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Pilots to Inform the Creation of Potential New Manufacturing Technology Acceleration Centers (M-TACs)

Response to NIST Request for Information – Docket No. 130426414-3414-01

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RTI INTERNATIONAL

Introduction

The National Institute of Standards and Technology (NIST) is piloting Manufacturing Technology Acceleration Centers (M-TACs) that will focus on addressing the technical and business challenges encountered by small and mid-sized U.S. manufacturers (SMMs) striving for profitable growth in a global and dynamic competitive marketplace. The M-TACs will seek to support SMMs as they attempt to integrate and adopt existing and emerging technologies into their processes and operations, and transition and commercialize new technologies for innovative new products and services. Implementing technologies will help the SMMs grow their businesses and compete within global manufacturing supply chains. M-TACs—envisioned as partner organizations to the NIST Manufacturing Extension Partnership (MEP) program and as connectors to resources such as research organizations, state and local technology-based economic development intermediaries, industry associations, and the planned National Network for Manufacturing Innovation (NNMI)—will provide deep technical expertise and supply chain knowledge to assist SMMs in adopting technology. RTI International is pleased to offer the information in this response to the Request for Information (RFI) to NIST, which is based on our long-standing work in technology commercialization for federal laboratories and universities and our deep understanding of the NIST MEP program, at both the system and Center levels.

About RTI International

RTI International (www.rti.org) is one of the world's leading nonprofit research institutes, dedicated to improving the human condition by turning knowledge into practice. Our staff of more than 3,700 provides research and technical services to governments and businesses in more than 75 countries in the areas of innovation and technology commercialization, health and pharmaceuticals, education and training, surveys and statistics, advanced technology, international development, economic and social policy, energy and the environment, and laboratory testing and chemical analysis.

RTI has worked in technology acceleration for 47 years, helping technology transfer organizations at government laboratories and universities to commercialize their technologies. Building on our history of success in commercialization, RTI has developed best practices and become a recognized leader domestically and internationally. Using a core commercialization team composed of engineers with multidisciplinary training and industry experience, RTI supports government, academic, and corporate organizations with services across the full innovation continuum, from early-stage research and development (R&D) to commercialization. We provide clients around the globe with insight, analysis, and connections to commercialize emerging technologies. Our insightful analyses contribute to a solid understanding and development of the value proposition of a technology and allow our clients to make informed decisions on their commercialization strategies and investments. RTI has performed thousands of technology assessments, developed hundreds of market commercialization plans, and facilitated hundreds of partnerships and licenses. Our current work with the NIST MEP system and its individual MEP Centers gives us insight into their capabilities and services and provides a basis for our feedback on the M-TAC program.

Discussion

Technology acceleration—the integration, adoption, transition, and commercialization of new technology—is a complex process involving many influencing factors that require organizations seeking to facilitate these actions, such as M-TACs, to merge complementary talents in science and technology, marketing and business, and supporting processes and resources. **Figure 1**, taken from Everett Rogers' diffusion of innovation theory and applied to technology acceleration, demonstrates the multitude of considerations that affect whether SMMs will adopt a new innovation or technology to then integrate it within their

company, or develop and commercialize it as a new product. If M-TACs are to be successful connectors and facilitators of technology acceleration for SMMs, they must consider all of these factors.

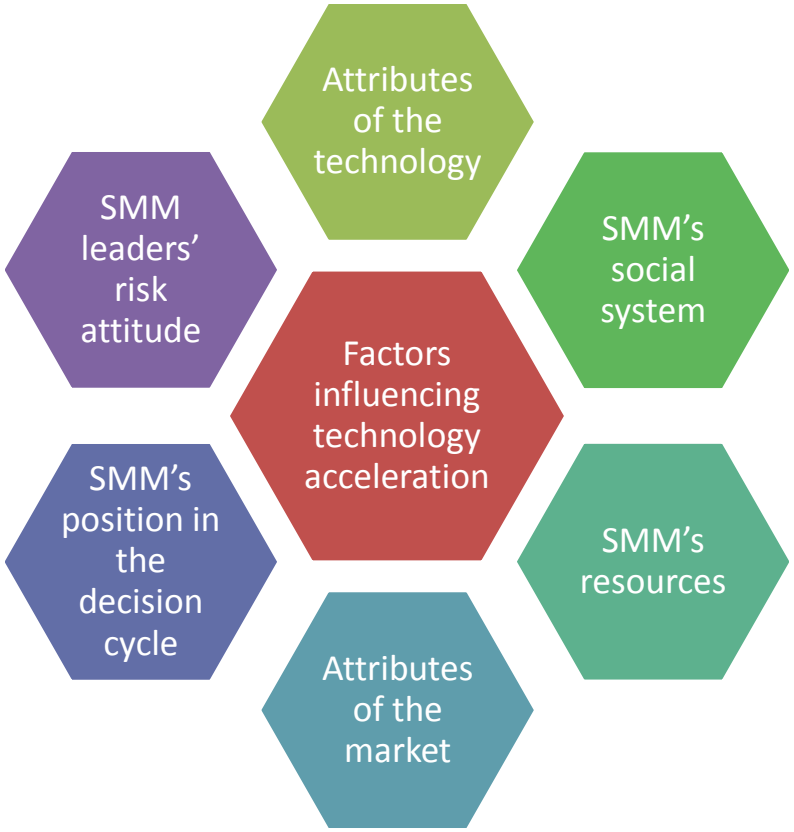

Figure 1: Diffusion of Innovation Theory Applied to Technology Acceleration

Source: RTI International based on E. Rogers

First and foremost, in order to convince SMMs to adopt and then either integrate or commercialize new technology, **SMMs must see a benefit sufficient to ensure a return on investment (ROI) of their time and resources to move toward technology adoption.** This ROI is based on three of the influencing factors shown in Figure 1: attributes of the technology, attributes of the market, and the availability of their own resources.

