

Military Products From Commercial Lines

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Abstract

"Military Products From Commercial Lines" is a pilot program within the Air Force Manufacturing Technology Directorate's Industrial Base Pilots Office. TRW's Military Electronics and Avionics Division (MEAD) will lead the program. This pilot program will demonstrate "dual use" manufacturing by producing F-22 military avionics modules on an automotive electronics production line operated by TRW's Transportation Electronics Division. To accomplish this requires a redesign of the modules so that they can be producible using commercial automotive electronics processes. Dual use manufacturing also dictates establishing compatible business policies and practices, manufacturing infrastructures and process technologies. Business Policies and Practices that must be changed involve accounting procedures, contracting requirements, audit requirements and quality control. Manufacturing infrastructure improvements include incorporation of advanced concurrent engineering tools and process control software to allow economic production of small lot sizes. Process technology changes involve designing production lines that are highly automated and compatible with commercial practices.

This paper will discuss TRW's approach to the pilot program and potential benefits that can be derived for the F-22 program in particular and the military industrial base in general.

Military Products From Commercial Lines

The future of defense manufacturing is military avionics manufactured in less time with lower costs and higher quality by a world class manufacturing organization. This vision will be demonstrated by the Wright Laboratory Manufacturing Technology Directorate's Industrial Base Pilot Program, "Military Products From Commercial Lines." The Pilot

Program, summarized in Figure 1, will demonstrate Air Force F-22 avionics

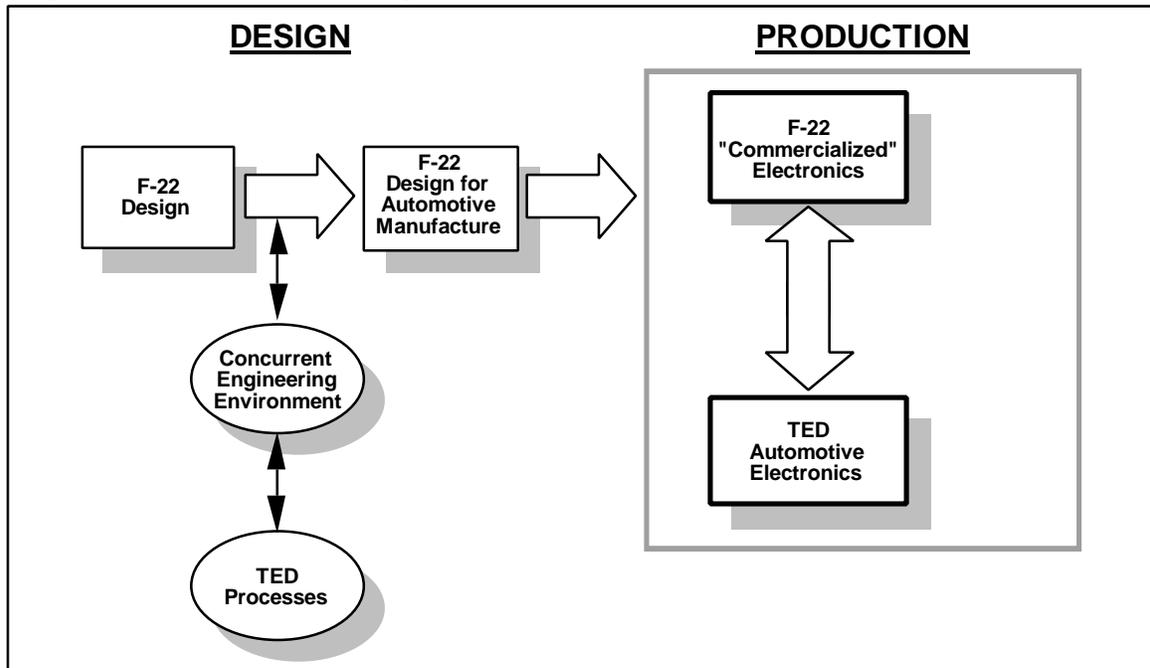


Figure 1. TRW Pilot Program

redesigned for commercial manufacture, then produced on an automotive electronics line belonging to TRW's Transportation Electronics Division (TED).

