# Assessing the Transition-to-Production Risk

## A New Methodology

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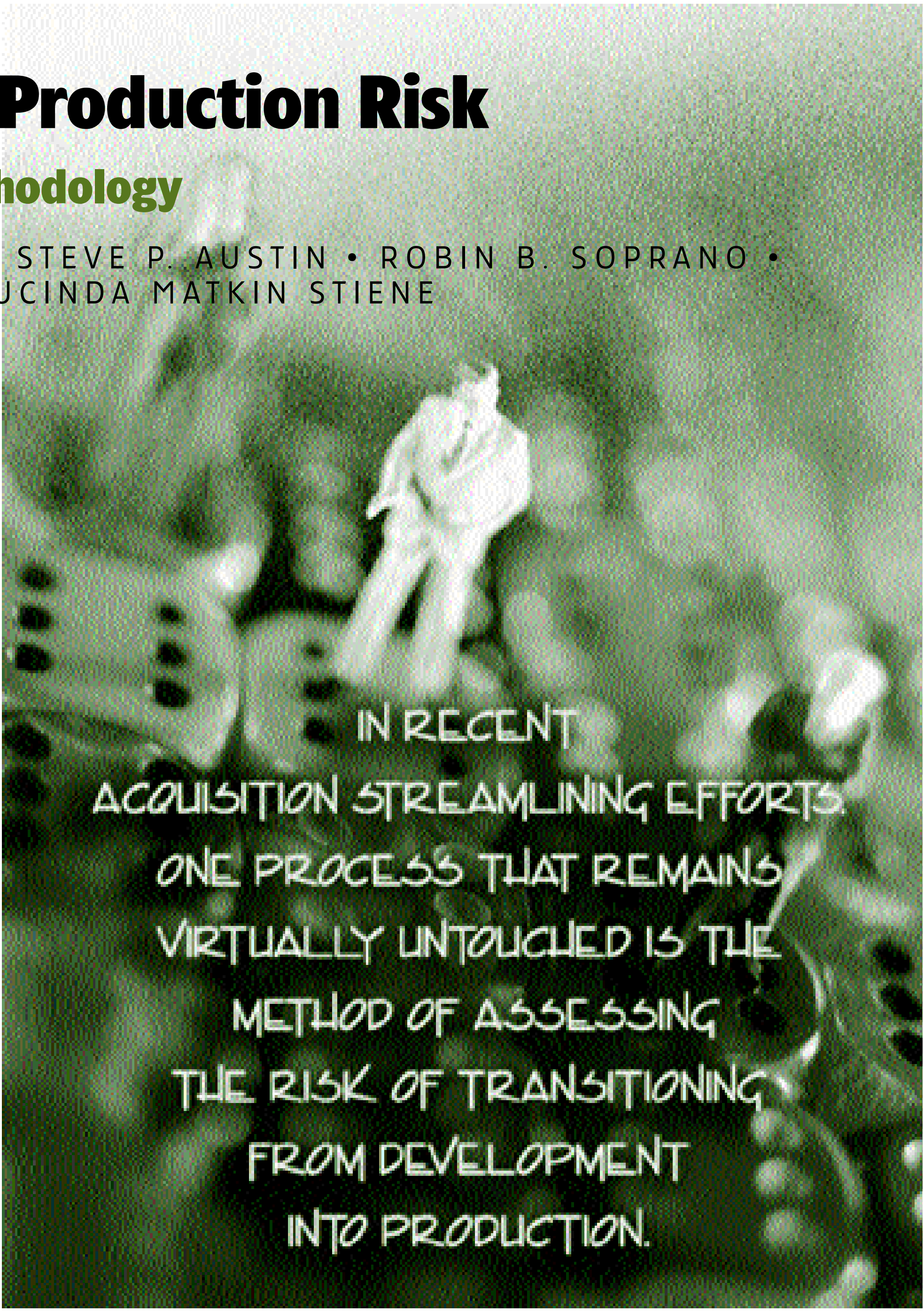
In recent acquisition streamlining efforts, one process that remains virtually untouched is the method of assessing the risk of transitioning from development into production. Traditionally, a formal Production Readiness Review (PRR) is conducted in support of program production decision milestones such as Low Rate Initial Production or Full Rate Production. The PRR team is composed of "independent" subject matter experts covering the gamut of functional areas such as hardware/software design, test, logistics, producibility and production planning, safety, and quality assurance. This team generally spends two to three days in each prime and major subcontractor facility evaluating evidence of accomplishments, proper planning, and program stability. Areas of risk are documented and summarized in a PRR report.




