National Institute of Standards and Technology
Request for Information
National Network for Manufacturing Innovation (NNMI)
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Attn: Dr. Michael Schen, Michael.schen@nist.gov (310-975-6741) and
Mr. Prasad Gupte, Prasad.gupte@nist.gov (310-975-5062

Response Prepared by: Smart Manufacturing Leadership Coalition (SMLC),
Point of Contact - Jim Davis, Vice Provost Information Technology and CTO at UCLA

This response to the RFI provides recommendations by the Smart Manufacturing Leadership Coalition (SMLC). The SMLC is a non-profit organization of manufacturers, manufacturing consortia, universities, and government laboratories and agencies committed to improving U.S. manufacturing competitiveness through the comprehensive adoption of Smart Manufacturing (SM) systems across entire manufacturing supply chains, complete product lifecycles, multiple industries, and small, medium and large enterprises. In particular, the SMLC is committed to substantially increasing the potential of and lowering the barriers to pervasive deployment of SM systems that make all information about the manufacturing process available when it is needed, where it is needed, and in the form that it is needed. In achieving this, the 21st century SM enterprise (from suppliers, OEMs, and companies to supply chains and industries) becomes integrated, knowledge-enabled, and model rich such that all operating actions are determined and executed proactively applying the best possible information and a wide range of performance metrics. An SM infrastructure is key to bringing new manufacturing technologies into operation and at the same time modernizing an extensive installed base of serviceable factory facilities in the U.S.

The SMLC has developed its recommendations through analysis of a broad cross section of industry test beds. Examples of industry defined 21st century SM systems include:

- dynamic machine tool management integrated into overall factory function and the smart energy grid
- real-time management, modeling, and control based on Big Data from low cost sensors
- real-time product qualification and integrated computation materials engineering during production
- dynamic business and operational tradeoff and risk decision-making
- real-time monitoring and end-to-end supply chain variability management
- integrated product and manufacturability planning

Through the comprehensive use of 21st century SM systems, manufacturing can achieve a quantum advance through integrated deployments of automation, information, and intelligence systems, as well as help expand these capabilities to small and medium enterprises. SMLC activities are built around industry-driven manufacturing test beds, development of a shared infrastructure called the **Smart Manufacturing Platform (SM Platform)**, and adoption of this shared infrastructure to achieve transformational impact in economic growth, manufacturing innovation, and global competitiveness.

The following is intended to provide SMLC's direct response to the questions listed in the RFI.

- Technologies With Broad Impact
  - What criteria should be used to select technology focus areas?
  - What technology focus areas that meet these criteria would you be willing to co-invest in?
  - What measures could demonstrate that Institute technology activities assist U.S. manufacturing?
  - What measures could assess the performance and impact of Institutes?

U.S. manufacturing companies have made significant investments in automation, information, and intelligence systems that have transformed many manufacturing tasks from manual to automated. Individual units and machines are highly optimized, and operations and management tasks have become much more sophisticated. A digital thread of information technology has proliferated throughout the entire life cycle of design and production. During the past 20 years the design of multitudes of products along with their manufacture, and the "smartness" of machines and pieces of equipment utilized have advanced noticeably. However, manufacturing has reached a threshold in which there is a critical need to move away from piecemeal implementation of automation and information systems, and jump start entirely new ways of designing and operating industrial plants and their respective supply chains. Today's outdated mainframe approach leads to uncoordinated applications and non-standardization, which complicates supply chain integration and risk management, limits opportunities for resilience when there are opportunities to manage situations dynamically, and increases the cost to design, implement, and maintain new manufacturing systems. Nearly 300,000 small and medium sized manufacturers in the U.S. could benefit greatly from smart technologies and their elements for deriving value from automation, information, and intelligence. However, the associated complexities and costs prohibit application.

Investments in SM technology have been largely limited and uneven, and companies that are making these investments are not able to reap the full benefit of the investment until their partners, suppliers, and customers also invest. Information and modeling systems for design have largely remained separated from manufacturing. Facilities and workforce infrastructure for next generation automation, information, and intelligence technologies are prohibitively expensive for many small manufactures and have restricted investment by large companies because of insufficient return on investment (ROI). This overall situation is further aggravated by the fact that U.S. businesses continue to delay replacement and modernization of 20 to 40 year old mainframe control systems for critical manufacturing processes due to financial constraints ranging from upfront capitalization to workforce training, and business, political, tax, and regulatory uncertainties involved in these long term investments. Further delays in making an estimated $50 billion investment to replace aging control systems may increase public safety risks while SM innovations hold the promise of a new era of zero tolerance for safety incidents.