The vision, Figure 2, goes beyond a simple migration of military processes to those of a commercial lean manufacturer. Rather, we will evolve beyond the lean production environment in place today at TED to a lean enterprise environment incorporating virtual design and test and enterprise-wide Computer Integrated Manufacturing (CIM).

would expect to realize at least 30% cost, schedule and quality improvement by simply adopting the existing TED processes; however, we will seek the even greater improvements offered by a lean enterprise. Early data shows an opportunity for an 80-90% reduction in time to market and 50% reduction in cost operating in a lean enterprise. The Pilot Program will lay the groundwork to fulfill this vision.

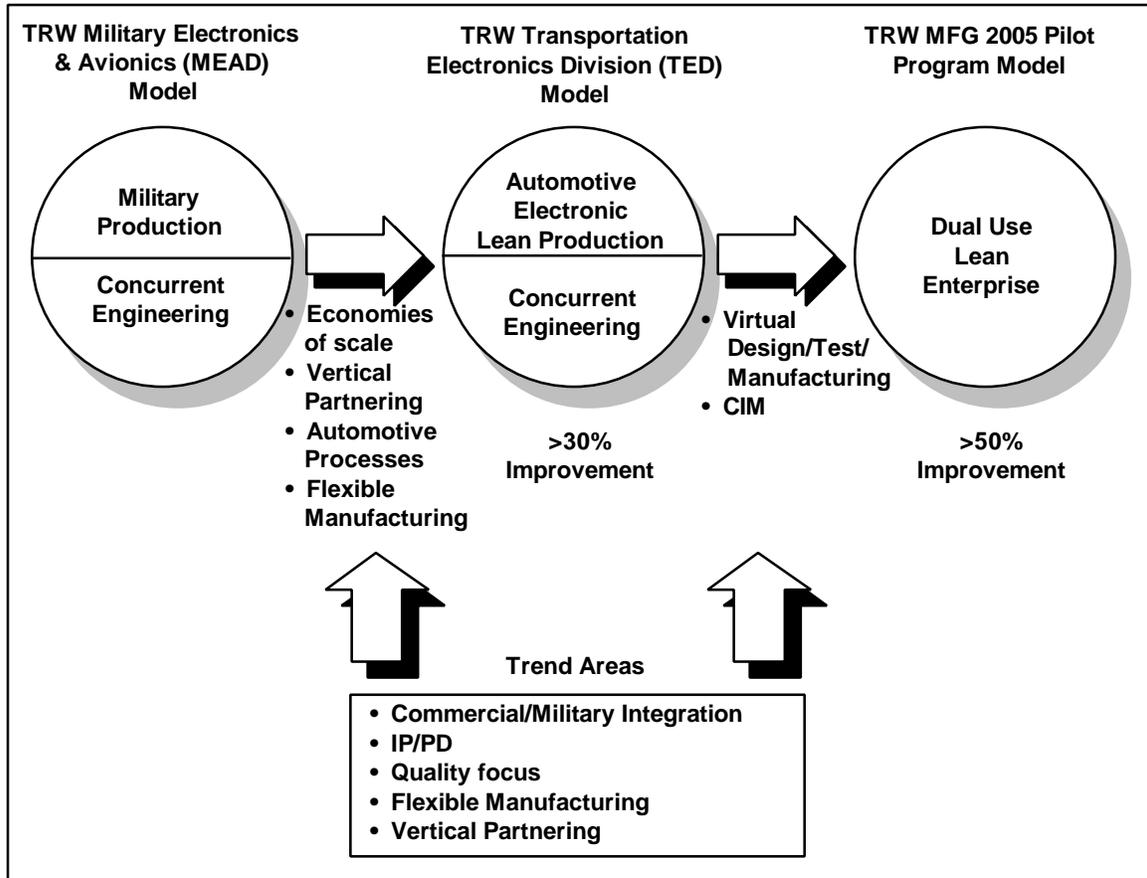


Figure 2. Our Pilot Program Will Lead to a Lean Enterprise

Commercial-Military Integration Is Necessary.

Commercial-Military Integration, or Dual Use, is not something that will be nice to have. It will be absolutely necessary for the health of the military industrial base, and by extension, the health of our national security. The supplier base for military electronics production is rapidly shrinking due to a lack of volume. We expect this to continue over the next several years as the overall defense budget shrinks. This rapidly shrinking supplier base will effect the ability to develop new systems in a normal, continuous fashion, but will also effect the ability to surge production in times of heightened threat environments. This means that without Dual Use, the Prototyping Plus concept could be hollow, having no means to manufacture the products that have been designed and put "on the shelf." (Figure 3) By employing world class, commercially based U.S.

