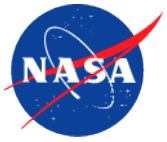
The Civilian Commercialization Readiness Pilot Program (CCRPP) is an additional funding opportunity available to small businesses, with a purpose of accelerating the transition of SBIR and STTR funded technologies to commercialization. Companies with SBIR/STTR Phase II awards resulting from Phase I awards from Program Year 2010 through 2014 are eligible to apply. The funding is a combination of additional SBIR/STTR Program investment and NASA or non-NASA entity investment. The SBIR/STTR Program will match between $500,000 and $1 million of the external investment.

You may complete the CCRPP application by logging in to the Submissions Electronic Handbook (EHB): https://sbir.gsfc.nasa.gov/submissions/public/login. You may download a copy of the application template for reference, by clicking here: https://sbir.gsfc.nasa.gov/sites/default/files/NASA_FY2019_CCRPP_Technical%20Application_Template.docx.

CCRPP Program Information

The SBIR/STTR Program is interested in advancing SBIR/STTR-developed technology through a combination of further SBIR/STTR program investment and non-SBIR/STTR program investor funds. The primary objective of the NASA CCRPP is an infusion or commercialization, not an incremental improvement in technology maturation alone. Technology maturation without infusion or commercialization will not be accepted for CCRPP. The CCRPP was created as part of the SBIR and STTR Reauthorization Act of 2012 (P. L. 112-81, Section 5001) with the purpose of accelerating the transition of SBIR and STTR funded technologies to commercialization. The CCRPP was reauthorized under the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Defense Reauthorization Act), Public Law 115-232, which was signed by the President on August 13, 2018.

Applicable Period / Solicitation	Minimum Investor Funding Required	Corresponding SBIR/STTR Program Contribution	CCRPP Application Period	Anticipated Period of Additional Performance
Phase II awards resulting from Phase I awards from Program Year 2010 – 2014 Solicitations are eligible to apply for the FY2019 CCRPP application period	$500,000	1:1 match to a maximum of $1,000,000 and a minimum of $500,000	November 5, 2018 through December 14, 2018	24 Months as a general guideline



1.0 CCRPP Guidelines

For a CCRPP award, the NASA SBIR/STTR Phase II technology proposed for advancement toward commercialization should have a strong relevance to NASA's missions, as well as a strong potential use by NASA and/or markets outside of NASA beyond the CCRPP investment. CCRPP funding is planned to be available to companies that either exercised their Phase II-E contract option or where the SBIR/STTR Phase II project has moved beyond the time window to enable those contract options (which expire once the Phase II contract is complete).

1.1 Technology Development

The technologies used by NASA require significant iterations between design, development, and testing, both at the component level and as integrated systems, before they can be used in NASA missions or applications. The iterative process between concept, design, testing, and evaluation matures technology on the Technology Readiness Level (TRL). The TRL scale is used to describe the stage of maturity in the development process from observation of basic principles through final product operation. See Table 1 for TRL descriptions.

The NASA SBIR/STTR Program funds projects to advance technologies for future NASA applications by starting from a relatively nascent stage in Phase 1, typically TRL 3. Successful Phase I projects that receive Phase II funds will often complete Phase II at TRL 5.

Many companies working on NASA SBIR or STTR projects typically face three challenges:

- Maturing their component technologies to higher TRL values
- Integrating those technologies into more complex systems
- Understanding a variety of customers beyond a potential NASA customer

1.2 Matching Funds

NASA will match the investments with SBIR/STTR program funds between $500,000 and $1 million for each CCRPP award. Eligible firms must identify an investor, obtain investment funding, and submit a letter of commitment from an investor to provide matching funds when submitting a CCRPP application. There can be more than one investor for each CCRPP application.

