DEVELOPMENT OF RISK MANAGEMENT DEFENSE EXTENSIONS TO THE PMI PROJECT MANAGEMENT BODY OF KNOWLEDGE

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This article describes the risk management defense extensions to the 2000 Project Management Institute (PMI) Project Management Body of Knowledge (2000 PMBOK® Guide). The Department of Defense (DoD) Draft Extension was developed to provide recommended tailoring of the 2000 PMBOK® Guide to Department of Defense-specific applications. The focus of this article is on Department of Defense-specific tailoring associated with risk management information that appears in Chapter 11 of the 2000 PMBOK® Guide, including key supplemental information and enhancements.

The concept of a Department of Defense (DoD) Extension to the Project Management Body of Knowledge (PMBOK®) Guide has its beginnings as early as the 1992 Project Management Institute (PMI) Symposium in Pittsburgh, Pennsylvania. Several PMI members — all members of the PMI Aerospace/Defense Specific Interest Group (A&D SIG) — agreed that a document supplementing the current PMBOK® Guide, with specific information on Defense Acquisition, was necessary for both defense contractors and foreign governments that procure defense systems. Besides supplemental DoD process information for each of the eight main PMBOK® knowledge areas (including risk management), five additional "defense intensive" areas were identified for inclusion in any extension to the PMBOK® Guide. These five additional areas are Systems Engineering Management, Software Development Management, Test and Evaluation Management, Logistics Management, and Manufacturing Management. In line with current DoD policy, each of these five areas — and other PMBOK® Guide supplemental material as well — are primarily composed of commercial practices; these practices have become an integral part of DoD acquisition processes.

In 1996, the PMI Standards Committee initiated a project to develop the process to implement the provision for extensions. The final report and proposed process were formally transmitted to the Director of Standards in March 1997; this event launched the formal development by the Defense Systems Management College/Defense Acquisition University (DSMC/DAU) of the Defense Extension to the PMBOK® Guide. At the same time, it was agreed between PMI and DSMC/DAU that the extension would focus on United States DoD concepts, processes, and procedures, with appropriate reference to the acquisition systems of allied foreign nations. The goal was to develop a PMI standard that could be used by defense contractors and foreign nations alike. The DoD Extension to the PMBOK® Guide began to take shape in 1999, when the work of 23 government and Defense industry contributors coalesced into a coherent usable document.

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At that time it was anticipated that the extension would be published "in the public domain"; that PMI's copyright for the PMBOK® Guide needed to be protected, and that the extension — as a PMBOK® Guide derivative work — also needed to incorporate protection of PMI intellectual property.

At the time that this article is being written, the DoD Extension is a draft document, i.e., the DoD Draft Extension, that has been reviewed by the PMI membership. Following completion of the review process, it is envisioned that the draft will become an accepted PMI standard. While this article focuses on the Risk Management part of the DoD Extension, it is important to keep a full perspective on all the parts that make up the Extension, since they are all important to the "art" of DoD aerospace/defense program management.

The risk management process presented in the Project Management PMBOK® Guide, generally applies to DoD acquisition programs. The DoD Draft Extension PMBOK® Guide provides supplemental information needed for the risk management of defense systems, as well as enhancements to the 2000 PMBOK® Guide material.

Information is provided in the DoD Draft Extension for several supplemental topics, including:

- DoD risk management policy;
- A summary of DoD risk management principles and lessons learned;
- DoD risk management structure;
- DoD risk management definitions and the Risk Management Process Model;
- Organizational and behavioral considerations for implementing risk management;
- The performance dimension of consequence of occurrence;
- The performance dimension of Monte Carlo simulation modeling;
- A structured approach for developing a risk handling strategy. (Defense Acquisition University (DAU), 2002a).

This article briefly addresses a few of these supplemental items.