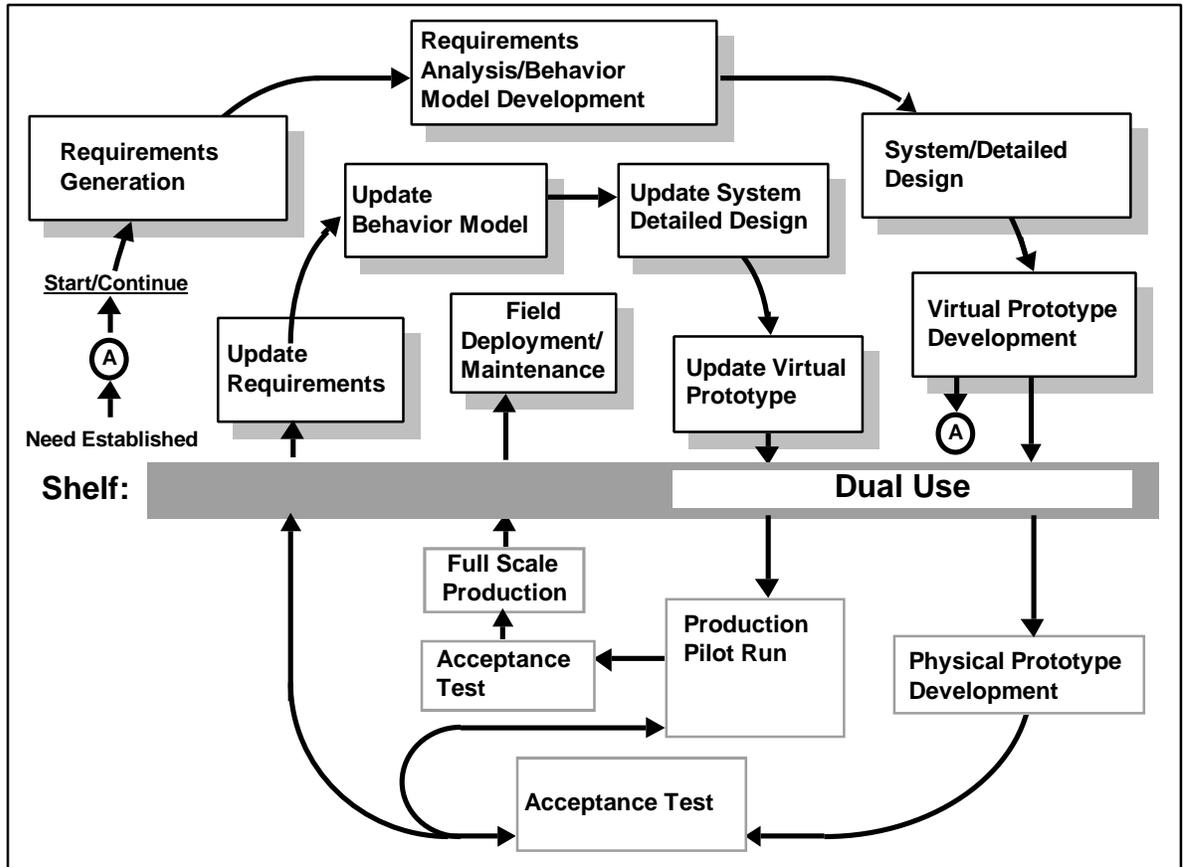


Figure 3. Dual Use Enables the Production Portion of the Prototyping Plus Concept

manufacturing organizations as Partners, a military avionics integrator can be assured of high quality, low cost production under both normal and surge conditions. This scenario assures a robust industrial base for military manufacturing. Our initial studies have shown that it is feasible to meet many of the performance/quality requirements using a commercially based electronics manufacturer. The barriers to making it a reality involve changing military business policies and practices and providing an economic incentive for the commercial company.

The F-22 Is A Pilot Program Sponsors

Under this Pilot Program, we will demonstrate the use of a commercially based design and manufacturing process for F-22 avionics manufacturing. The F-22 System Program Office

endorses the program and has signed Memoranda of Understanding with the Wright Laboratory Manufacturing Technology Directorate.

Our Pilot Program schedules correlate with those of the F-22 such that their production approaches could be affected by the results of the Pilot. This provides a "window of opportunity" for Technology Transition.

TRW Employs World Class Electronics Manufacturing.