1.3 Anticipated Budget and Number of Awards

The anticipated budget, award number, and award value are as follows:

- Maximum NASA SBIR/STTR CCRPP expenditure for FY2019 is $6.5 million
- Quantity of Awards will depend on budget, demand, quality of applications, and non-SBIR/STTR matching amounts

Amount of award is a maximum of $2 million per award ($1 million from SBIR/STTR Program funds and $1 million from non-SBIR/STTR government funds). If the matching funds are from a non-government source,

an external arrangement between the SBC and the investor must be provided to the government for confirmation. The company, if selected for FY2019 CCRPP award, is only eligible to receive one CCRPP award.

1.4 Who May Apply for a CCRPP Award

NASA's CCRPP is available to Small Business Concerns that:

- Have a completed SBIR/STTR Phase II award selected from NASA solicitations issued from fiscal year 2010 and through 2014. However, for a NASA SBIR/STTR Phase II award from the 2014 solicitation, NASA will not require completed performance of Phase II-E or Phase II-X options associated with a NASA SBIR/STTR Phase II award
- The proposed CCRPP work should not duplicate any work being or to be performed in the Phase II-E or Phase II-X option
- Have not yet received a CCRPP award (or its equivalent) or a sequential Phase II award from any federal Agency for the Phase II technology associated with the Phase II award
- Have secured an investor(s) willing to contribute matching funding to the maturation of the technology detailed in the application of research related to NASA interests

1.5 Definition of an Investor

Investor(s) must be external to the NASA SBIR/STTR Program, which may include such entities as another company, a venture capital firm, an individual investor, a non-SBIR/STTR government program, or any combination of the above. An external investor cannot include the owners of the small business, their family members, and/or "affiliates" of the small business, as defined in Title 13 of the Code of Federal Regulations (C.F.R.), Section 121.103.

1.5.1 Specific Examples of What Does and Does Not Qualify As Investment

This section contains questions and answers regarding NASA's guidance for the types of investment from external investors that qualify as an investment under the CCRPP program. The following includes specific examples of company-investor relationships and whether these relationships qualify as a CCRPP investment or not. If you have questions about whether a particular company-investor relationship qualifies, please contact the NASA SBIR/STTR Help Desk at sbir@reisys.com or (301) 937-0888. The Help Desk will refer any policy or substantive questions to appropriate NASA personnel for an official response.

Item Number:	Question:	Answer:
1	Can a small business contribute its own internal funds to qualify for the CCRPP?	No. NASA is seeking external, third party validation of the technology, and requires that the funds come from an external investor. Please note that a subcontractor of the SBIR/STTR project will not qualify as an external investor.

2	Company A spins off company B, which wins a SBIR award. Company A then wants to contribute matching funds to qualify company B for the CCRPP. Can A be considered an external investor for purposes of the CCRPP?	In making our determination of whether company A is an external investor, we would be guided by the definition of "affiliates" in 13 C.F.R. Sec. 121.103, discussed above. Our presumption is that in this example A and B would be considered "affiliates," and that A would therefore not be an external investor for purposes of the CCRPP.
3	Small business A wins a SBIR award. The president of A is a major shareholder in another company B, which wants to contribute matching funds to qualify S for the CCRPP. Can B be considered an external investor?	Our presumption is that B would not be considered an external investor. Our determination would be guided by whether the president's stake in B is large enough that A and B would be considered "affiliates" under **13 C.F.R. Sec. 121.103 (link is external)**. Subsection (c) of Section 121.103 specifically discusses affiliation based on stock ownership: c. Affiliation based on stock ownership. A person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock. If two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern. If A and B are found to be affiliates, we would determine that B is not an external investor.
4	Does the external investor have to be a single entity (e.g., a single venture capital firm) or can it be more than one entity (e.g., two angel investors and a venture capital firm)?	It can be more than one entity.
5	Small business A contributes matching funds to small company B in order to qualify B for the CCRPP, and, at the same time, B contributes matching funds to A in order to qualify A for the CCRPP.	No. A and B's relationship is such that their investment in each other would not provide external validation of the commercial potential of their respective SBIR projects. We would therefore not consider them to be external investors for purposes of the CCRPP.

