

Appendix C – Using MRLs in Non-Acquisition Programs (e.g. S&T, Title III)

Readiness Levels in Capability and Commodity Assessments

1.0 Introduction

The concept of Manufacturing Readiness Levels was developed to assess manufacturing risk and readiness for systems targeted for or to transition into the DOD acquisition life-cycle. The MRL process has been used successfully to assess systems in specific program phases related to established acquisition milestones, and specific requirements are established for manufacturing readiness at each milestone or design review. When one is attempting to perform a readiness and risk assessment for basic technical capability or commodity manufacturing not specifically targeted for acquisition he will soon discover that the majority of acquisition requirements apply to basic materials and commodities manufacturing, but some do not apply at all, and others need some modifications. The need has arisen, therefore, to develop a separate time-independent set of capability readiness levels focusing specifically on the research and development of basic materials and commodities. These new readiness levels can be used for technical/risk assessments from basic materials research, development, and production.

2.0 Purpose of Capability Manufacturing Readiness Levels (CMRLs)

A new set of criteria has been established to assess the level of risk and readiness of developing a capability and/or commodities. These “Capability Manufacturing Readiness Levels,” or CMRLs, adopt most of the same structure and definitions used for MRLs with some terminology changes but are independent of the DOD acquisition time-dependent life-cycle. For capability and commodity risk assessments, the product life cycle was divided into five phases: Research (encompassing what would be regarded as the Pre-MSA and MSA phases in an acquisition program), Technology Development (what now is called TMRR in acquisition), Product Development (e.g., the EMD phase in acquisition), Production (including Pilot Line, LRIP and FRP), and finally, Sustainment. The criteria or questions to be asked in determining the CMRL of a developmental item or product are categorized by same nine threads and 22 sub-threads as MRLs, and CMRLs use the same scale from One (the most basic level) to Ten (the most advanced state of readiness). Terms specific to acquisition programs such as milestones and program phases have been modified or deleted, but the progression from immature capability to advanced is preserved. Specific reference to DOD design reviews has also been eliminated, though there remains a need for rigorous design analysis and reviews applicable to the production of the material or commodity being analyzed.

It should be noted as with MRLs, any questionnaire used to determine risk and readiness of an item for manufacture must be tailored to the characteristics and targeted maturity level of that item. Also, the focus of the analysis is *not the number*, but the *level of risk* to be encountered in the manufacture of the item. It is good to keep in mind that in the development of almost all

capabilities and commodities, the purpose is to produce and/or demonstrate that you can achieve the quality and rates required by a potential customer. No matter what the vaunted performance capability of an item, it is of little use to the customer if it cannot be produced in an economic and efficient manner and is consistently reliable in its operation. The CMRL criteria questionnaire can be used to great effectiveness to determine the risks to production if used judiciously and tailored to the specific development.

3.0 How to Use CMRLs

It is essential at the beginning of the process to define the requirements for a required capability or commodity. This is critical both to perform the capability maturity/risk assessment and subsequently, to transfer the capability to the customer. One must work closely with potential customer(s) to establish these requirements which may include material specifications, desired capability/capacity to be demonstrated, cost targets, yields, etc. Once the requirements have been defined, they can be benchmarked using CMRL criteria to determine the current capability/commodity manufacturing maturity level. With this information, one can then define activities required to achieve the desired manufacturing maturity. This process is identical to a typical MRL assessment, but some terms in a few of the questions have been changed. At the end of the CMRL assessment, you will be able to benchmark the demonstrated level of manufacturing maturity—but only against those requirements you have specified. The insertion of new capabilities into a new program must always be re-assessed, specifically addressing system-level program requirements against the MRL criteria. Also note that even though the system-level MRL might drop, program risk should be well understood and manageable because of insight obtained through the capability readiness assessment.

3.1 CMRLs in Basic Research (6.1) – (Research Phase)

The MRL process in Basic Research has limited applicability. The lower CMRLs (1-3) are better reserved for characterizing the state of the manufacturing risk of a potential product than for assessing manufacturing of the scientific discovery. Assessing how to manufacture new technologies or materials may provide insight into new processes that should be developed to achieve innovative new products. In this early stage, CMRLs should only be used to make informed decisions on which manufacturing risk areas or technologies to address when proceeding to Applied Research, or alternatively, to define where more basic manufacturing research must be done.

3.2 CMRLs in Applied Research (6.2) – (Research Phase)

The CMRL process in Applied Research should use CMRLs 1-4 to assess the manufacturing feasibility of the research product. Information gained from an identifying manufacturing risks in the Applied Research phase should be used to provide leadership knowledge of potential manufacturing shortfalls that must be addressed in future Technology Development phases.

3.3 CMRLs in Advanced Technology Development (ATD) (6.3) – (Technology Development phase)

The objective of an ATD program is to meet the larger Defense Department enterprise's needs as efficiently and effectively as possible. To effectively transition ATDs one must address the manufacturing maturity of the prototypes being developed, and this requires the greatest degree of collaboration between research and production communities.

- One of the performance objectives to be achieved in the ATD phase on programs with hardware being transitioned should be to gain an understanding of the CMRL at the completion of the ATD. To do that, use the criteria for CMRLs 1-6.
- Performance objectives should be established by the potential customer(s) including the CMRL criteria necessary to transition from Technology Development into Product Development and/or Production, depending on the maturity of the capability
- At the beginning of ATD, overall cost, schedule and performance goals should be reviewed with the customer(s). They can provide resources to execute joint manufacturing requirements appropriate to their objectives. It is especially critical that the cost goals reflect manufacturing cost considerations.

To effectively transition ATD programs one must know the manufacturing maturity and understand the manufacturing risks are before transitioning an ATD into the next phases.

3.4 Other Developmental Non-Acquisition Programs

There are a number of other developmental non-acquisition program efforts where the use of CMRLs could be effectively used. These include efforts that have as their primary goal developing manufacturing capability and/or where there is a high confidence capability will be delivered to the Warfighter. In these cases, CMRLs should be part of the management assessment to ensure transition is done effectively. Using CMRLs will provide the customer with a better understanding of the risk they assume by proceeding to the next phase.

The following are some programs that develop manufacturing capability for the customer(s):

- DOD Manufacturing Science & Technology (DMS&T) projects
- DOD Manufacturing Technology (ManTech) Programs
- DOD Title III Projects
- Manufacturing Small Business Independent Research (SBIR) Projects

Programs where there exists a high expectation of delivery capability to the Warfighter:

- Advanced Concept Technology Demonstration (ACTD)
- Joint Capability Technology Demonstration (JCTD)
- Defense Acquisition Challenge (DAC) Programs
- Rapid Fielding Projects

To effectively transition these programs one must know their manufacturing maturity and the risks before transitioning into the next phase.

4.0 Summary

Capability Manufacturing Readiness Levels (CMRLs) have been developed to help in the assessment of non-acquisition program developmental commodities and capabilities to determine the level of manufacturing maturity/risk inherent in developing this new capability/commodity. These differ from MRLs in that they are independent of the DOD acquisition life-cycle. The CMRL criteria questionnaire must to be tailored to focus on the specific commodity or material application and the targeted level of readiness for the developmental item. If used judiciously, a CMRL approach can assist in the economic and efficient production of reliable commodities for the user.