DoD Risk Management Structure and Process Model

In the DoD risk management process structure, given in Figure 1 (DAU, 2002b), there are four process steps, with risk assessment further broken down into risk identification and risk analysis. This process structure is similar to that given in the 2000 PMBOK® Guide (Project Management Institute [PMI], 2000), except for the following considerations. First, risk analysis is split into qualitative and quantitative risk analysis process steps in the 2000 PMBOK® Guide, whereas in the DoD Draft Extension it is treated as a single process step. The rationale for the DoD approach is that many of the same inputs, resources, and use of outputs exist for both qualitative and quantitative risk analysis, and some potential methodologies blur the boundary between these forms of risk analysis (e.g., the use of probability tables estimated from a statistical analysis of survey results). Second, the DoD Draft Extension emphasizes the feedback term present from risk monitoring (as shown in Figure 1) to the other process steps, which is not illustrated in the 2000 PMBOK® Guide process flow (Conrow, 2000; DAU, 2002a).

Some Organizational and Behavioral Considerations for Implementing Risk Management

Organizational and behavioral considerations for implementing risk management are not discussed in the 2000 PMBOK® Guide. A summary of some key considerations outlined in the DoD Draft Extension that apply to a variety of programs is now given.

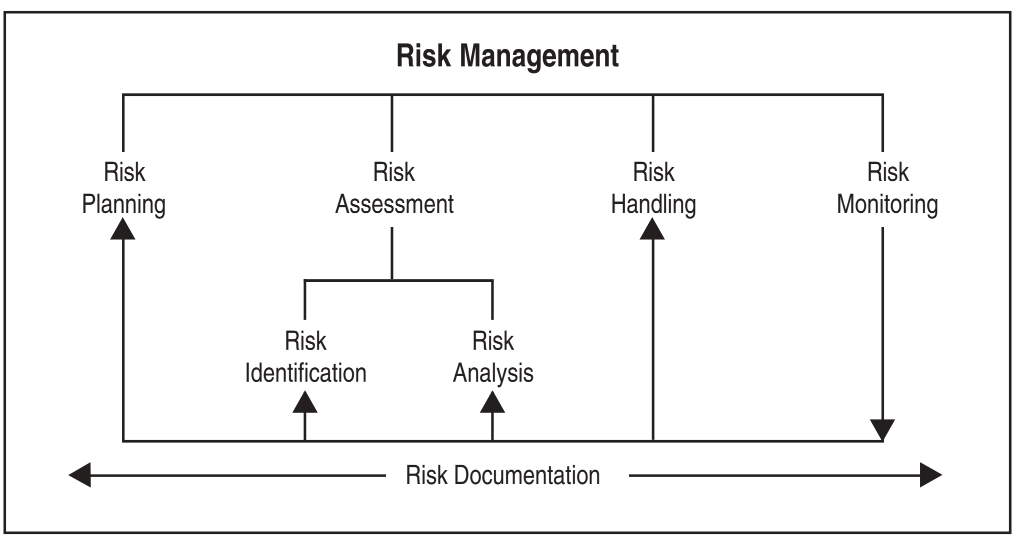

Figure 1. DoD Risk Management Structure (DAU, 2002a)

While a comprehensive, structured, repeatable risk management process is important for effective risk management, it is equally important that proper organizational and behavioral considerations exist to implement the process properly. Even a state-of-the-art risk management process that is not implemented or executed well will have a low overall effectiveness.

While tailoring should be performed on a program-to-program basis, it is important that risk management roles and responsibilities be defined in the Risk Management Plan (RMP) and executed during the program life cycle; else there will be little focus or accountability. Some key roles and responsibilities include (Conrow, 2000; DAU, 2002a; DAU, 2002b):

- Which group of program personnel will have responsibility for risk management decision making (e.g., Risk Management Board [RMB] or Level 1 Integrated Product Team (IPT)?

- Who chairs the RMB [e.g., program manager (PM), deputy program manager (DPM)]?

- Which group maintains and updates the risk management process (e.g., program management, systems engineering)?

- Who develops the RMP (e.g., risk manager)?

- Which individual or group is responsible for leading risk management implementation and training others in risk management principles (e.g., risk manager)?

- Who performs risk management (e.g., everyone)?

- Who assigns focal points to a given risk issue (e.g., RMB or Level I IPT together with the cognizant IPT)?

- Who develops draft risk analyses (e.g., focal point together with the cognizant IPT Lead), and which group approves the results (e.g., RMB or Level 1 IPT)?

