

U.S. Army Contracting Command – Red River Army Depot (ACC-RRAD)

Organic Industrial Base (OIB) Modernization Commercial Solutions Opening (CSO)

Solicitation Number: W911RQ-21-S-C001

1. General Information

1.1 Authority

The 2014 Quadrennial Defense Review (QDR) established innovation as a central line of effort in the national defense strategy of the United States. The decisive military advantage of the United States over its adversaries and peer competitors is steadily eroding. Consequently, under section 879 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2017 (Pub. L. 114-328) contracting officers may acquire innovative commercial items, technologies, or services using a competitive procedure called a Commercial Solutions Opening (CSO). Under a CSO, the Department of Defense may competitively select proposals received in response to a general solicitation, similar to a broad agency announcement, based on a review of proposals by scientific, technological, or other subject-matter expert peers. **Use of a CSO in accordance with Class Deviation 2022-O0007 is considered to be a competitive procedure for the purposes of 10 U.S.C. chapter 221 and FAR 6.102.** Finally, Contracting Officers shall treat items, technologies, and services acquired using a CSO as commercial items. Contracts or agreements under this authority shall be fixed-price, including fixed-price incentive fee contracts.

1.2 Background

The U.S. Army recognizes that investments in producibility and advanced manufacturing will need to continue to be made to support a vast array of crucial activities, including but not limited to acquisition, sustainment, logistics, and ultimately the Army's Modernization of its Organic Industrial base (OIB). In order to deliver impactful operational results, the US Army must modernize the OIB, particularly in the areas of Agile / flexible facilities, connected digital enterprise, advanced manufacturing, Digital Twin, automation, and cyber security. DEVCOM has coined these technologies collectively as Convergent Manufacturing.

With the focus on both “new capabilities” and “operational constructs” convergent manufacturing technologies will accelerate the OIB's capability to get advanced solutions to the Warfighter while enhancing and optimizing the Defense Manufacturing Base for today and tomorrow's missions.

Manufacturing excellence is critical for Army technology dominance and force projection to increase the “Speed of Battle.”

This CSO will utilize a solicitation process authorized by Section 879 of the National Defense Authorization Act (NDAA) for Fiscal Year 2017 (Pub. L. 114-328) and implemented through DFARS Deviation 2018-O0016. Under this CSO, the DoD will be allowed to competitively procure innovative commercial items, technologies, and services. CSO procedures provide a streamlined acquisition process and simplified contract terms resulting in FAR-based contracts awarded under Part 12 Commercial Item Procedures. Both traditional and non-traditional defense contractors may be awarded contracts under this CSO. Under a CSO DoD contracting officers may competitively select proposals received in response to a general competitive solicitation, similar to a broad agency announcement, based on a review of proposals by scientific, technological, or other subject matter experts.

1.3 CSO Procedure

This CSO is a competitive solicitation posted on a Government Point of Entry (GPE) www.sam.gov continuously open until September 30, 2022. The government reserves the right to extend this CSO beyond the open until date by amendment if the authority is extended. Under this CSO the DoD may seek solution briefs, presentations/pitches and/or proposals from traditional and nontraditional business entities. This CSO is intended to seek proposals for innovative, commercial products, commercial technologies and services or adaptations/modifications of existing commercial product technologies and services to enable the seamless integration of manufacturing resources from across the enterprise to meet U.S. Army needs. This include, but are not limited to, the linking of legacy analogue manufacturing systems with modern digital systems, the expansion of modeling and simulation to speed up decision making and the ability to deliver the right materiel solution to the soldier at the right time and in the right place. This CSO may result in the award of various types of contracts, which may include but are not limited to commercially-available technologies immediately available, commercially-available technologies fueled by commercial or strategic investment, but also concept demonstrations, pilots, and agile development activities that can incrementally improve commercial technologies, existing government-owned capabilities, or concepts for broad defense applications. The government intends to award FAR-based contracts under Part 12 Commercial Item Procedures, but reserves the right to award additional types of contracts depending on the specific Area of Interest (AoI) and industrial base responses to the AoI.