TRW will use its Transportation Electronics Division (TED) as its first tier partner. TED will, in turn, employ its established set of suppliers to provide the parts and assemblies, thus assuring a controlled process and a high quality focus, with projected defect rates less than 20 parts per million (Figure 4). TED was chosen for three reasons. First, and foremost, TED is a high quality, world-class manufacturer of automotive electronics and has been successful in competing for world-wide automotive business, even in Japan. World-class manufacturing connotes market-driven quality, costs and delivery schedules. Second, TED's manufacturing capability can be modified to handle F-22 modules. And third, TED's automotive electronics test and durability requirements are, in many cases, as stringent as those required for military electronics.

Flexible Manufacturing Is the Key to Dual Use.

Dual Use, as we have defined it, will not work without a flexible manufacturing capability. The root problem is that the low volume of military electronics does not provide enough economic incentive for a commercial manufacturer. Flexible manufacturing allows small lot sizes to be intermingled with other production lots to maintain a high utilization rate for the line. TRW will demonstrate flexible manufacturing at its TED Marshall Plant by running F-22 and automotive electronics boards down the same line. TRW will establish a "lot size of one" capability; i.e., equipment change over time between products theoretically goes to zero. This approach will allow us to take advantage of the existing quality and cost benefits from a high volume, world class production line.

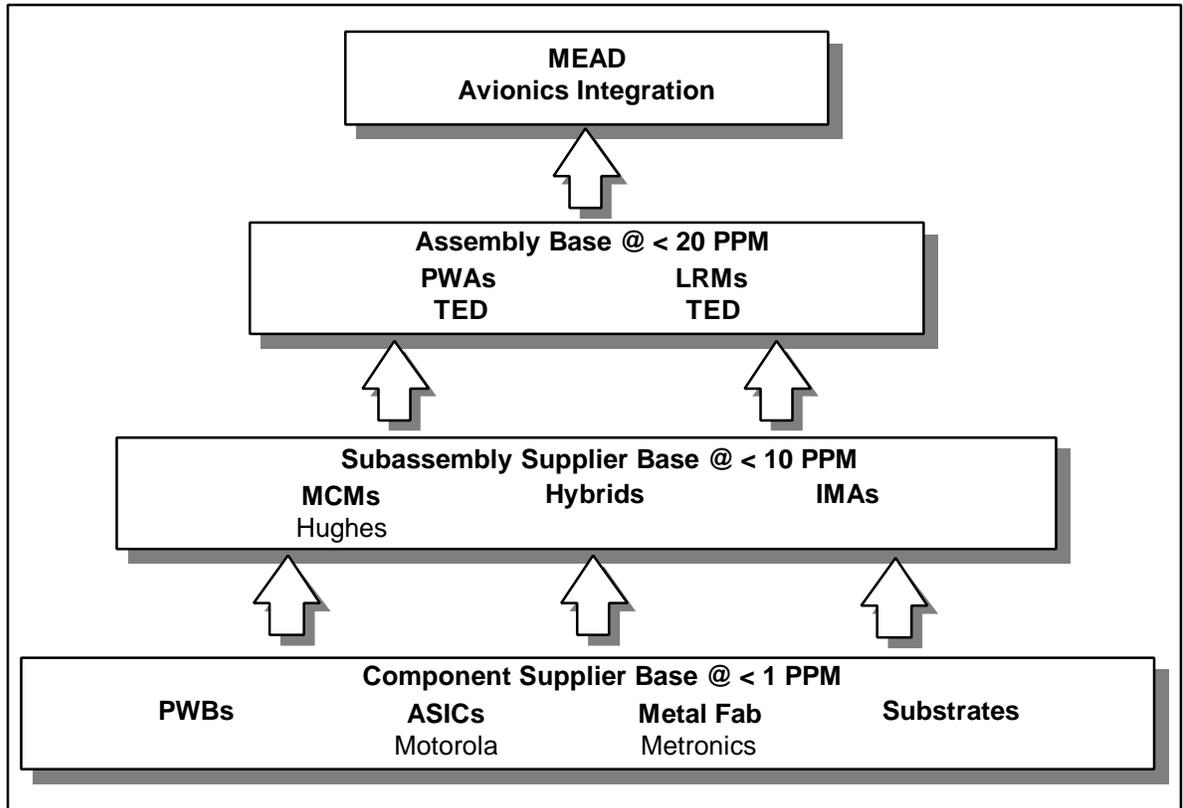


Figure 4. TRW's Partnering Vision

Integrating The Manufacturing Infrastructure Is Essential.