In selecting manufacturing technology focus areas for the NNMI that can jump start manufacturing operations, productivity, and jobs in the U.S., SMLC believes the overarching selection criterion should be one of achieving a quantum transformation from optimizing individual unit processes to optimizing enterprises. This will require breadth of applicability across entire manufacturing enterprises including supply chains, complete product lifecycles, multiple industry sectors, and small, medium and large manufacturers and suppliers. **If broadly adopted, SM systems become one of the best examples of manufacturing technology with the comprehensive scope to achieve transformational impact in economic growth, manufacturing innovation, and global competitiveness.**

A cost effective infrastructure to integrate manufacturing intelligence in real-time across an entire production operation does not currently exist. As a result, SMLC believes an Institute should be created with the dual goals of developing an industry funded and shared SM Platform that will accelerate SM system deployment and promoting it with test beds that span continuous, batch and discrete manufacturing structures and industries. The SM Platform is a shared, open architecture and application software and services infrastructure that integrates components required to assemble customized SM systems in a standards-based deployment infrastructure. SM Platform emphasizes the construction of data-driven workflows designed for performance objectives, thereby focusing on the manufacturing use and deployment of the modeling, simulation and analytical software and not just the application code itself. The strength of the SM Platform is that it is IT provider and production technology agnostic, thereby making extreme sharing of Apps (modularized models and analytics) and workflow (how Apps need to work in the manufacturing setting) deployment capabilities possible while being interoperable with specific factory and supplier IT provider platforms. It also takes full advantage of networked information and resources for manufacturing, making possible a new workflow service model of taking data to the model instead of the existing paradigm of taking the model to the data. A workflow service model frees companies from the computational infrastructure to run software. How to deploy application code is not left to one-off deployment, but becomes part of the SM Platform architecture. In general, the SM Platform contains the invariant protocols, generalized Apps, and App development methodologies needed in an SM system. **Apps** are the generalized software modules available through the SM Platform that manufacturers use to build customized product qualification functions, computational materials engineering models, decision capabilities, energy and sustainability dashboards, and energy productivity metrics to name a few. The content and open architecture of the SM Platform will allow manufacturers to assemble, evaluate and deploy combinations of data, controls, models, simulations, and performance indicators into a system with the appropriate scope and degree of rigor and risk for their company, regardless of industry or organization size. As infrastructure, the SM Platform reflects a comprehensive and integrated approach that offers the potential to avoid the high cost of developing one-off, pinpoint solutions. The deployment of SM within a consistent open standards infrastructure is a key to moving away from piecemeal implementation and on to a comprehensive systems approach that allow manufacturers to take full advantage of networked information and resources.

The SM Institute would have the goal of providing the shared infrastructure that allows all companies to readily deploy data-driven, actionable, design, and in-production intelligence about a manufacturing process and product to enable and improve respective business objectives. In so doing, the SM Institute makes it possible for all companies to treat their intelligence about a product and process as an integrated enterprise asset. The SMLC as a 501c6 organization is positioned to lead and be the lead organization for the SM Institute and is structured to enter formal partnerships to implement manufacturing test beds, and bridge the cyber system infrastructure of SM with the physical and workforce systems and infrastructures. Furthermore, the SMLC is positioned to spawn and coordinate across other private-public and private-private partnerships, research partnerships, and programs that are organized through other institutional leads.

Within the overarching criterion of applicability, there are five generalized measurements that can be used to evaluate the benefits of various manufacturing technologies when applied throughout an entire enterprise:

- In the concept, design, engineering and prototyping phases of product development, the time and cost to get products to market are critical. In addition, the ability to select among design options to achieve optimal product and process feasibility is critical to minimizing development time and cost, as well as downstream design backtracking. Since new product introductions as well as product transitions are linked through manufacturing operations, new manufacturing technology should enable a reduction in the time and cost to get products to market.
- New manufacturing technology should demonstrate the ability to plan and evaluate manufacturing process options or changes to improve key operating metrics such as energy productivity, production yield, production cycle time, quality, supply chain integration, and environmental performance. These activities should also be linked to key design and cross-functional support activities, and recognize that design produces key models that underpin the automation, information, and intelligence systems in manufacturing.
- Numerous technologies are underutilized in manufacturing processes (e.g. sensor fusion and computational fluid dynamics), emerging technologies (e.g. additive manufacturing), and next generation capabilities (e.g. integrated computational materials engineering). New manufacturing technology should provide the ability to integrate underutilized technologies from other disciplines to improve manufacturing operations.
- Investments in new manufacturing technology should provide attractive payback periods and ROI in large

companies, as well as small and medium enterprises (SMEs).

