Response to the Request for Information (RFI)

On

Proposed New Program: National Network for Manufacturing Innovation (NNMI)

Responder: University of Texas at Arlington Research Institute (UTARI)

Date: 10/25/2012

Relevant expertise of the responder: Advanced Manufacturing, Holistic Optimization of Manufacturing Cycle, Flexible Manufacturing Systems, Heterogeneous System Integration, Robotics, Micro/Nano Manufacturing

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Technologies with Broad Impact

1. What criteria should be used to select technology focus areas?

Creation of high quality, higher paying jobs through high-tech manufacturing infrastructures across the nation for advanced, superior quality products

2. What technology focus areas that meet these criteria would you be willing to co-invest in?

Technology focus should be on smart manufacturing approaches that are intelligent, flexible and low cost.

- Intelligence can be incorporated through advanced robotic methods.
- Flexibility can be achieved through unique and revolutionary design for the production/assembly line that can be easily and quickly reconfigured for multiple products, thus offering a product-independent, site-independent manufacturing solution.
- Lower cost in setting up the manufacturing line can be accomplished by carefully investigating its building blocks, such as manipulator, equipment, tools, support hardware and software etc., and optimizing the selection criteria, based on their specifications, for the targeted application range. Cost can be further lowered by replacing [expensive hardware with highest possible specs + nominal software with open loop control] with [inexpensive hardware with necessary and sufficient specs + advanced software with hybrid feedback control].

3. What measures could demonstrate that Institute technology activities assist U.S. manufacturing?

Commercially viable development of high quality, reliable products with a competitive price range that:

- Attracts the consumer market through new features and efficient usability;
- Addresses to specific high value requirements from defense, medical and education sectors;
- Offers a risk free and high-standard work environment for potential workers in the manufacturing infrastructure.

4. What measures could assess the performance and impact of Institutes?

Performance and impact of the Institutes for Manufacturing Innovation (IMIs) can be assessed by the following measures:

- Number of direct and indirect jobs created, in short term as well as long term, through a specific manufacturing infrastructure
- Extent of superiority or technological advancement contributed by a specific manufacturing infrastructure, to the national security, healthcare, consumer approval rate, user safety and quality of life
- Manufacturability in terms of production yield, manufacturing cost, overall time and product performance
- Sustainability in terms of product appeal, scope for growth, market size
- Compatibility to and implementation of green technologies that can promote sustainable management of resources
- Flexibility in terms of material selection, manufacturing process variation and production site

Institute Structure and Governance

5. What business models would be effective for the Institutes to manage business decisions?

A multi-tier business model will be effective, where business decisions are managed by taking inputs from academic researchers, industry representatives, and program facilitators from the Federal and State Governments. The focus of this multi-tiered or "push-pull" business model should be to balance the needs of the industry, the market and the society ("the pull") with the breakthrough innovation and education needs from academia ("the push"). Thus all the participating members can benefit from the advanced manufacturing infrastructure.

6. What governance models would be effective for the Institutes to manage governance decisions?

Similar to a 501 c3 business model with advisory boards from industry, academia and the Government

7. What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access and licensing?

Participation from multiple sectors, such as industry, academia and Government, is crucial for the success of the Institutes. Financial remunerations on contributed intellectual properties should be managed in a cogent, coherent and proportionate manner with proper IP protection and share.

8. How should a network of Institutes optimally operate?

- Sharing of technologies, specifications and results through a central repository
- Exchange of personnel, advisors and other contributing entities
- A annual conference, open to all contributors across the nation, to share ideas and outcomes

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9. What measures could assess effectiveness of Network structure and governance?

- Increase in the revenue
- Number of resulting products and corresponding market size
- Number and diversity of participating entities
- Exports and success rates in the International market
- Number of new manufacturing infrastructures established in the nation

Strategies for Sustainable Institute Operations

10. How should initial funding co-investments of the Federal government and others be organized by types and proportions?

Initial investments should be made at multiple levels; Federal Government contributing to the bulk of it, followed by the State Governments. Benefiting and emerging (from the advanced manufacturing R&D at the institutes) industries also should make contributions, in proportion. Once a particular technology reaches market, funds can be allocated from the generated revenue, for further improvements of the technology.