- Who develops draft risk handling plans (e.g., focal point together with the cognizant IPT Lead), and which group approves the plans (e.g., RMB or Level 1 IPT)?

- Which group collects and examines risk-monitoring metrics (e.g., focal point and cognizant IPT Lead together with the RMB or Level 1 IPT)?

The above questions and areas of responsibility are not intended to be all-inclusive. In addition, the best approach for addressing these items will vary on a program-to-program basis and depend upon a host of organization, contractual, and other considerations.

While organizational roles and responsibilities are often relatively straightforward to develop, behavioral considerations may be much more difficult to identify and correct or enhance as warranted. While behavioral considerations generally involve creating an environment conducive to performing risk management efficiently, it often requires examining attitudes and approaches that exist across the program. For example, program upper management should not only be supportive of risk management but also use risk management principles in their decision making. This is important because program personnel will observe upper management involvement in risk management, and if it appears that risk management is just given lip service, then other program personnel may be reluctant to participate actively. Conversely, this does not mean that the PM or DPM should be the risk manager except possibly on small programs, but just that they are actively engaged and using the process. Middle managers, such as the risk manager, should not lead risk management because this will potentially send the wrong message of its importance to program personnel. It is equally important to have working-level personnel actively apply risk management principles in their daily work, since they are often much closer to potential risk issues than upper management. Thus, from the PM to the most junior program personnel, risk management should ideally be integrated as part of the job function — not in a bureaucratic sense, but to assist them in decision making.

The Performance Dimension of Consequence of Occurrence

The 2000 PMBOK® Guide includes cost, quality, schedule, and scope dimensions of risk analysis consequence of occurrence, whereas the DoD Draft Extension recognizes the cost, performance, and schedule (C,P,S) consequence of occurrence dimensions (PMI, 2000; DAU, 2002a).

Technical performance is a concept that is effectively absent from the 2000 PMBOK® Guide, yet it is a primary driver for the development of DoD as well as many non-DoD and commercial systems. In fact, cost growth and schedule slippage often occur when unrealistically high levels of performance are required and little flexibility is provided to degrade performance during the course of the program (Conrow, 1995). Performance is also one of the three key system attributes (along with cost and schedule) that are used to measure program outcomes (e.g., in Selected Acquisition Reports).

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Quality is often a cause rather than an impact to the program and can generally be broken down into C,P,S components (e.g., reliability given by mean time between failure is often treated as a performance characteristic). (For example, holding all else constant, poor quality will tend to lead to increased cost, increased schedule, and decreased performance for a fabricated item.) Scope is not recommended as a consequence of occurrence dimension since it is often the super set of C,P,S, and thus both correlated and redundant with C,P,S.

The Performance Dimension of Monte Carlo Simulation Modeling

Monte Carlo simulations are not universally applicable, but should be considered as a candidate tool and technique for conducting a risk analysis. The 2000 PMBOK® Guide (PMI, 2000) mentions cost and schedule Monte Carlo simulations, but not performance simulations. Performance Monte Carlo simulations are a key architecture, system, and component design tool for numerous types of defense and non-defense items. For example, the performance of an application specific integrated circuit (ASIC) is often modeled by a Monte Carlo simulation prior to releasing the design to silicon layout, because any error in the design may lead to a very costly and time consuming redesign. (In fact, for a complex ASIC it is almost impossible to verify the design without using a simulation or comparable tool.) The basic structure of a performance simulation will depend upon the item being evaluated, and will vary on a case-by-case basis; while for cost and schedule simulations, the basic nature of the implementation remains at least somewhat similar across a wide variety of projects.