### A Better Way

In the fall of 1997, a team of engineers from the Production Engineering Division of the Research, Development and Engineering Center (RDEC) at the U.S. Army Aviation and Missile Command (AMCOM) in Huntsville, Ala., set out to streamline this process to better suit

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the programs they supported. To fulfill the requirement of assuring the decision maker that the risk of transitioning from Development into Production was acceptable, the team identified two programs to use the flagship methodology: Unmanned Ground Vehicle (UGV) and Enhanced Fiber Optic Guided Missile (EFOG-M). The National Missile Defense Ground-Based Interceptor program applied the methodology approximately a year later.

## The Traditional Process

The traditional process was costly, both in terms of time and funding. While the ideal evaluation team would be completely independent, it was necessary for the team to have a general understanding of the program. Therefore, PRR team members were usually personnel providing functional support to, and being reimbursed from, the program under evaluation; they were not actually employees of the project/program office. However, in recent years, project office personnel have participated in the review in ever-increasing numbers. Depending on program size and complexity, the cost of conducting this formal examination of a program in the traditional manner might cost several hundred thousand dollars and could take several weeks or months to complete. The culmination of the process was a report that provided a one-time snapshot of the program in support of a milestone decision.

Using the traditional process is inconsistent with the dynamic Integrated Product Team (IPT) approach, where risk assessment and mitigation must be a continuous, real-time activity. In addition, programs are struggling for both government and contractor personnel as well as funding resources. Given the current environment, the need to revisit the way we conduct Production Risk Assessments (PRAs) is obvious. The review or assessment must be conducted in a more "seamless" fashion and provide a results- or performance-oriented view of program production readiness. The concept of using program personnel for the assessment goes hand-in-hand with the integrated relationships of the IPT environment, provides a means to save time and money, and helps to provide insightful, timely information.

The traditional process was also very subjective. Typically, the subject matter expert formulated lists of relevant questions in advance for consistency at each facility. However, there was no concrete definition of what the expected outcome should be or what was required for success. The outcome of the review was very much dependent on the personnel selected for the team.

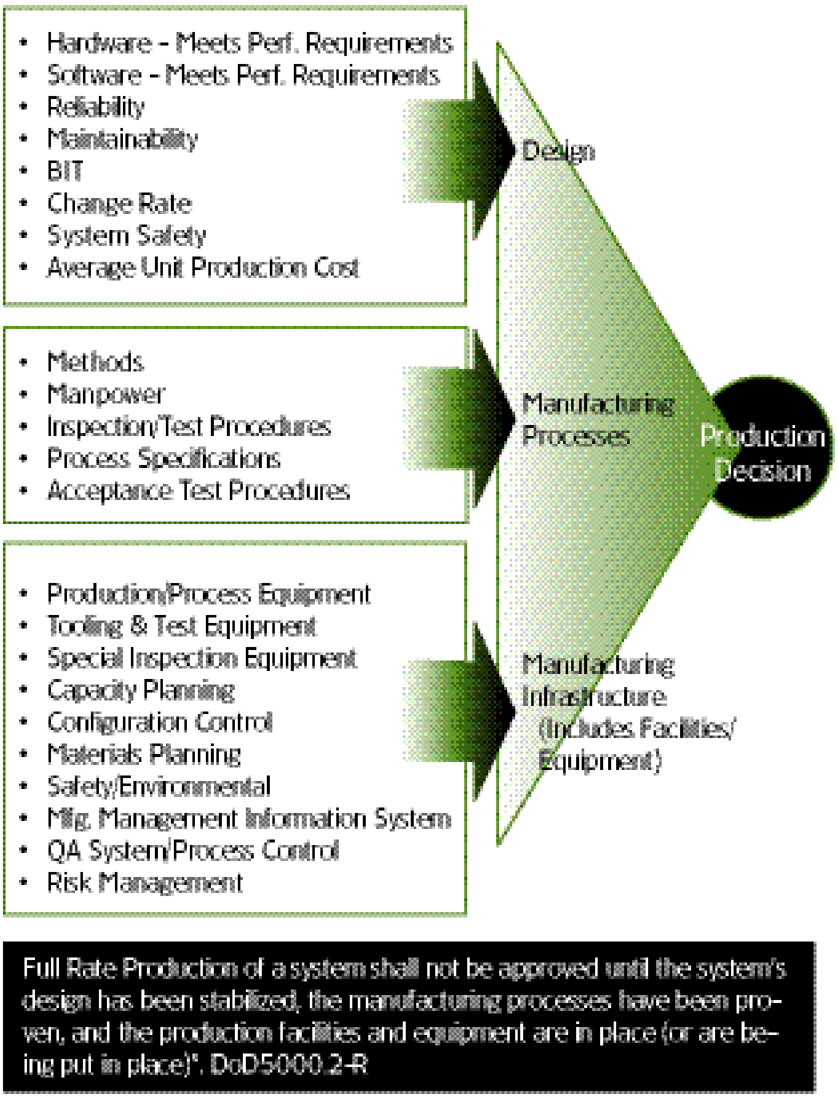
Formal PRR reports are no longer required as mandatory documentation to support a Milestone III decision. The current guidance in DoD 5000.2-R simply states, "Full Rate Production of a system shall not be approved until the system's design has been stabilized, the manufacturing processes are proven, and the production facilities and equipment are in place (or are being put in place)."