	Do A and B qualify as external investors under the CCRPP?	
6	Can a family member of an employee of small business A contribute funds to qualify A for the CCRPP?	No, except under rare circumstances. Again, we would be guided by the definition of "affiliates" in **13 C.F.R. Sec. 121.103 (link is external)**. The family member presumptively would be an affiliate of company A and not an external investor.
7	Venture capital firm A currently is a 22 percent shareholder in small company B. Can A invest additional funds in B to qualify B for the CCRPP?	Our presumption is yes. In making our determination, we would be guided by whether A and B are "affiliates," as defined in **13 C.F.R. Sec. 121.103 (link is external)**. Section 121.103 provides (in subsection (b)(5)) that a venture capital firm is not affiliated with a company if the venture capital firm does not control the company -- e.g., by owning more than 50 percent of the stock of a small company (prior to its investment under the CCRPP), as described in **13 C.F.R. 107.865 (link is external)**.
8	Large company A makes a cash investment in small company B, and then serves as a subcontractor to B on an SBIR project. Can A's investment in B count as a matching contribution for purposes of the CCRPP?	Only A's cash investment net of its subcontracting effort can count as matching funds for purposes of CCRPP. For example, if A invests $750,000 in B and subcontracts with B for $250,000, only A's net contribution ($500,000) can count as matching funds for purposes of the CCRPP.
9	Company A makes a cash investment in small company B for purposes of CCRPP, and also enters into a separate contract with B under which A provides certain goods/services to B in return for $500,000. Can A's cash investment in B count as a matching contribution for purposes of the CCRPP?	As in the previous example, only A's cash investment net of the $500,000 it receives from B can count as matching funds for purposes of the CCRPP.
10	A group of investors wishes to invest funds in small company A to qualify A for the CCRPP. One of the investors is a family member of A's president, who wants to contribute $50,000 toward the	The family member's investment of $50,000 does not count, as the family member is not an external investor (see item (6) above). Contributions of the other investors can count provided that they meet the other conditions for the CCRPP (e.g., each must be an external investor).

	effort. Can the group's investment in A count as a matching contribution to qualify A for the CCRPP?	
11	Can a loan from an external party qualify as an "investment" for purposes of the CCRPP?	No. The rationale behind the CCRPP is that an external party is betting on the company's success in bringing the technology to market as an investor, not just its ability to recover a loan as a lender.
12	How about a loan that is convertible to equity?	A loan that is convertible to equity at the company's discretion would count as an investment under the following circumstances: (1) the loan is provided by a public entity (e.g., a state agency), or (2) the loan is provided by a private entity, and the SBIR company actually converts the loan to equity before the CCRPP contract is executed.
13	Can in-kind contributions from an external investor count as matching funds under the CCRPP?	No. The matching contribution must be in funds, regardless of source. A cash contribution is a stronger signal of the external investor's interest in the technology, and can be readily verified.
14	Can purchases of a purchase order from an external investor count as a matching contribution under the CCRPP?	No. Purchases will not be considered an investment, since a purchase may only represent a procurement need, not a desire to further the technology. Refer to question 15.
15	If large company A pays small company B for work related to B's SBIR project and expects a deliverable (goods or services) from B in return, would that qualify as an "investment"?	This arrangement would not qualify as an investment for the same reason a loan does not qualify. Specifically, in this situation the large company is not betting on the small company's success in bringing the technology to market, but merely is looking to purchase a deliverable. Refer to item 14.
16	Can entity A's investment in small company B during the first month of B's Phase I SBIR project count as a matching contribution to qualify B for the CCRPP?	No. The investment must occur within 45 days of the company's notification of selection, without constraints.
17	Small company A is collaborating with a university on an STTR project. Investor B wishes to provide funds to the university in order to qualify A for the STTR CCRPP.	In order to qualify A for the STTR CCRPP, B's investment of funds must be in small company A, not in the university. A can then subcontract some of the funds to the university.