- Technology infrastructure that comprehensively lowers costs of systems deployment should also facilitate and incent contribution and innovation from a wide base of expertise that includes small, medium, and large companies, consultation firms, providers and suppliers, universities, and entrepreneurs.

SMLC is already investing in SM system technology and the SM Platform. SMLC has invested nearly $750k in the development of the SM Platform plan and specification, and the formation of deep collaborations. The SMLC has further committed to significant cost share through the availability of test beds, and has identified a full range of new or untapped opportunities for SM systems. These opportunities include adaptable machine use benchmarking, information and innovation in an integrated supply chain, integrated dynamic energy management across multiple units, tracking and traceability, pin point product recalls, expanded innovation base, rapid in-production product qualification, agile product transitions, simultaneous product and manufacture planning, and operational management of tradeoffs and risks. These common opportunities have been identified across numerous industries critical to the U.S. such as oil and gas, chemical, metal, glass, pharmaceutical, automotive, aerospace, food, and defense manufacturing.

SMLC estimates that installation of an SM system with the infrastructure of the SM Platform would offer payback periods of less than one year for a number of untapped opportunities - paybacks that are substantially increased by significant cost reductions (i.e. calculated 3 and 4 to 1 reduction in the cost and time required to deploy multiple new SM systems involving high fidelity modeling compared to one off approaches). As importantly, the SM Platform provides capability that has been heretofore unavailable or prohibitive to SMEs. The ROI on providing nearly 300,000 SMEs with access to smart capabilities and the subsequent broadening of the base of manufacturing innovation is very large. The SM Platform technical architecture and business model are being designed to incentivize broad contribution to a workflow Apps store that in turn will be broadly accessible for use.

- Institute Structure and Governance
  - What business models would be effective for the Institutes to manage business decisions?
  - What governance models would be effective for the Institutes to manage governance decisions?
  - What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access, and licensing?
  - How should a network of Institutes optimally operate?
  - What measures could assess effectiveness of Network structure and governance?

The financial and business model for an Institute will need to evolve through various phases to achieve sustainable operations. Initially, an institute would be a publicly funded venture with cost share but will systematically transition to self-sufficiency through phases that establish credibility and promote growth. The Institute should be guided by a consistent industry driven Board of Directors that can oversee priorities and investments to accomplish each phase, maintain continuity with phase transitions and move the technology of focus into an industry driven operating system. **SMLC believes the overall keys to success in adoption of new manufacturing technology are deep collaboration, partnerships and test beds.** The challenges associated with commercialization of transformational manufacturing technology are too broad to be solved by any single company or organization; hence the involvement of collaborative partnerships, a focused emphasis on open standards and the critical role of industry test beds. A well-defined set of collaborations around specific Institute goals, and a governance structure to oversee partnership roles and their development progression are essential. These collaboration roles include a full portfolio of test beds, SM Platform development, domain modeling, R&D, integrated performance metrics, standards/interoperability, SME involvement, and training and education programs. These are all distinct roles that need to be integrated and managed appropriately at each phase of development.

The questions regarding Institute Structure and Governance can best be answered by providing a brief description of the SMLC as an ideal organization structure to pursue development, assimilation and commercialization of the SM Platform.

Despite the potential impact of SM systems, the development of the infrastructure that will accelerate their deployment represents a large, risky investment that no single company or small group of companies will or can undertake. The large, cross-industry development components that need to go forward simultaneously in an integrated manner require deep collaborations across the manufacturing industry, and individual manufacturers will always find it easier to justify piecemeal implementation of SM-based process control and automation systems than long-term infrastructure investments. As a result, a public-private partnership is the only way to address the stalemate of investment, R&D constraints, and cross industry collaboration that exists between corporate goals and broad public benefit.