## Improving the Process?

It seemed that the process could be improved by changing the PRR team structure or make-up and by developing concrete criteria to reduce the subjectivity of the assessment. The team decided to re-think the entire process and to determine what was truly important in determining production transition risk.

Using program personnel, via IPTs or existing functional structures, an iterative and organized PRA should be com-

FIGURE 1. **Production Decision Criteria**



pleted to streamline the process of assessing the risk involved in transitioning from development into production. In keeping with the DoD 5000-series guidance, three logical areas to be evaluated are Design, Manufacturing Processes, and the Manufacturing Infrastructure.

Considering the Design, the team would assess the stability of hardware and software design, looking at issues such as reliability, maintainability, Built-in-Test (BIT), system safety, and average unit production cost. Evaluating the manufacturing processes captures the maturity of the work instructions, manpower, process capabilities, and inspection/test and acceptance procedures. Assessing manufacturing infrastructure would focus on the maturity of the manufacturing facility and support structure. These areas would be assessed for a specified level of the hardware/software Work Breakdown Structure (WBS) or major hardware deliverable products.

Figure 1 illustrates this concept and indicates specific criteria that could be used for conducting a PRA using this methodology. Traditionally, a PRR also captured the maturity of all "production phase" issues, including many areas such as logistical and training concerns. However, this recommended approach has been purposely narrowed to consider only those processes that affect the design stability, the validation or prove-out of manufacturing processes, or the manufacturing infrastructure. The team recommendation was to have other disciplines such as logistics develop their own criteria or metrics that could be assessed separately or in conjunction with the production discipline.

Rather than rely on subjective opinions of subject matter experts, these criteria have been established to provide the framework for a more objective, quantitative, and thorough assessment of selected areas of production risk. Standard risk assessment worksheets exhibiting the criteria for each element are recommended to properly and less subjectively determine the current status based on established and agreed-to "metrics." A scoring scheme would then be used to quantify risk associated with each hardware or product element at the major assembly or subassembly level. Using a predefined scale, the calculated risk for each WBS element or deliverable would be assigned a high, medium, or low risk.

The "metrics" are a gradation of statements for each criterion that represent the potential status with increasing probability of success. Each metric is evaluated using a predefined rating scale of .1, .3, .5, .7, and .9, corresponding to successive levels of maturity toward production readiness. The metric descriptions in each column should be tailored to reflect benchmark accomplishments. For rating and scoring purposes, each criterion could be equally weighted or weighted differently as decided by the team responsible for that element. For each program, the weighting may be designated differently, but agreed to before beginning the assessment. A summary of risks would be presented for each WBS element assessed. No total program risk should be assigned due to the ambiguity of such a high-level rating.

## Does One Size Fit All?

While the new assessment process is an improvement from the traditional process, it may not be suitable for all programs and is not suggested as a one-size-fits-all solution. However, the methodology, in theory, remains the same for most programs. The beauty of this approach is that it is just that—an approach.

The specific criteria and metrics must be tailored to fit the program as well as the decision maker. What's important to one program may not be as critical for others. The illustration in Figure 1 is intended simply to start the thought process. The criteria and metrics presented here represent a first cut or a place to begin. We strongly recommend that these criteria and metrics be carefully reviewed and tailored appropriately for each program. Additionally, a time-phased or iterative approach should be pursued to establish a baseline; then re-visit the assessment as the program progresses toward a production phase or decision.

Those who attempt to apply this approach will find that a great deal of work must go into the planning phase, and that to be successful all "functionals" must be involved. A core team must be organized to orchestrate, but all parties must "buy in" to the approach and the criteria. Once agreement is gained and the criteria are baselined, the actual conduct of the assessment becomes very simple and can be accomplished very quickly, making an iterative process less cumbersome.

The team make-up is another variable that is program-specific. Depending on the contractual environment and geographic locations, the blend of government and contractor personnel will vary. For the highest probability of success, we recommend a joint team. This can be accomplished from different locations using a variety of electronic communications available today such as e-mail, video teleconferencing, and the use of Web-based applications.