	Can B's investment in the university count as a matching contribution to qualify A for the CCRPP?	
18	Must the activities funded by the investor be explained in the application's statement of work for the small company's CCRPP?	Yes. The external investor's funds must pay for activities that further the development and/or commercialization of the company's Phase II work. Including this information in the application assists with verification.
19	Our small business has existing contracts and/or grants. Can these count as matching investments?	Yes, if the existing contract or grant is directly related to the CCRPP work proposed and the money targeted for the CCRPP effort has not yet been spent; e.g., a Phase III contract for the same technology or a modification and funding for another contract that specifically relates to the technology. Generally these must be awarded after the CCRPP application is submitted to be considered a matching investment.

2.0 General Guidance on What Qualifies As Investment

The investment must be used to fund work that directly furthers the work done in the Phase II.

Commitment must be made prior to the award, but the expenditure must be concurrent with the CCRPP performance. The Federal Agency or NASA internal investor's funds must pay for activities that further the development and/or commercialization of the company's SBIR/STTR technology beyond the Phase II work (e.g., further R&D, manufacturing, marketing, etc.).

Non-Federal agency investments must be an arrangement in which the external investor provides funding to the small business in return for such items as: equity, a share of royalties, rights in the technology, a percentage of profit, or any combination of the above. Additional funding associated with CCRPP shall further the technology of the original SBIR Phase II contract.

For investments from sources external to the Federal Government, NASA considers factors such as ownership, management, previous relationships with or ties to another concern and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, may be treated as one party with such interests aggregated.

2.1 Investor Letter Guidelines

A letter of commitment from the investor shall be provided during the application period (similar documentation without a corresponding commitment letter will not be accepted). Please use this **document** as a template.

The letter of commitment must contain the following information:

- The investor contact information including their business address, title, email address, phone number, signature, and be on official letterhead
- The investor's willingness to verify the commitment
- The total amount of the investment, accompanying an acknowledgment that the investment is being made in response to and referencing the company's specific Phase II R&D effort
- An acknowledgment that the entire amount of unencumbered matching funds will be available and transferred within 45 days of the small business notification that it has been selected for a CCRPP Contract without constraints
- Indicate if the investor is also the customer for this CCRPP project as described in the technical application form
    - Describe how the investor/customer plans to use or deploy the technology
- Descriptive statement of Minimum Acceptable Readiness level, broken out by Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL) at end of CCRPP effort. See **Table 1** for TRL descriptions and **Table 2** for MRL descriptions
- Statement of investment use and timeline of need
    - For an investment from NASA or other Government agency, the statement shall include a brief statement of how the resulting CCRPP technology will be integrated into the program's or agency's future activities, and if future funding to the Small Business Concern is planned or expected above and beyond the CCRPP effort. Include a brief statement of the impact of this project on the Agency
    - For investment(s) from a private sector investor, it should include a brief statement of how the investment will further the technology originally proposed in the Phase II, or the commercialization of a product resulting from the Phase II. Include a brief statement of the anticipated impact of this project
    - Timeline on dates when the investor or identified customer needs the resulting technology or product.

- https://sbir.gsfc.nasa.gov/sites/default/files/NASA_FY2019_CCRPP_Technical%20Application_Template.docx

3.0 Application Requirements

What needs to be submitted online for a CCRPP Application?

The following items must be submitted electronically:

- Firm Certifications: Provide information about the Firm. Firm Certifications are collected at the Firm level and are applicable to all applications.
- Audit Information: Provide audit information about the Firm. Audit Information is collected at the Firm level and is applicable to all applications.
- Prior Awards Addendum: Provide information about prior Phase I/II awards. Prior Awards Addendum is required if the Firm has received more than 15 SBIR or STTR Phase II in the prior five fiscal years.