The SMLC is a non-profit organization committed to the development and deployment of SM systems through an implementation agenda for building a scaled, shared infrastructure called the SM Platform. The SMLC has been formed as a coalition of industry practitioners, suppliers, universities, and government laboratories and agencies specifically for the purpose of launching the SM Platform. The SMLC is comprised of large, global manufacturing companies and IT providers that not only have the capacity to drive decision processes for the SM Platform, but also the ability to stress the importance of actions that address the needs of SMEs as a key collaboration group. The SMLC intends to sponsor, facilitate, coordinate, and oversee the build out of the SM Platform in concert with a series of manufacturing test beds that define the necessary functionalities of the platform, including insertion of next generation technologies. In this manner the SM Platform will move from prototype to a sustaining entity. An SM Institute can also serve as a common infrastructure to link information, digital resources, and specific business objectives among other Institutes. At this time, the SMLC is structured around an industry driven Board of Directors that involves all of the stakeholder groups to oversee priorities and investments to accomplish each phase and move the SM Platform into an industry driven operating entity.

The SMLC is structured to enable stakeholders in the SM industry to form collaborative R&D, implementation, and advocacy teams for development of the approaches, standards, platforms, and shared infrastructure that facilitate the broad adoption of SM Systems that promote the pervasive application of manufacturing intelligence. A key underlying factor for SMLC's success is the direct participation by industry, government, and university technical resources. SMLC understands the value in identifying key manufacturing challenges and building the SM Platform around tangible business objectives and has developed an SM Platform implementation roadmap that is keyed off of industry test bed sites and situations. By definition, the SM Platform is industry driven (made by manufacturers for manufacturers and technology developers), and a coordinated portfolio of test beds and partners are needed to drive each of the implementation phases at different stages of lifecycle maturity. The SMLC already has test beds as SM Platform development and demonstration sites with General Dynamics for machine instrumentation and function benchmarking in production of defense equipment, General Mills for supplier and manufacturing cross management, modeling and control using Big Data in the food industry, and Praxair for integrated performance metrics and advanced modeling in the production of industrial gases. Additional test bed sites aimed at manufacturing processes are in development in power generation, pharmaceutical, defense manufacturing, automotive and other industry segments. Key relationships are in place with the Jet Propulsion Laboratory (JPL), a Federally Funded Research and Development Center managed for NASA by the California Institute of Technology (Caltech) in developing the SM Platform for design and engineering tools and practices, integrating these with manufacturing and populating the workflow Apps store. Caltech is providing expertise in integrated computational materials engineering (ICME) and making available its Materials and Process Simulation Center (MSC) and Computational Materials Design Facility (CMDF) as a test bed for new model and algorithm developments. The AVESTAR™ Center at the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) and West Virginia University's (WVU) National Research Center for Coal & Energy (NRCCE) are driving the development of the SM Platform by providing expertise and workflow Apps in the power generation domain. EPRI is providing key direction on the broad-based challenges of interfacing electricity generation and distribution via the Smart Grid with end-use in advanced manufacturing. This includes key expertise with advanced sensors, robotics, electro-technologies, advanced motors and drives, and performance opportunities with respect to energy efficiency, power quality, and smart grid integration. The University of Texas Austin and other universities are providing sensor and modeling expertise in chemical, materials and pharmaceutical processing. JPL, NETL and EPRI are additionally sponsoring small, medium, and large manufacturer test beds. NIST is a critical partner in the development of standards and practices for smart factory architecture, and the SMLC is already working with a number of key consortia partners on industry-driven metrics, interface technologies, and SME outreach including AIChE, ACEEE, NCMS and California Manufacturing Technology Consulting (CMTC) as a regional MEP program group. UCLA has teamed with Nimbis, Inc. to prototype the SM Platform as an Internet service structure and to coordinate network linkages that bring these and other key resources and capabilities around the country together. Key automation platform providers, Rockwell, Honeywell, Emerson, and Invensys have come together on the development of an industry driven reference architecture ensuring SM Platform interoperability. Professional Engineering firms that face the challenges of integrating the disparate IT systems and disconnected production technologies are equally critical as are the consortia and associations representing practitioners at manufacturers of every size.

These roles provide a specific example of a potential SM Institute team formed around clearly defined collaborations aimed at specific objectives. These also demonstrate the SMLC's orchestration of a broad based infrastructure initiative based on and driven by a portfolio of industry test beds that encompass diverse problem objectives that integrate design, engineering, and manufacturing across multiple industry segments, and involve small, medium, and large companies.

- Strategies for Sustainable Institute Operations
  - How should initial funding co-investments of the Federal government and others be organized by types and proportions?
  - What arrangements for co-investment proportions and types could help an Institute become self-sustaining?
  - What measures could assess progress of an Institute towards being self-sustaining?
  - What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?
  - How should Institutes engage other manufacturing related programs and networks?
  - How should Institutes interact with state and local economic development authorities?
  - What measures could assess Institute contributions to long-term national security and competitiveness?