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A Structured Approach for Developing a Risk Handling Strategy

While both the 2000 PMBOK® Guide (PMI, 2000) and DoD Draft Extension (DAU, 2002a) employ the same risk handling options (assumption [acceptance], avoidance, control [mitigation], and transfer [transference]), the DoD Draft Extension also emphasizes a structured approach for developing an overall risk handling strategy (Conrow, 2000; DAU, 2002a). (Note: In the 2000 PMBOK® Guide, the risk handling step is termed risk response planning.) Risk assumption is an acknowledgement of the existence of a particular risk situation and a conscious decision to accept the associated level of risk, without any special efforts to control it. Risk avoidance involves a change in the concept, requirements, specifications and/or practices that reduce risk to an acceptable level. Risk control does not attempt to eliminate the source of the risk but seeks to mitigate or control the risks. Risk transfer often involves reallocating risks across design segments (e.g., hardware and software) during the early development process or redistributing risks between parties (e.g., between buyer and seller) (DAU, 2002b).

This structured approach includes first selecting the best risk handling option, then choosing the most appropriate implementation approach. This forms the primary risk handling strategy. The structured approach for choosing the most desirable option and implementation approach is important because often program personnel jump to the "answer" rather than thinking through whether or not their strategy is the most desirable one or even an acceptable one. For high risks and other cases specified by the program RMB (or equivalent), one or more secondary risk handling strategies may also be required. Here, program personnel should use the same type of process employed to evaluate the four risk handling options as in the primary strategy, choose the best one, then select the most appropriate implementation approach. While the primary and secondary risk handling strategies may use the same risk handling option, they will use a different implementation approach.

SOME DOD DRAFT EXTENSION ENHANCEMENTS

Several enhancements are provided or referenced in the DoD Draft Extensions. The following is a brief discussion of some of these enhancements.

KEY GROUND RULES AND ASSUMPTIONS AND RISK CATEGORIES

The DoD Draft Extension includes key ground rules, assumptions, and risk categories as inputs to the risk planning process (DAU, 2002a), rather than as inputs to risk identification (risk categories) or risk identification tools and techniques (assumptions analysis) (PMI, 2000). The advantage of the former approach is that the information is included in the RMP and thus a consideration for every risk-management process step, rather than being limited solely to risk identification. For example, including a discussion of candidate risk categories as part of the RMP will help program personnel not only in risk identification, but also in evaluating the level of risk present (risk analysis), and possibly in developing risk-handling plans and in monitoring risk issues (by focusing on potential risk issues better). Even in the case of risk identification, it is helpful for program personnel to have thought through potential ground rules and assumptions and examined candidate risk categories before performing formal risk identification to reduce the likelihood that errors will be made during this process.

PROCESSES FOR EVALUATING RISKS

The DoD Draft Extension includes a discussion of three different processes commonly used for risk identification and analysis (DAU, 2002a). These approaches include: critical process, Work Breakdown Structure (WBS), and integrated product/process. The 2000 PMBOK® Guide includes a discussion of the WBS, but not the critical process and integrated product/process approaches (PMI, 2000). (The WBS approach has strong historical precedence and is widely used within DoD. In this approach the focus is on products or system elements and the processes associated with those elements.)

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Critical process approach. This approach is used to identify candidate technical risks by assessing the variance between design, test, and production processes and industry Best Practices. It was originally applied to programs transitioning from the development to production phases. A primary benefit of this approach is that it addresses common sources of process risk in many programs. The actual program baseline is developed and compared to a baseline of industrywide processes and practices that are critical to the program. This forms a basis for performing risk identification and assisting in performing risk analysis and to some extent selecting implementation approaches for risk handling. The critical process approach has many benefits, but these processes are often not directly related to individual WBS elements. It may also be difficult to implement early in the development process before mature design, test, production, and other processes are in place.

Integrated Process/Product approach. This technical risk assessment approach is derived primarily from the critical process approach and incorporates some aspects of the WBS approach. Here, the systems engineering process defines design and product solutions in terms of design, test, and manufacturing requirements. The resulting solutions and their associated processes are compared to a baseline of industrywide processes and practices that are critical to the program. These requirements are also mapped to the WBS, which provides a structure for relating the program's technical objectives to product-oriented elements and the processes needed for their achievement. The emphasis in this approach is on systems engineering along with process and product solutions, which is particularly important during the initial phases of product design and production.