The CSO solicitation process may include a multi-phased solicitation and evaluation approach that is dependent upon specific AoIs. The AoIs are focused topic(s)/categories that will be published separately via the GPE at www.beta.sam.gov. The following phases may be used: Phase 1 – Submission of written solution brief, Phase 2 – Presentation/Pitch (if applicable), and Phase 3 – Request for Commercial Solution Proposal (CSP). A CSO is considered a competitive process, intended to ensure that competitive procedures are used to the maximum extent practicable. All solution briefs, presentations/pitches and/or proposals submitted in response to any AoI will be in response to and governed by this CSO.

The CSO outlines the procedures that are available for utilization by the government for AoIs to ensure a competitive process is followed. The competitive process under this CSO may result in a two or three phase approach (solution brief, presentation/pitch (if applicable), and a full written proposal):

Phase 1 solution briefs: A solution brief must be submitted as specified in Sections 3.2 of this CSO. The government will evaluate solution briefs against the criteria stated in this CSO. The government will not pay companies for the costs associated with solution brief submissions.

Phase 2 Presentations/Pitches (if applicable): Companies who's solution briefs are evaluated to be of merit, may be invited to provide a pitch following the instructions provided in Sections 3.3 of this CSO. In the event that the government requires a demonstration, additional information will be provided in the specific AoI highlighting those procedures, otherwise Phase 2 will be comprised solely of the presentation/pitch. The government reserves the right to request additional technical information to determine if a company has a viable solution for the government's specific AoI. The government will not pay companies for costs associated with pitches, unless otherwise stipulated.

Phase 3 Request for Commercial Solution Proposal (CSP): Those companies that are evaluated to be of merit through Phase 1 or Phase 2 or a combination of these avenues, may be invited to submit a full written proposal following the instructions provided in Section 3.4 of this CSO. RFPs under this CSO are subject to the availability of government funds. The government will not pay companies for costs associated with developing submissions in regards to this CSO or resulting AoI, unless otherwise stipulated within the AoI.

NOTE: The government reserves the right to forgo Phase 2 by directly requesting CSPs from “all or some” of the proposed solutions based on the individual merits. The government also reserves the right to move expeditiously through the phases based on the merit of submissions if urgent requirements arise.

The government may add AoIs against this CSO at any time throughout its duration. Interested companies are encouraged to frequently check the GPE website for new AoI postings.

Benefits of the CSO process and the potential for award include:

1. A streamlined application process requiring only minimal corporate and technical information for fast track evaluation timelines for Solutions Briefs.
2. Negotiable payment terms for non-dilutive capital.
3. Negotiable intellectual property (IP) rights.
4. Secure and direct feedback from end users, mission partners and users within the DoD to help product teams develop and hone product design and functionality.
5. Each proposal is evaluated on its individual merits rather than on a comparative basis.

NOTE: During any step of the CSO, the government may send questions or comments for the offerors to address via email.

2. Definitions

1. “Area of Interest” (AoI) means an announcement posted on the GPE website, which may result in the award of various types of contracts that will be dependent on the specific AoI requirement.
2. “Commercial Solutions Opening” (CSO) is a competitive procedure contracting officers may use to acquire innovative commercial items, technologies, or services.
3. Commercial Solution Proposal (CSP): is a commercial proposal that is submitted in response to an AoI that is governed by a CSO. CSPs may be requested as a result of solution briefs and/or presentations/pitches.
4. “Nontraditional Defense Contractor” is defined in 10 U.S.C. § 2302(9) as an entity that is not currently performing and has not performed, for a least the one-year period preceding the solicitation of sources by the DoD for the procurement or transaction, any contract or subcontract for the DoD that is subject to full coverage under the cost accounting standards prescribed pursuant to 41 U.S.C. § 1502 and the regulations implementing such section. This includes all small business concerns under the criteria and size standards in 13 C.F.R. § 121.
5. “Nonprofit Research Institution” means a nonprofit institution, as defined in 15 U.S.C. § 3703 as an organization owned and operated exclusively for scientific or educational purposes, no part of the net earnings of which ensures to the benefit of any private shareholder or individual.
6. “Small Business Concerns” is defined in the Small Business Act (15 U.S.C 632).
7. “Innovative” means any item that is—