11. What arrangements for co-investment proportions and types could help an Institute become self-sustaining?

After the initial stage of commercialization, an institute should work directly with the industries on a partnership basis for further funding in order to support the upgrade and improvements for the technologies.

12. What measures could assess progress of an Institute towards being self-sustaining?

- Generating funds directly from the market
- Being able to attract and support more advanced manufacturing technologies
- Increase in the operational budget (positively)

13. What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?

- By highlighting clear distinctions in quality of products domestically made vs. imported from outside
- By promoting consumer awareness about safety, choices, information regarding the imported products vs. domestic products
- By developing new/better products and increasing exports

14. How should Institutes engage other manufacturing related programs and networks?

- Joint development programs
- Multi-agency solicitations
- A nation-wide knowledgebase of advanced manufacturing technologies
- Through common industry base that is already existing or to be established in the nation

15. How should Institutes interact with state and local economic development authorities?

By encouraging high-tech manufacturing and incentivizing the effort through financial, logistical, and technological assistance

16. What measures could assess Institute contributions to long term national security and competitiveness?

More advanced manufacturing programs and corresponding projects run in collaboration with defense contractors and suppliers.

Education and Workforce Development

17. How could Institutes support advanced manufacturing workforce development at all educational levels?

By introducing "advanced manufacturing methodologies" in the course curriculums of higher education; and promoting industry-academic consortia framework to exchange ideas, discuss requirements, and carry out joint development efforts.

18. How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?

By promoting industry-academic consortia framework to exchange ideas, discuss requirements, and carry out joint development efforts. Higher funding levels for SBIRs, STTRs, and joint proposals can be encouraging.

19. How could Institutes and the NNMI leverage and complement other education and workforce development programs?

It can be achieved by encouraging educators and students to think about real-world, commercializable applications for the knowledge base. This can be implemented, at a national level, via design competitions for specific manufacturing processes; technical conferences and workshops; joint research and development programs that include multiple academic institutes with one or more industry partners to swiftly and smoothly transition the generated technology in to commercialization.

20. What measures could assess Institute performance and impact on education and workforce development?

Number of projects running at the institute that actively involve research entities from academia and/or leverages/supports, at a fundamental level, the curriculum

21. How might institutes integrate R&D activities and education to best prepare the current and future workforce?

By offering first hand exposure to and hands-on training on new manufacturing methodologies to educators and students through periodic interaction sessions

Other Input: Path to rapid productization via flexible manufacturing – A need of the hour

Successful transformation of any novel idea into a commercializable product relies on two intertwined factors: first; finding the right steps for the product development and second; having the enabling technologies to execute those development steps. While the first one is primarily an optimization problem, requiring evaluation of trade-offs among manufacturing metrics such as production cost, time, yield and product performance, the second one is mainly executional and requires real implementation of technology via tools, processes and other hardware.

Traditionally, in manufacturing analysis and optimization models, it is considered that respective enabling technologies exist, in already standardized forms, to carry out the manufacturing steps as predicted. However, this assumption is not always valid and especially in cases of entirely new ideas, revolutionary product designs and emerging technology areas, it becomes imperative that both the product and production system be evolved together in order to keep the overall development time and cost at a minimum and thereby allowing a viable manufacturing structure. For such situations, a novel, holistic research and development architecture is needed to rapidly advance the technology readiness level (TRL) and finally transition the idea into sustainable commercialization of the product.

Some of the typical aspects that the designers of advanced manufacturing must focus on are:

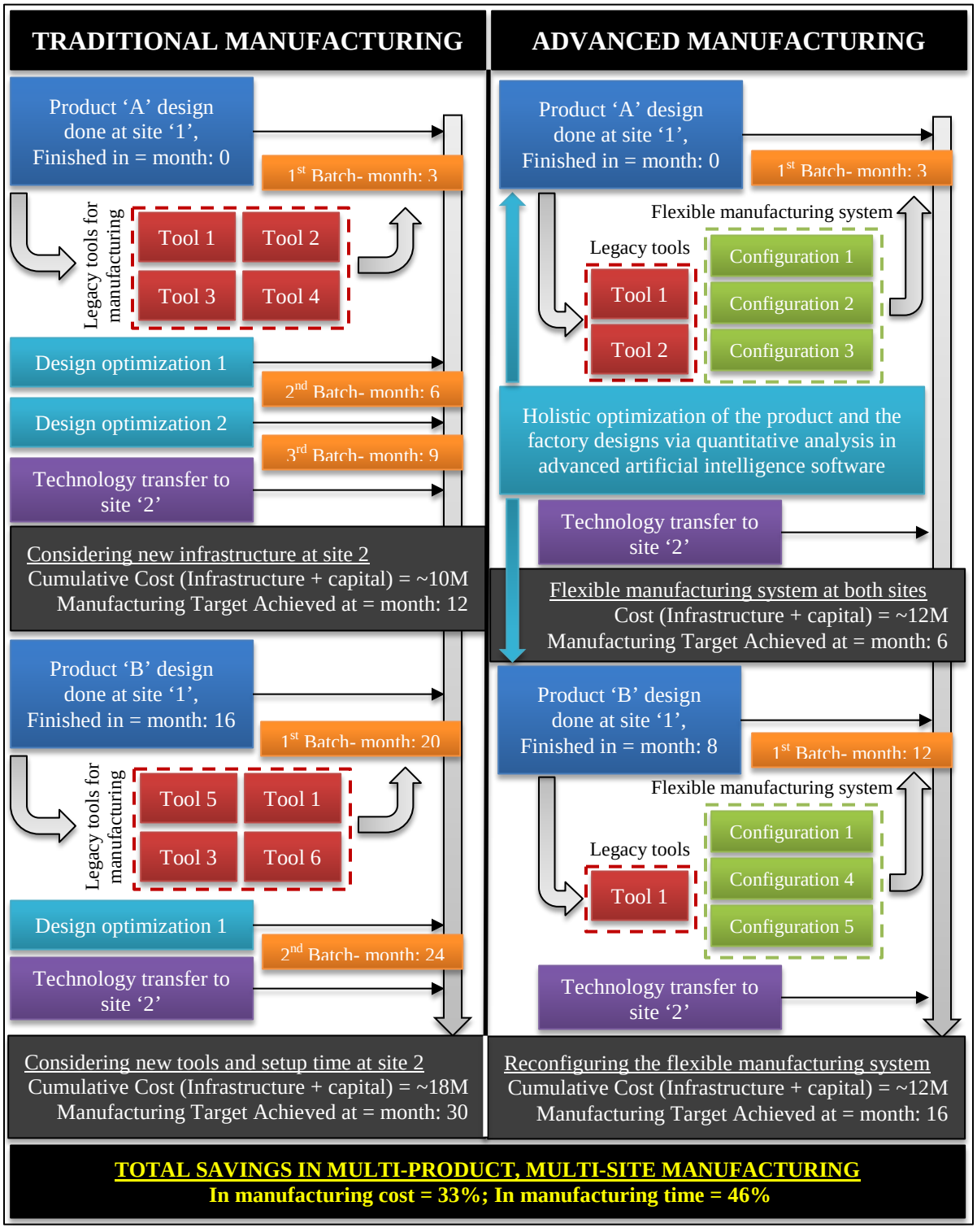
- Selection of granularity for manufacturing components; such as part design, type of tools, number of manipulation systems, category of sub tasks etc.
- Seamless integration of multiple diverse processes for a heterogeneous product having parts of different scale, shape and materials
- Seamless transition from product to product, at minimum investment and effort
- Portability of manufacturing
- Reliability of product

These factors depend on numerous input parameters spread over the entire manufacturing process that includes design, machining, assembly, packaging, testing and also production management. Careful evaluation of these parameters, in a quantitative manner, and generation of an optimized configuration of hardware, software and processes for manufacturing is extremely critical; especially for new product ideas for which off-the-shelf solutions are not yet available.

The key to the success in this manufacturing model is the concurrent engineering of the product and the factory, both simultaneously. The holism in such a disruptive manufacturing framework must be aided by fast and reliable modeling of the entire process via a collection of interdisciplinary analytical, simulation-based and experimental techniques. Concept realization and implementation will require an entirely new class of robotic hardware and intelligent software applications.

The vision of making manufacturing independent of products, tools, sites and production volumes will inspire many new research and developments by allowing low-cost, high throughput development of the end products without compromising on the quality. It will also

prove extremely useful for sustainable production of highly specialized products manufactured in low to medium quantities; thus opening up a pathway to on-demand, on-site manufacturing.



A comparative overview of typical manufacturing process flow today vs. in the future

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