Carlo simulation, conventional optimization, simulation optimization, stochastic programming, robust optimization | Academic, General Business, Oil & Gas, Pharmaceuticals, Insurance, Manufacturing/Distribution | 2GB | Windows 7, Vista or XP |
| Risk Solver Premium | Frontline Systems Inc. | Risk analysis, Monte Carlo simulation, simulation optimization | Academic, Oil & Gas, Pharmaceuticals, Insurance, Manufacturing/Distribution | 2GB | Windows 7, Vista or XP |
| ServiceModel Optimization Suite | ProModel Corporation | Design, plan, evaluate and improve service industry systems such as Financial Services, Logistics, Business Re-Engineering | Financial Services, Logistics, Transportation, Food & Hotel Services, Entertainment, and Other Service Industries | 512MB min; Recommend 2 GB | Windows XP, Vista, Windows 7 |
| ShowFlow | Webb Systems Limited | manufacturing; logistics; financial services | manufacturing - bottleneck analysis; layout revsions; new equipment evaluation | 1GB | Windows 2000; XP; Vista; 7 |

| Software | Vendor | Typical Applications of the software | Primary Markets for which the software is applied | RAM | Operating Systems |
|---|---|---|---|---|---|
| Simcad Pro-Patented Dynamic Process Simulator | CreateASoft, Inc | Continual Process Improvement, Facility Layout/Design, RFID/RTLS, Process Optimization, Lean, CapEx Justification | Manufacturing Solutions, Healthcare Solutions, Supply Chain Logistics Solutions,Service/Office Simulation Tools | 256 | Windows 2000 (XP/Vista). Will run on a MAC with a Windows Emulator.If 3D Graphics are needed, a hardware acceleration board will help in increasing the system performance. |
| SIMUL8 Professional | SIMUL8 Corporation | Optimize throughput, maximize resource utilization, identify bottlenecks, reduced risk decisions, business process management | Business processes: call center, manufacturing, supply chain, logistics, healthcare, financial, education | 256MB | All Windows editions including Windows 7& Vista, Linux, Mac OS |
| SIMUL8 Standard | SIMUL8 Corporation | Optimize throughput, maximize resource utilization, identify bottlenecks, reduced risk decisions, business process management | Business processes: call center, manufacturing, supply chain, logistics, healthcare, financial, education | 256MB | All Windows editions including Windows 7 & Vista, Linux, Mac OS |
| SIMUL8 Web | SIMUL8 Corporation | Simulation on the web. Share the benefits and power of simulation with others, no install, no learning curve. | Business processes: call center, manufacturing, supply chain, logistics, healthcare, financial, education | Browser requirements only. | All operating systems. |
| SLIM | MJC2 | Strategic modelling, simulation and optimisation. | All large logistics and transport operations. | varies | many including Windows, UNIX and Linux |
| SLX | Wolverine Software Corporation | High-end, unique applications that require features not built into off-the-shelf simulation software | Air Traffic control, homeland security, telecommunications, logistics | | Windows XP/Vista/7 |
| Stat::Fit | Geer Mountain Software Corporation | Statistically fits input data to analytical distributions and exports into specific forms to simulation software. | Simulation and modeling, risk assessment, reliability, quality, engineering and financial management. | 4 MB | PC / Windows |
| Tecnomatix Plant Simulation | Siemens PLM Software | Tecnomatix Plant Simulation software enables the simulation and optimization of production systems and processes. | Airports Aerospace Automotive and Supplier Consulting houses CPG Defense Electronic Logistic MRO Ports Shipyard Whitegood | 1GB | Windows XP, Windows Vista |
| Vanguard Business Analytics Suite | Vanguard Software | Collaborative modeling, strategic planning, risk analysis, forecasting, portfolio management, optimization, Web-based what-if | Consulting (internal/external), pharmaceuticals, oil & gas, aerospace, manufacturing, marketing, finance, academic | 128MB | Windows 2000, XP, Vista |
| Vanguard Strategic Forecasting Suite | Vanguard Software | Collaborative modeling, strategic planning, risk analysis, forecasting, portfolio management, optimization, Web-based what-if | Consulting (internal/external), pharmaceuticals, oil & gas, aerospace, manufacturing, marketing, finance, academic | 128MB | Windows 2000, XP, Vista |
| Vanguard System | Vanguard Software | Collaborative modeling, strategic planning, risk analysis, forecasting, portfolio management, optimization, Web-based what-if | Consulting (internal/external), pharmaceuticals, oil & gas, aerospace, manufacturing, marketing, finance, academic | | |

| Software | Vendor | Typical Applications of the software | Primary Markets for which the software is applied | RAM | Operating Systems |
|---|---|---|---|---|---|
| WebGPSS | Beliber AB | General purpose discrete events simulation of situations with uncertainty, requiring many runs | Education, esp. students of business, logistics, supply chain systems | 8 MB | Windows |
| XLSim 3.0 | AnalyCorp | Small traditional Monte Carlo applications, and interactive simulations based on DISTs. | General market for small Monte Carlo simulation models. | | Vista, XP. Requires Excel 2003 or 2007 for Windows. |