- a. A commercially available technology, process, or method, that allows for expeditious production/distribution that is new as of the date of submission of proposal; or
- b. A new technology, process, or method, including research and development that is new as of the date of submission of proposal; or
- c. A new application or adaptation of an existing technology, process, or method as of the date of submission of a proposal; or
- d. An existing item within the production/commercialization phase (i.e. after design or development, and before widespread government adoption) as well as adaptations of existing commercial products.

3. Guidelines for Solution Briefs, Pitches, and Proposals

3.1 General Guidelines

Unnecessarily elaborate brochures or proposals are not desired.

When applicable, use of a diagram(s) or figure(s) to depict to the essence of the proposed solution is strongly encouraged.

Companies may submit multiple solution briefs in response to any single AoI if each submission represents a separate and distinct concept. Individual solution briefs may only address one concept based on the stated AoI.

The period of performance for any solution brief or CSP submitted under this CSO should generally be no greater than 12 months (unless otherwise specified in the AoI).

Technical data with military application may require approval, authorization, or license for lawful exportation.

All solution briefs, presentations/pitches, and proposals must be unclassified. Do NOT mark any documents as "CONFIDENTIAL". solution briefs, presentations/pitches, and proposals containing data that is not to be disclosed to the public for any purpose or use by the government except for evaluation purposes shall include the following general disclaimer on the cover page: "This [select one: solution brief, Presentation/Pitch, or Proposal] includes data that shall not be disclosed outside the government , except to non-government personnel for evaluation purposes, and shall not be duplicated, used, or disclosed -- in whole or in part -- for any purpose other than to evaluate this submission. If, however, an agreement is awarded to this company as a result of -- or in connection with -- the submission of this data, the government shall have the right to duplicate, use, or disclose the data to the extent agreed upon by both parties in the resulting agreement. This restriction does not limit the government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in sheets [insert numbers or other identification of sheets]"

Recommended marking (header or footer) for portions of business plans and/or technical information that are to be protected for a period of five years from FOIA disclosure:

"5 U.S.C. §552, provides that disclosure of certain types of information (i.e. trade secrets and commercial or financial information) is not required, and may not be compelled, for five years after the date on which the information is received by the Department of Defense."

NOTE: Foreign-Owned businesses may independently submit a solution or do so as part of a teaming arrangement with one or more United States-Owned businesses. However, the ability to obtain an agreement based upon a submission may depend upon the ability of the Foreign-Owned business to obtain necessary clearances and approvals to obtain proscribed information.

Questions regarding the objectives or preparation of the solution brief should be addressed to the POCs listed in the respective AoI.

Submissions must be submitted electronically as prescribed in the respective AoI.

Submission sent through other channels or after the prescribed AoI open period has ended will not be considered, reviewed nor evaluated.

Entities submitting solution briefs that are not chosen for the presentation/pitch phase or the CSP phase will be notified in writing as soon as practicable. Further verbal feedback may be provided, upon request, at the Contracting/Agreements Officer's discretion.

3.2 Phase 1 Solution Brief:

3.2.1 Phase 1 Solution Brief Content:

Solution briefs should not exceed five (5) single-sided written pages using 12-point font or, alternatively, solution briefs may take the form of briefing slides which should not exceed fifteen (15) slides unless otherwise stated on the subject AoI.