- Commercial Metrics Survey: Provide information about Phase I/II awards, Phase II project commercialization information, a brief commercialization narrative, and a POC to verify/maintain the commercialization information.
- Contact Information: Provide contact information for the Authorized Contract Negotiator (ACN), Principal Investigator (PI) and Business Official (BO) for the application
- Application Certifications: Provide information about the application. Application Certifications are collected at an application level and applicable only to the application it is completed for.Application Summary: Provide the TRL, a brief summary of the application, and potential NASA- and Non-NASA applications.
- CCRPP Technical Application: Provide the rationale, strategy, actions, roles and responsibilities of participants to mature the identified SBIR/STTR technology product and/or service for the specified application and customer. **Note**: This form must be completed offline and uploaded as part of the application. Please use this **document** as a template.
- Application Budget: Provide the budget summary including estimated costs with detailed information for Direct Labor, Overhead, ODCs, Subcontractors/Consultants, G&A, Profit/Cost Sharing, and the Investor(s).
- Briefing Chart: Provide brief information on Identification and Significance of Innovation, Technical Objectives, Work Plan Summary and Proposed Deliverables, NASA Applications, Non-NASA Applications, and Firm Contact.
- Letter of Commitment: Provide a letter of commitment from the Investor. This is an agreement between the applicant and the investor that the SBIR/STTR project has demonstrated sufficient results and that expansion and acceleration of project efforts in line with NASA interests are justified. A letter of commitment is required from each Investor of the project effort. Please use this **document** as a template.

Application Format Requirements

A CCRPP application shall not exceed a total of 33 standard 8 1/2 x 11 inch (21.6 x 27.9 cm) pages, inclusive of the technical content and the required forms. Application Certifications, Application Summary, and Application Budget count as one page each, regardless of whether the completed forms print as more than one page. Each page shall be numbered consecutively at the bottom. Margins shall be 1.0 inch (2.5 cm). All required items of information must be covered in the application and will count towards the total page count. The space allocated to each part of the technical content will depend on the project chosen and the applicant's approach.

Note: The Government administratively screens all applications and reserves the right to reject any application that does not conform to following formatting requirements.

3.1 Definitions

Brassboard: A medium fidelity functional unit that typically tries to make use of as much operational hardware/software as possible and begins to address scaling issues associated with the operational system. It does not have the engineering pedigree in all aspects, but is structured to be able to operate in simulated operational environments in order to assess performance of critical functions

Breadboard: A low fidelity unit that demonstrates function only, without respect to form or fit in the case of hardware, or platform in the case of software. It often uses commercial and/or ad hoc components and is not intended to provide definitive information regarding operational performance

Engineering Unit: A high fidelity unit that demonstrates critical aspects of the engineering processes involved in the development of the operational unit. Engineering test units are intended to closely resemble the final product (hardware/software) to the maximum extent possible and are built and tested so as to establish confidence that the design will function in the expected environments. In some cases, the engineering unit will become the final product, assuming proper traceability has been exercised over the components and hardware handling

Laboratory Environment: An environment that does not address in any manner the environment to be encountered by the system, subsystem, or component (hardware or software) during its intended operation. Tests in a laboratory environment are solely for the purpose of demonstrating the underlying principles of technical performance (functions), without respect to the impact of environment

Manufacturability: Extent to which a good can be manufactured with relative ease at minimum cost and maximum reliability. The general engineering art of designing products in such a way that they are easy to manufacture

Mission Configuration: The final architecture/system design of the product that will be used in the operational environment. If the product is a subsystem/component, then it is embedded in the actual system in the actual configuration used in operation

Operational Environment: The environment in which the final product will be operated. In the case of space flight hardware/software, it is space. In the case of ground-based or airborne systems that are not directed toward space flight, it will be the environments defined by the scope of operations. For software, the environment will be defined by the operational platform

Proof of Concept: Analytical and experimental demonstration of hardware/software concepts that may or may not be incorporated into subsequent development and/or operational units

Proto-type Unit: The prototype unit demonstrates form, fit, and function at a scale deemed to be representative of the final product operating in its operational environment. A subscale test article provides fidelity sufficient to permit validation of analytical models capable of predicting the behavior of full-scale systems in an operational environment

Relevant Environment: Not all systems, subsystems, and/or components need to be operated in the operational environment in order to satisfactorily address performance margin requirements. Consequently, the relevant environment is the specific subset of the operational environment that is required to demonstrate critical "at risk" aspects of the final product performance in an operational environment. It is an environment that focuses specifically on "stressing" the technology advance in question

3.2 Technology Readiness Level (TRL) Descriptions

The TRL describes the stage of maturity in the development process from observation of basic principles through final product operation. Exit criteria, documenting principles and concepts, determine when applications or performance have been satisfactorily demonstrated in the appropriate environment required for that level, as shown in the table below.