## Application Case Studies

### The EFOG-M Program

On Sept. 29, 1997, the Deputy for Systems Acquisition (DSA) called for a modified PRR or PRA in support of the decision to spend the $13 million procurement funding that had been appropriated for the EFOG-M program. While EFOG-M was not designated an ACAT program, this DSA decision was to be considered a Limited Procurement Decision.

A PRA Plan was developed and approved that incorporated a streamlined and iterative team EFOG-M self-assessment using predefined metrics and criteria. The plan called for an initial, informal assessment to create a PRA baseline and updates to be conducted regularly as the Seeker design stabilized and production planning efforts matured. The Initial PRA Plan was signed on April 8, 1998. The EFOG-M program was the first to use the new methodology.

To simplify the PRA, the Seeker was evaluated at only the final assembly level. The initial assessment was intended not only to create a baseline, but also to validate the methodology, criteria, and metrics. The assessment was intentionally kept simple so this could be accomplished. Six hardware assemblies were assessed, and many components or subassemblies were grouped into higher level assemblies for ease of assessment. Many hardware elements were not mature enough to assess individually due to the nature of the incremental integration and test process.

The overall response to the PRA methodology was considered favorable to both the government and the contractor. The following discussion is from a May 18, 1998, briefing on the PRA Lessons Learned.

### What We Learned

- Methodology seemed to work.
- Discovered some metrics need to be "tweaked."
- Less time consuming than traditional PRR.
- Less subjectivity; more discussion over rationale than rating.

### What We Need To Do Better Next Time

- Better define team members for each product assessment.
- Need to ensure entire functional team is involved in the process—at the same time
- Need to break down into more manageable products by contractor.

The initial assessment was completed in May 1998. As planning for the next iteration was underway, we received guidance from management to halt all efforts on the PRA because of program funding and instability. At the time the initial PRA was completed, the plan was to conduct a PRA Update by June 25, 1998, and another Pre-Decision Assessment 30 days prior to the DSA decision. This decision was expected to occur in the September/October 1998 timeframe. The decision was never made, and the EFOG-M program was terminated.

### The Vehicle Teleoperated (VT)/Standardized Robotic System (SRS) Program

At the Milestone (MS) I/II review on Nov. 4, 1997, the DSA gave approval for the VT/SRS program to enter a combined Program Definition/Risk Reduction and Engineering and Manufacturing Development phase. As part of the exit criteria for this phase, production readiness was to be verified in accordance with the Production Validation Plan. The Production Validation Plan contained the requirement for PRAs. The PRA plan was developed, coordinated, approved, and signed on June 24, 1998. The plan detailed requirements for two formal assessments: one prior to the start of production of the Operational Test hardware and the second prior to the MS III production decision.

In an effort to baseline the contractor's design and planning efforts, an initial assessment was conducted in September of 1998, 45 days after contract award. Through this assessment, the government/contractor team was able to become familiar with the database and determine efforts required to achieve a successful production go-ahead at the end of this contract phase. Due to several design, schedule, and cost problems, the two formal PRAs identified in the plan were never completed. In fact, when the contract reached the target price, the government chose not to fund beyond that point.

FIGURE 2. **NMD GBI Design Metric Sample**

| EVENT | DESIGN | | |
|---|---|---|---|
| CRITERIA | Schedule of Engineering Releases | Technical Documentation Stability | Producibility / Manufacturability |
| WS CDR | 100% of BV1 specifications (HW/SW) interface documentation, drawings, under Configuration Control | C1 Hardware/Software Requirements Identified BV3/IFT Hardware/Software Specification Documents Complete | Producibility opportunities identified |
| DRR | 100% of BV2, 75% of BV3 & 75% of IFT specifications (HW/SW), interface documentation, drawings, under Configuration Control | C1 Hardware/Software Specification Documents Complete | Producibility trades initiated and implementation planning started |
| DAB '01 | 100% of IFT and >30% of C1 specifications (HW/SW), interface documentation, drawings, under Configuration Control | >30% of C1 Drawings Released & CSCI Code Developed | Critical Item Identification & Manufacturability assessed |
| IFT 13 | >60% of C1 specifications (HW/SW) interface documentation, drawings, under Configuration Control | >60% of C1 Drawings Released & CSCI Code Developed | Critical Item Producibility Plan Complete |
| DAB '03 | >90% of C1 specifications (HW/SW), interface documentation, drawings, under Configuration Control | >90% of C1 Drawings Released & CSCI Code Developed | Critical Item Producibility Plan Implemented |