Solution briefs must include the following:

1. Company Name, Title, Date, Point of Contact Name, E-Mail Address, Phone, and Address. Specifically identify the AoI for which the solution brief is submitted.
2. Executive Summary: Provide an executive summary of the technology or service. (This is included in the 5 written pages limit).
3. Technology Concept: Show and/or describe how your proposed solution or potential new capabilities represent an application of innovative commercial products, innovative commercial technologies and services or adaptations/modifications of existing commercial product technologies and services to the AoI. Describe the unique aspects of your technology and the proposed work as it relates to the AoI. Identify whether the effort includes the pilot or demonstration of existing commercial technology (identified as commercially ready and viable technology), or the development of technology for potential defense application. If development or adaptation is proposed, identify a suggested path to mature the technology. Identify aspects of your proposal, to include date and software, which may be considered proprietary.
4. Price: Provide a rough order of magnitude price for the proposed solution, and include desired payment terms.

NOTE: The title page does not count against page limit, however, the executive summary does.

3.2.2 Phase 1 Solution Brief Basis of Evaluation:

Solution brief evaluation criteria are listed in order of importance from top to bottom. Individual solution briefs will be evaluated against the evaluation criteria described below:

1. Responsiveness of the solution brief in addressing the AoI with a commercially available product and/or process readily available to meet the immediate needs;
2. The technical merit of the proposed solution, including the extent to which the proposed solution is unique, and/or innovative to government application.; and
3. The extent to which funding is available for the proposed effort.

Solution briefs will be evaluated on the evaluation criteria listed above, not against other solution briefs submitted in response to the same AoI. The government may elect to use external market research in the evaluation of a company's viability. The government reserves the right to select "all, some, or none" of the solution briefs submitted in response to the AoI. The government will endeavor to complete the Phase 1 evaluation of solution briefs within 30 calendar days of the closing of the submittal period and will attempt to notify the company of the results of the evaluation as soon as practicable.

Additional technical evaluation criteria specific to a particular project may be used. In these instances, the additional criteria will be posted within or as an attachment to the AoI on the GPE website.

Upon review of a solution brief, the government may elect to invite "all, some or none" of the proposed solutions into Phase 2, the presentation/pitch or directly request CSPs based on the merits of the solution brief. In Phase 2, companies are invited to pitch and further discuss their proposed concept/technology/solution in person or virtually. During Phase 2, the government may request and/or provide additional information to the company.

3.3 Phase 2 Presentation/Pitch (if applicable):

3.3.1 Phase 2 Presentation/Pitch Content:

In Phase 2 if applicable, companies must provide a presentation/pitch to demonstrate and provide further details on the technical and business viability of their proposed solution. The government reserves the right to request an in-person, virtual or paper presentation depending on the specific requirement. Specific requirements of the pitch will be covered in the AoI. In the event that the government requires a demonstration, additional information will be provided in the specific AoI highlighting those procedures, otherwise Phase 2 will be comprised solely of the presentation/pitch. In addition to the presentation/pitch, the government, at its discretion, may request an additional written submission to supplement/clarify the information provided in the Phase 1 solution brief. During the Phase 2 presentation/pitch, the company must detail/address the following:

A description or demonstration of how the proposed solution represents an innovative application of commercial technology to the AoI.

1. A rough order of magnitude (ROM) price and notional schedule.
2. Any Intellectual Property (IP) involved in the effort and associated restrictions on the government's use of that IP.

3. Additional information/detail from the company's Phase 1 solution brief, as specified in the government's invitation to Phase 2.

3.3.2 Phase 2 Presentation/Pitch Basis of Evaluation:

Individual presentations/pitches will be evaluated against the evaluation criteria below and not against any other presentations/pitches held under the same AoI. Presentation/pitch submissions will be valid for 90 days after pitch evaluation. The government will aim to complete evaluation of presentation/pitches within 30 calendar days of the presentation/pitch. Individual Review Panels (IRP) will be determined for each AoI posted under this CSO. After completing the evaluation of presentation/pitch submissions, the government will notify the company that: they may submit a CSP for evaluation in Phase 3; their proposed concept/technology/solution is not of continued interest to the government and they will not be required to submit a CSP Phase 3 CSP for evaluation; or their proposed concept/technology/solution is of continued interest to the government, but is not currently eligible for an invitation to Phase 3 CSP submission due to the current lack of government resources and/or funding.