Table 1: TRL Descriptions

TRL	Definition	Hardware Description	Software Description	Exit Criteria
1	Basic principles observed and reported	Scientific knowledge generated underpinning hardware technology concepts/applications	Scientific knowledge generated underpinning basic properties of software architecture and mathematical formulation	Peer reviewed publication of research underlying the proposed concept/application
2	Technology concept and/or application formulated	Invention begins, practical application is identified but is speculative, no experimental proof or detailed analysis is available to support the conjecture	Practical application is identified but is speculative, no experimental proof or detailed analysis is available to support the conjecture. Basic properties of algorithms, representations and concepts defined. Basic principles coded. Experiments performed with synthetic data	Documented description of the application/concept that addresses feasibility and benefit
3	Analytical and experimental critical function and/or characteristic proof of concept	Analytical studies place the technology in an appropriate context and laboratory demonstrations, modeling and simulation validate analytical prediction	Development of limited functionality to validate critical properties and predictions using non-integrated software components	Documented analytical/experi-mental results validating predictions of key parameters
4	Component and/or breadboard validation in laboratory environment	A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments, and associated performance predictions are defined	Key, functionally critical, software components are integrated, and functionally validated, to establish interoperability and begin architecture development. Relevant Environments	Documented test performance demonstrating agreement with analytical predictions. Documented definition

		relative to the final operating environment	defined and performance in this environment predicted.	of relevant environment.
5	Component and/or breadboard validation in relevant environment	A medium fidelity system/component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realistic support elements that demonstrates overall performance in critical areas. Performance predictions are made for subsequent development phases.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system, tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.
6	System/sub-system model or prototype demonstration in a relevant environment	A high fidelity system/component prototype that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype implementations of the software demonstrated on full-scale realistic problems. Partially integrate with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions
7	System prototype demonstration in an operational environment	A high fidelity engineering unit that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate performance in the actual operational environment and platform (ground, airborne, or space)	Prototype software exists having all key functionality available for demonstration and test. Well integrated with operational hardware/software systems demonstrating operational feasibility. Most software bugs removed. Limited documentation available.	Documented test performance demonstrating agreement with analytical predictions
8	Actual system completed and "flight qualified"	All software has been thoroughly debugged and fully integrated with all operational hardware and software systems. All user	Prototype software exists having all key functionality available for demonstration and test. Well integrated with operational	Documented test performance demonstrating

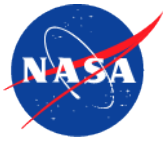
	through test and demonstration	documentation, training documentation, and maintenance documentation completed. All functionality successfully demonstrated in simulated operational scenarios. Verification and Validation (V&V) completed.	hardware/software systems demonstrating operational feasibility. Most software bugs removed. Limited documentation available.	agreement with analytical predictions
9	Actual system flight proven through successful mission operations	The final product is successfully operated in an actual mission	All software has been thoroughly debugged and fully integrated with all operational hardware/software systems. All documentation has been completed. Sustaining software engineering support is in place. System has been successfully operated in the operational environment.	Documented mission operational results