Flexible manufacturing requires two things - a highly producible design and flexible on-line control of the manufacturing process. To support the design process, we will establish a concurrent engineering environment that will foster the integration of the design, test and manufacturing functions and the use of Integrated Product Teams (IPTs). The environment will allow us to combine the current design and validation phases into one design/validation phase with a goal of halving the design/validation phase. This is made possible by replacing the engineering validation breadboarding phase with simulation and by incorporating design for manufacturability (Figure 5). The concurrent engineering environment will be an extension to the concepts espoused in the ManTech Directorate's Continuous Electronics Enhancements using Simulatable Specifications (CEENSS) program. The other part of the flexible manufacturing equation, on-line control of the

manufacturing process, will also be addressed during our Pilot Program. We will integrate the "above the shop floor" concurrent engineering environment and management information systems with production machinery to create a "lot size of one" manufacturing environment.

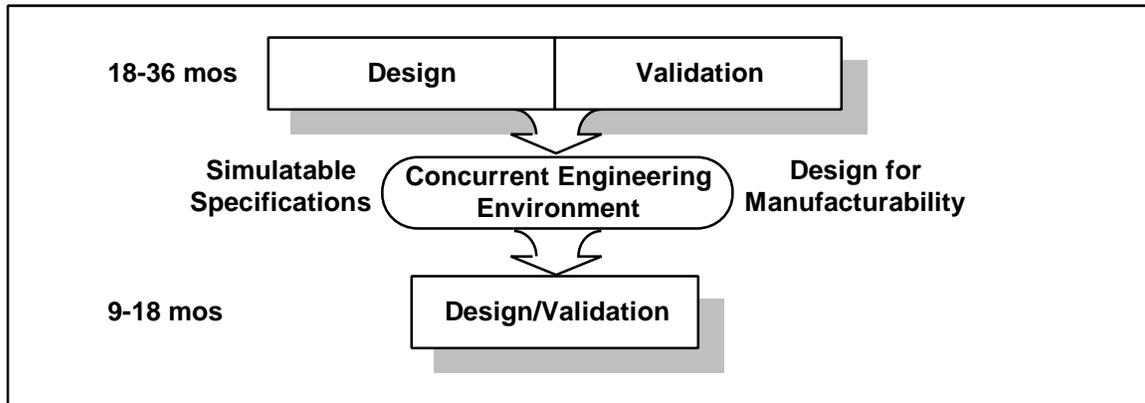


Figure 5. Our Concurrent Engineering Environment Goal is to Halve the Electronics Design/Validation Cycle

Changing Business Policies and Practices (BP&Ps) Provides Extensive Benefits.

By adopting commercially based parts management BP&P, we are estimating a 30% reduction in the total cost of TRW F-22 materials. Our objective during the Pilot Program is to identify and quantify other high leverage BP&Ps, then migrate them for use on the F-22 and other programs. BP&P barriers must be broken to enable Dual Use. One of the critical issues is to structure BP&Ps to incentivise military contractors to adopt a Dual Use paradigm. Old incentives, such as maximizing burdenable labor of the prime contractor, must be replaced with new incentives that allow equitable return to the prime contractor on products that are manufactured by their Dual Use Partner.

Our Approach Creates A Win-Win-Win Scenario. The focus of our Pilot Program, F-22 avionics flexible manufacturing, addresses opportunities that could revolutionize the way the DoD and its contractors can develop produce defense electronics. We believe that

our Pilot Program will complement and validate the Lean Aircraft Initiative objective of adopting lean production techniques, as practiced in the automotive industry, to the aircraft industry. TRW's Military Electronics and Avionics Division (MEAD) is the prime contractor for the Communications, Navigation and Identification (CNI) avionics on the F-22. TRW's Transportation Electronics Division (TED) is a world class manufacturer of automotive electronics, including engine controllers and airbag sensors, and is successfully employing lean production techniques. By first demonstrating the ability of TED to manufacture MEAD's F-22 avionics and then transitioning the technologies and practices to actual use, we can create a win-win-win scenario for military contractors, commercial contractors and the DoD. Military contractors, such as MEAD, gain a high quality, economical source for their avionics electronic module production. Commercial contractors, such as TED, gain new product lines that can be non-intrusively integrated with existing production lines under a "lot size of one" capability. And finally, the DoD can assure itself of a quality manufacturing base that will be flexible enough to meet defense requirements, both routine and emergency.