NOTE: 120 days after presentation/pitch evaluation, if government funding or resources are not assigned to a Phase 3 CSP, the government will provide a notification of non-eligibility and officially close the AoI selection process.

Presentation/Pitch evaluation criteria are listed in order of importance from top to bottom. Presentation/pitches shall be evaluated/scored on the following factors:

1. Level of relevancy of the solution in addressing the AoI with a commercially available product and/or process;
2. The technical merit of the proposed solution adequately addressed the AoI need(s) and demonstrated feasibility for the government to pursue the proposed solution;
3. Level of uniqueness, and/or innovative approach to solve the government's need;
4. Level of technical risk/maturity;
5. Level of risk placed with the proposed ROM;
6. Level of risk in the proposed milestone schedule and its ability to meet the AoI need within a relevant time period;
7. Level of risk in the company's viability and business solution; and
8. Level of potential risk in anticipated IP and data rights assertions

3.4 Phase 3 Proposal:

The third and final Phase of the CSO process is the CSP. Through AoIs, offeror(s) will be invited to submit a CSP based on the defined CSO phased approach that will be utilized. Offerors must ensure that the CSP is valid for at least 120 days from the submission date. If necessary offerors invited to submit a CSP may be advised to schedule a teleconference with technical and contracting staff to address any feedback contained in the request for CSP. The CSP must be prepared in two separate Volumes as follows: Volume I Technical and Volume II Price. Each Volume will have its separate related Attachments. Additional applicable forms will be provided in the AoI.

3.4.1 Phase 3 Proposal Content

Based upon the results of market research, Phase 1 and/or Phase 2 evaluation(s) above, the government may request a CSP. If that occurs, a company, or companies will be invited to develop and submit a written proposal as well as negotiate appropriate terms and conditions, as applicable, governing the requirement. At this stage, the selected companies may discuss proposal development details during the proposal writing process with their assigned government expert(s) or government teaming partner(s).

Additionally, companies are invited to provide their own internal terms and conditions that may be consolidated with those of the government. This includes, but is not limited to, Service License Agreements (SLA) and/or User License Agreements (ULA).

Companies should note that there are certain terms and conditions the government may be unable to accept. However, projects awarded through the CSO may provide flexibility to adopt customary industry standards where it is otherwise legal and meets the government's general public responsibility.

3.4.1.1 Section 1 Technical Proposal Volume:

Offerors must not include any cost information in the Technical Proposal Volume.

The technical volume must include a detailed work plan indicating how each aspect of the objectives is to be accomplished. The technical volume should be in as much detail as the offeror considers necessary to fully explain its proposed technical approach or method, including all assumptions utilized to develop its proposed solution and associated costs. The technical volume should reflect a clear understanding of the nature of the work being undertaken. The technical volume must include information on how the project will be organized, staffed, and managed. Information should be provided that demonstrates your understanding and management of important events or tasks. The technical volume must include a list of suggested deliverables and deliverable dates.

NOTE: The government reserves the right to further define the required technical proposal content based upon the specific AoI requirements.

3.4.1.2 Section 2 Price Proposal Volume:

The price volume must contain sufficient information to allow the government to perform a basic analysis of the proposed cost or price of the work. If the proposal includes a time and materials contract line item, the proposal must include labor categories and corresponding number of direct labor hours; fixed hourly rates that include wages, overhead, general and administrative expenses, and profit; and costs for materials, supported by vendor quotes, supplier agreements or other bases of estimate. The government reserves the right to request any other price data or supporting cost information the government deems necessary to determine the total overall price is fair and reasonable. This can include but is not limited to commercial price catalog(s), previous commercial sales receipts, and/or other proprietary information to help the government determine reasonableness and future budgetary cost estimates.

NOTE: The cost of preparing proposals in response to this CSO is NOT considered a direct charge to any resulting AoI award or any other contract. Proposal preparation costs are not recoverable.

NOTE: The government reserves the right to further define the required price proposal content based upon the specific AoI requirements.