3.3 Manufacturing Readiness Level (MRL) Descriptions

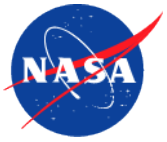
Table 2: MRL Descriptions

Stage	MRL	Definition	Description
Material Solutions Analysis	1	Basic manufacturing implications identified	Basic research expands scientific principles that may have manufacturing implications. The focus is on a high level assessment of manufacturing opportunities. The research is unfettered.
	2	Manufacturing concepts identified	Invention begins. Manufacturing science and/or concept described in application context. Identification of material and process approaches are limited to paper studies and

			analysis. Initial manufacturing feasibility and issues are emerging.
	3	Manufacturing proof of concept developed	Conduct analytical or laboratory experiments to validate paper studies. Experimental hardware or processes have been created, but are not yet integrated or representative. Materials and/or processes have been characterized for manufacturability and availability but further evaluation and demonstration is required.
	4	Capability to produce the technology in a laboratory environment	Required investments, such as manufacturing technology development identified. Processes to ensure manufacturability and quality are in place and are sufficient to produce technology demonstrators. Manufacturing risks identified for prototype build. Manufacturing cost drivers identified. Manufacturability assessments of design concepts have been completed. Key design performance parameters identified. Special needs identified for tooling, facilities, material handling and skills.
Technology Development	5	Capability to produce prototype components in a production relevant environment	Manufacturing strategy refined and integrated with Risk Management Plan. Identification of enabling/critical technologies and components is complete. Prototype materials, tooling and test equipment, as well as personnel skills, have been demonstrated on components in a production relevant environment, but many manufacturing processes and procedures are still in development.



			Manufacturing technology development efforts initiated or ongoing. Manufacturability assessments of key technologies and components ongoing. Cost model based upon detailed end-to-end value stream map.
	6	Capability to produce a prototype system or subsystem in a production relevant environment	Initial manufacturing approach developed. Majority of manufacturing processes have been defined and characterized, but there are still significant engineering/design changes. Preliminary design of critical components completed. Manufacturability assessments of key technologies complete. Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated on subsystems/ systems in a production relevant environment. Detailed cost analysis includes design trades. Cost targets allocated. Manufacturability considerations shape system development plans. Long lead and key supply chain elements identified. Industrial Capabilities Assessment for Milestone B completed.
Engineering and Manufacturing Development	7	Capability to produce systems, subsystems or components in a production representative environment	Detailed design is underway. Material specifications are approved. Materials available to meet planned pilot line build schedule. Manufacturing processes and procedures demonstrated in a production representative environment. Detailed manufacturability trade studies and risk assessments underway. Cost



			models updated with detailed designs, rolled up to system level and tracked against targets. Unit cost reduction efforts underway. Supply chain and supplier Quality Assurance assessed. Long lead procurement plans in place. Production tooling and test equipment design and development initiated.
	8	Pilot line capability demonstrated. Ready to begin low rate production.	Detailed system design essentially complete and sufficiently stable to enter low rate production. All materials are available to meet planned low rate production schedule. Manufacturing and quality processes and procedures proven in a pilot line environment, under control and ready for low rate production. Known manufacturability risks pose no significant risk for low rate production. Engineering cost model driven by detailed design and validated. Supply chain established and stable. Industrial Capabilities Assessment for Milestone C completed.
Production and Deployment	9	Low Rate Production demonstrated. Capability in place to begin Full Rate Production.	Major system design features are stable and proven in test and evaluation. Materials are available to meet planned rate production schedules. Manufacturing processes and procedures are established and controlled to three-sigma or some other appropriate quality level to meet design key characteristic tolerances in a low rate production environment. Production risk monitoring ongoing. LIRP(link is external) cost goals met, learning

			curve validated. Actual cost model developed for Full Rate Production environment, with impact of Continuous improvement.
Operations and Support	10	Low Rate Production demonstrated. Capability in place to begin Full Rate Production.	This is the highest level of production readiness. Engineering/design changes are few and generally limited to quality and cost improvements. System, components or items are in rate production and meet all engineering, performance, quality and reliability requirements. All materials, manufacturing processes and procedures, inspection and test equipment are in production and controlled to six-sigma or some other appropriate quality level. Full Rate Production unit cost meets goal, and funding is sufficient for production at required rates. Lean practices well established and continuous process improvements ongoing.