Overall the best method for demonstrating progress toward self-sustaining operations in an Institute will be explicit delineation of implementation phases, developed plans for achieving defined goals including financial sustainability and a project management structure that checks progress against plans and objectives for each particular phase. Another measure of progress is the results collected from test bed operations, especially results that validate the claims of the Institute's new manufacturing technology – substantially lowered cost of SM System deployment, ease of constructing workflow applications, ease of contributing an app for the non-IT manufacturing expert. Validating results from Institute test beds can also be used to promote further adoption of the Institute's technology, and the financial impact of the results should be incorporated and monetized in the overall financial forecast for the Institute.

For all Institutes government funding should be focused in the first 3 years of operation to bring initial versions of their technologies to early use, especially in manufacturing test beds. In the 3 to 5 year period, funding from commercial sources such as services, fees, functions and test beds should increase and lead to self-sustaining operations. In this process, attractive international opportunities will undoubtedly emerge, but as first movers with sustaining operations, the Institutes should have a competitive edge and continue to drive their technologies forward.

From the perspective of a potential institute focused on infrastructure development, there are examples of open infrastructure platforms and their benefits for static applications of modeling and simulation. For example, Autonomie, developed by Argonne National Laboratory, enables the rapid integration of proprietary and public models into a total vehicle simulation. Adaptive Vehicle Make (AVM) developed by the Defense Advanced Research Projects Agency (DARPA) reduces the time and cost of developing complex vehicle systems. Smartphone operating systems from Apple and Google reduce the time and cost of writing Apps. These are examples that simultaneously demonstrate the value of a unified platform infrastructure in reducing cost and time of building functional systems. An SM Institute with similar overall goals would be different in two key ways. First, it will need to prove and demonstrate a new technology in that the SM Platform will be the first of its kind in manufacturing to address composable real-time modeling and simulation workflow applications in a service architecture. Second, it needs to become a commercial entity for operational sustainability but needs to begin with government, cost shared investment. There will need to be more government investment up front and while test beds operate in a hybrid mode – in house methods and with SM Platform, until value and trust can build and reduced risk can be assured.

SMLC projects an SM Institute focused on broad based infrastructure and development of the SM Platform will require an implementation plan that moves through distinct phases such as launching a prototype SM Platform, testing and demonstrating the SM Platform, demonstrating the Apps store from both distribution and contribution perspectives, validation and verification of the SM Platform with selected Apps. Technical phases will need to coincide with moving into commercialization by populating the Apps store, and scaling the SM Institute to serve as an infrastructure to resolve specific manufacturing business objectives through modeling and simulation in real-time. An SM Institute would launch not only as a virtual set of information technology and SM Systems deployment services, but also as a physical facility that can partner with industry test beds, physical technology Institutes, various consortia, and individual companies to form project teams, research teams, provide consultation and support a range of services on the use of the SM Platform. The SMLC expects to scale the Institute through regionally based physical and virtual satellite Institute capabilities while keeping SM Platform services, standards, toolkits, and the Apps store coordinated, open, and interoperable.

The central goal for an SM Institute will be to develop, validate and commercialize the SM Platform. The SM Institute would lay the commercialization foundation by first guiding the development, then piloting and finally adopting the SM Platform. Since the eventual SM Institute customers are represented by a broad membership of the SMLC, the business plan for commercialization would be based on valid assumptions and anticipated demand. By lowering the implementation barriers around cost, complexity, ease-of-use, and measurement availability, the U.S. manufacturing industry (OEM's) can deploy foundational infrastructure for vertically and horizontally oriented manufacturing intelligence to collectively strengthen capability. By lowering the cost and effort to implement and support these technologies, SMEs are incentivized to adopt new manufacturing practices that improve their performance in the form of available Apps that could be hosted in the cloud. Creating an open manufacturing management App store to market and use models will also stimulate entrepreneurs to develop and license their IP in the form of models that can be plugged into the SM Platform. The strength of these broad manufacturing operations across multiple industries, including the defense industrial base and any size organization, will contribute not only to US competitiveness but also to national security.