3.4.2 Proposal Basis of Evaluation:

Proposals will be reviewed as received by a government subject matter expert(s). In all cases, proprietary information shall be protected from competitors. The CSO evaluation criteria is listed in order of importance from top to bottom. The government subject matter expert(s) will first review the proposal for adequacy and eligibility to determine the extent to which the following requirements are met:

1. The merit and risk elements of the proposed technical approach are acceptable and address the priorities outlined in the AoIs;
2. The proposal performance schedule is realistic and/or adequate; and,
3. The proposed price is fair and reasonable.

NOTE: The government reserves the right to further define the basis for evaluation based upon the specific AoI requirements.

3.4.3 Proposal Evaluation Rating:

1. The Technical Proposal Volume will be evaluated and categorized as follows:
 - a. **Acceptable:** The proposal has been evaluated and deemed appropriate for additional consideration and discussion. The proposal is generally considered well-conceived, scientifically or technically sound, and important to program goals and objectives. Proposal submissions given this designation may proceed into negotiations or directly to the award process.

Note: An acceptable rating does not guarantee contract award. The following will be taken into consideration: program priorities, negotiations, and availability of funds.
 - b. **Unacceptable:** The proposal has been evaluated and deemed inappropriate for additional consideration and discussion at this time. Proposals given this designation are not technically sound or do not meet program priorities and will be rejected.
2. The Price Proposal Volume will be evaluated and categorized as follows:
 - a. **Fair and Reasonable:** The price proposal has been evaluated and deemed fair and reasonable. Proposal submissions given this designation may proceed to the award process

Note: A fair and reasonable price determination does not guarantee contract award. The following will be taken into consideration: program priorities, negotiations, and availability of funds.
 - b. **Not Fair and Reasonable:** The price proposal has been evaluated and deemed to not be fair and reasonable. Proposal submissions given this designation may not proceed to the award process without negotiations that result in a fair and reasonable determination.

4. Awards

4.1 General Guidelines

Upon favorable review and funds availability, the government may choose to make a fixed price award using FAR Part 12 Acquisition of Commercial Items or other authority. The Contracting Officer reserves the right to negotiate directly with the company on the terms and conditions prior to execution of the resulting contract, including payment terms, and will execute the contract/agreement on behalf of the government. Be advised, only a Contracting Officer has the authority to enter into, or modify, a binding contract on behalf of the United States Government.

In order to receive either a fixed price award using FAR 12 Acquisition of Commercial Items or other authority:

1. A company must have a Unique Entity ID (UEI) and must register in the System for Award Management (SAM) prior to receiving an award or agreement. Companies are advised to commence SAM registration upon perusing an AoI announcement. A company must also register in the prescribed government invoicing system (ex. Wide Area Work Flow).
2. A company must be determined to be responsible by the Contracting Officer and must not be suspended or debarred from award by the Federal Government nor be prohibited by Presidential Executive Order and/or law from receiving an award.

Receipt of a request for CSP does not guarantee that a company will receive an award and the government reserves the right, at any point prior to award of a contract/agreement, to cancel the request for CSP. The government reserves the right to make awards to all, some, or none of the selected solutions.

NOTE: The government reserves the right to amend this CSO solicitation as necessary amendments for emerging requirements and changes in authority occur. Amendments to this CSO will be posted through GPE.

4.2 Procurement Integrity Act (PIA)

The CSO solicitation process for FAR contracts is covered by the Procurement Integrity Act (PIA). PIA is implemented for FAR contracts through FAR part 3.104. Accordingly, the CSO competitive solicitation process and awards made thereby must adhere to the ethical standards required by the PIA.