QUALITATIVE RISK ANALYSIS TOOLS AND TECHNIQUES

The use of ordinal probability and consequence of occurrence scales is a tool and technique common to the 2000 PMBOK® Guide (PMI, 2000) and the DoD Draft Extension (DAU, 2002a), the DoD Draft Extension cautions not to perform mathematical operations on results obtained from (raw) ordinal risk scales. Instead, it recommends mapping the probability of occurrence and consequence of occurrence results into risk levels by using a risk mapping matrix. (An example risk mapping matrix is given in Figure 2. Here, ordinal probability and consequence levels

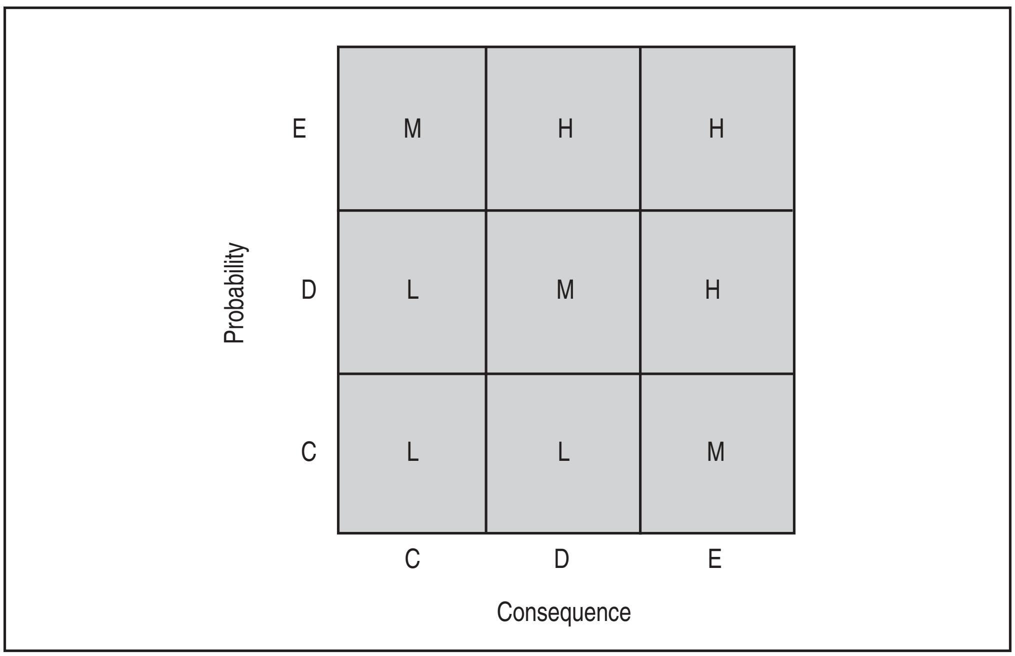

Figure 2. Example Risk Mapping Matrix

are assumed and E > D > C. The resulting risk levels are low [L], medium [M], and high [H].)

This is because most risk scales have coefficients that are ordinal, not cardinal, and their true value is unknown. (Note: Cardinal values can be presented as ordinal values [e.g., 0.5 and 0.4 as E and D where E > D], but ordinal values should never be presented as or assumed to be cardinal values [e.g., E and D where E > D as 0.5 and 0.4].) Performing mathematical operations on results obtained from ordinal scales can lead to results that will at best be uncertain or misleading, if not completely meaningless, and could result in erroneous risk ratings even in terms of the Top 5 program risks (Conrow, 2000; DAU, 2002b). It can be easily shown that errors exceeding several hundred percent can exist in ordinal scale coefficients that are erroneously assumed to be cardinal. Such errors may overwhelm the accuracy and certainty of most all risk analyses. While procedures exist to calibrate ordinal scales, they are generally difficult and costly to implement.

The DoD Draft Extension also cautions against the use of a risk-mapping matrix that has asymmetric boundaries between risk levels (e.g., L, M, H). This is because the risk level boundaries are often guessed and not based upon any conclusive evidence. In addition, an asymmetric risk-mapping matrix, which requires either a risk averse or risk taker position, cannot be used at the same time as other methodologies, such as expected monetary value (equivalent to deterministic decision tree analysis), which requires a risk neutral assumption.

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