The strength of the SM Platform is that it is IT provider and production technology agnostic, thereby making extreme sharing of Apps and workflow deployment capabilities possible while being interoperable with factory and supplier IT provider platforms which are designed for specific product and manufacturing needs. The SM Platform will include an Apps store, workflow toolkits and access to resources, and is being designed to be open architecture and openly available as infrastructure at "no cost." The financial and operational sustainability of the SM Platform will center on workflow Apps consultation, technical application and deployment services, but not on the SM Platform itself. First and foremost, the SM Platform will address the beneficial application and untapped opportunities for manufacturing and integrated design and engineering. Revenue to sustain an SM Institute can come from the use of workflow Apps and workflow templates that can be contributed by all stakeholders (SMEs, large companies, software providers, universities, entrepreneurs) across a spectrum of open source to fee-for-use Apps, comprehensive consultation services from design to manufacturing, comprehensive software and workflow certification services, and computational services. The SM Platform architecture itself, workflow construction toolkits and some Apps will be open and accessible as determined by the SMLC Board to benefit the manufacturing space and support a pre-competitive infrastructure by cutting these costs. Individual IP will rest with the value added Apps and workflows. This IP will be licensed accordingly between interested parties on exclusive and non-exclusive bases. IP related to the SM Platform infrastructure will be retained by the SMLC. The SM Platform will interface with proprietary in-factory platforms through the standards based reference architecture.

- Education and Workforce Development
  - How could Institutes support advanced manufacturing workforce development at all educational levels?
  - How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?
  - How could Institutes and the NNMI leverage and complement other education and workforce development programs?
  - What measures could assess Institute performance and impact on education and workforce development?
  - How might institutes integrate R&D activities and education to best prepare the current and future workforce?

While there are many pathways for educating the workforce, it is essential that university and college curricula incorporate courses and training in new manufacturing technology. Inclusion of these concepts in higher education will ensure a cadre of engineers and scientists trained in the needed disciplines.

SMLC believes SM systems and the SM Platform speak the language of the current generation of students, and has the potential to convert a seemingly uninteresting structure of machines into an IT problem solving environment with challenging jobs and significant career opportunities. Deployment of SM systems can be enhanced by industrial training programs with direct in-plant experience intended to train operators in the use of new tools and to ensure that human factors are continuously incorporated into computational and automated plant systems. Training modules, new educational curricula, and smart design standards like those being developed at SMLC, and effective learner interfaces, will all contribute to creating a workforce skilled in SM techniques and provide pathways for continuous learning. Education at higher levels (secondary schools, junior colleges and universities) should be better aligned with the skills needed to create improved smart industries. Collaboration between industry and educational facilities, especially within local communities, will help to establish curricula that are dynamic and relevant to current industry needs. Training provided by industry should be structured for all levels of employees and build knowledge of key performance indicators used in business analysis. Skilled workers would be able to rapidly adapt to new, smart technology. In turn, SM technology would incorporate operational feedback to provide continuous learning for workers.

These programs should be addressed within a specific operational framework that can focus on education, training, and skill sets to achieve stated objectives. The SMLC is doing this by defining broad based, industry “test beds” to embrace SME’s, organize education and training around participation, and at the same time build out and align SM Platform services. These are being constructed as regional partnerships. The California Manufacturing Technology Consortium (CMTC) is teaming with UCLA, NASA/JPL, Caltech, and other southern California universities and manufacturers to develop, test, and demonstrate the SM Platform for the regional needs of this SME base. Similarly, Rockwell Automation, the University of Wisconsin in Madison and Milwaukee, and local area industries are developing a regional test bed around supply chain opportunities for that SME base. These regional test bed efforts are being coordinated with national certification efforts such as those available through the Society of Manufacturing Engineering and AIChE and SME/individual outreach through MESA and NCMS.

In addition to fostering manufacturing skills within higher education, it is equally important to use these kinds of regional test beds to change the perception of manufacturing as “dumb and dirty”, and instill interest at a young age. The SMLC plans to develop community-outreach programs in higher education to ensure that information and education transfers to the next generation and across academic institutions. Similar programs can be created across universities, state colleges, community colleges and technical schools to create a network of manufacturing education programs. Volunteer programs that give exposure to advanced manufacturing and strengthen STEM education in K-12 (i.e. site visits, tutoring sessions, camp programs, contests, presentations) will prepare the new generation workforce, and change how advanced manufacturing jobs are perceived. These programs will engage industry (i.e. speaking engagements, sponsored contests or donated materials).

The SMLC also plans to work with organizations that lead existing programs that support manufacturing education. For example, the SME Education Foundation has developed a set of programs to addresses the shortage of manufacturing and technical skills within the United States. Through this program, the foundation has garnered support for this initiative through partnerships and sponsors both in industry and education sectors primarily in the Midwest and East Coast. SMLC can work with its broad base of members in support to expand such educational programs, leverage efforts and move programs forward nationwide.