5. Contact Information:

Innovation Team Leader: Mark Crawford; mark.g.crawford.civ@army.mil

Contracting Officer: Gary Richardson; gary.richardson4.civ@army.mil

CSO POC: Adam Ragland; adam.s.ragland.civ@army.mil

CSO POC: Michael Brown; michael.s.brown224.civ@army.mil

Contracting/Agreement Officer: [To be identified on the specific AoIs](#)

Contract Specialist: [To be identified on the specific AoIs](#)

6. General Areas of Interest (AoI):

- (1) **Agile / Flexible Facilities** - world class adaptive manufacturing facilities and capabilities that are scalable and integrate resources for rapid response to the Warfighter; Integration of Physical & Virtual manufacturing processes and technologies enables Agile Production Lines for Weapon

System Manufacturing. Agile facilities ensure product flexibility, improved capability to rapidly respond to engineering changes, and improve responses to variabilities of supply chain / quality. Agile Facilities provide capability to produce multiple weapon components on a single production line at a single location for improved quality, reliability, and safety with augmented process control and monitoring.

(2) **Connected Digital Enterprise (CDE)** - Creates end-to-end visibility across the arsenal or depot facility to increase production volume and tighter quality control. Real-time monitoring across process and batch manufacturing, unlocking the data needed cost control down to the unit level. Adoption of data driven manufacturing and advanced analytics troubleshoot problems, perform root cause analysis, improve product quality, and control per-unit costs. The CDE will be built on the 5G cellular network for low latency providing connectivity for thousands of industry 4.0 technologies. The CDE will be augmented with industrial automation software and technology to include with internet of things, cloud –based computing, artificial intelligence, and mixed reality to drive new levels of productivity.

(3) **Advanced Manufacturing** - enhancing the speed, build envelope, accuracy, finish, resolution of the processes and scaling; Agile Manufacturing, Hybrid Manufacturing Cells, Advanced Robotics, Point of Need Agile Manufacturing Kits, Human-machine interfaces, integrated control systems, artificial intelligent and machine learning couple with real-time process monitoring to perform predictive maintenance and scheduling, reduce reject rates, improve Performance to Promise (P2P), safety and performance of machine tools and operations. Army, Federal, Industry, Academia and International partners are exploring many convergent manufacturing technologies that have direct applications to future U.S. Army / OIB missions. These manufacturing innovations have the potential to revolutionize U.S Army OIB in the mid- and far-term.

(4) **Model Based / Digital Twin** - Digital twin in manufacturing aids in **monitoring the components via sensors to improving production awareness**. With digital twin technologies, planners and engineers can make predictions to foresee maintenance issues and improve production performance. Digital twins can be used to manage functional assets like manufacturing machinery, including machines and plants. With the digital twin component, process management can be greatly simplified via addition of analytics, artificial intelligence, machine learning, Industrial Internet of Things (IIoT), and advanced visualization.

(5) **Automation** - Automation can be defined as an automatic control measure that uses feedback loops (input) from sensors, cameras, encoders, lasers, and probes to control (output) a process, mechanism, or system. Automation is achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices, and computers, usually in combination. The benefit of automation includes labor savings, reducing waste, savings in electricity costs, savings in material costs, and improvements to quality, accuracy, and precision. In the simplest type of an automatic control loop, a controller compares a measured value of a process with a desired set value and processes the resulting error signal to change some input to the process. Opportunities for automation could be robotic painting and welding, and pick and sort for warehousing.

(6) **Advanced Analytics** - is the autonomous or semi-autonomous examination of data or content using sophisticated techniques and tools, typically beyond those of traditional preventative maintenance, process control and business intelligence, to discover deeper insights, make predictions, or generate recommendations. Advanced analytic techniques include those such as data/text mining, machine learning, pattern matching, forecasting, visualization, semantic analysis, sentiment analysis, network and cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, neural networks.

(7) **Workforce Development** - talent management programs for building a skilled and dynamic intellectual base. Intellectual base capable of operating in an environment of convergent manufacturing, advance manufacturing, agile/flexible facilities, connected digital enterprise, model based/digital twin technologies, automation and advanced analytics or other AoIs identified by the Government or that come to fruition as a result of this COS.

(8) **Energy and Chemical** - safe and sustainable use by various Unit Process and Unit Operations such as surface coating, cleaning, rubber denuding, stripping and plating.