- Technology attributes affecting adoption include its relative advantage to existing technologies, its complexity, its compatibility with the surrounding system, and its demonstrability to decision makers.
- Market attributes include need and potential demand, and barriers to entry, including regulatory issues and end-user acceptance.
- SMM resources include not only financial means to invest in technology acceleration, but also time, capabilities, and internal expertise. SMMs are often time-constrained and focused on the business operations at hand. They can be financially constrained, often lacking the funds to invest in a new technology or the skills necessary to use the technology. SMMs can also be

capability-constrained, lacking in employees with the expertise to develop or commercialize the new technology.

In addition to factors influencing ROI decisions, Figure 1 also shows the social and psychological factors affecting technology adoption:

- The SMM's social system is made of established norms in which the SMM operates and includes its degree of connectiveness (both internally and externally), the level of communication within the company, the influence of its opinion leaders, and whether it has change agents, all contributing to the SMM's ability to both decide to and then successfully take on new innovations.
- Innovation diffusion is influenced by a decision cycle that SMM leadership traverse in order to move forward on technology adoption. Where leadership is positioned in the decision cycle has an influence on how receptive they are to providing resources toward implementing or developing new technology. The cycle starts when they first learn about the potential benefits of adopting the technology, and then moves to the persuasion and decision phases. Once a decision is made to move forward with investing some time and resources, there is typically a testing and confirmation phase that helps leadership to verify that this was indeed the right decision. At any time during these phases new information could come to the fore that will stop the technology acceleration project.
- The SMM leadership's risk attitude will also affect the degree of their organization's propensity to adopt new technology. This is shown in Rogers' well-known innovation adoption curve in **Figure 2**. Where executives and decision makers fall within a spectrum of risk-taking behaviors and where in this spectrum a SMM falls at a given time will affect the SMM's propensity to adopt new technology.

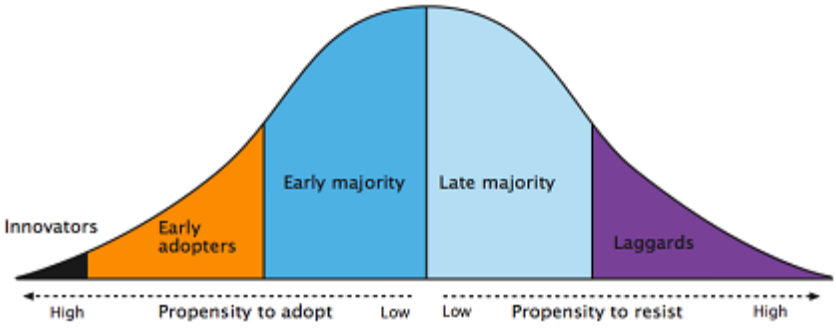

Figure 2: Innovation adoption curve

Source: E. Rogers; Les Robinson, Enabling Change, www.enablingchange.com.au

To address the above challenges, M-TACs must be staffed with personnel who understand all of these factors and how they will impact an SMM's innovative capacity and ability to commercialize technologies. To do this M-TAC personnel must be experienced business consultants who not only understand science, technology, marketing, and business, but who are also skilled at seeing the big picture from a supply chain needs perspective, building networks and making connections, and

confidently interfacing with all levels of personnel from top executives to those on the shop floor. An M-TAC's operations must be set up to encourage cross-geography and cross-industry networks built on open communication channels—both internally and externally among other M-TACs and MEP Centers. They must have clear goals and well-defined value and impact measures to ensure that they are bringing real results to those they serve.

Response to Questions

1. Technology transition and commercialization tools and services that should be provided by M-TACs

- The M-TACs should be designed with the above SMM issues in mind, ensuring that M-TACs can provide access to services to assist SMMs in all areas where they need assistance. These include helping SMMs to evaluate the ROI of specific technology acceleration opportunities, identifying funding mechanisms to enable technology purchases, connecting them with training resources or installation support that can enhance their capabilities, and providing executive coaching and education to reduce and manage risks. Note that M-TACs do not necessarily have to provide all the services in-house, but they do need to ensure that they have access to service providers that can perform those services (i.e., MEP Centers, community colleges, state technology-based economic development programs such as Pennsylvania's Ben Franklin Technology Partners, and other third-party providers).

- It is important to note that SMM adoption of technology for manufacturing process enhancement **is completely different** from technology adoption for product development and commercialization. In the first case (**goal 1, manufacturing process enhancement**), where an SMM wishes to change the way they manufacture their goods using a disruptive new technology such as additive manufacturing, SMMs may need training and support, or perhaps verification testing services, to bring the technology onboard. In the second case (**goal 2, product development and commercialization**), where an SMM wishes to commercialize new technology developed by research organizations into a new product, SMMs will need to understand market barriers and opportunities to create and realize a market entry strategy, identify intellectual property issues, find engineering capabilities to continue technology development, conduct product testing and refinement, and possibly provide ongoing customer support. It is clear that achieving these two goals will require very different activities and capabilities for which SMMs will require different kinds of support. We recommend that M-TACs be clear about the two goals and identify operational processes and services appropriate to both of them. For goal 2, **Figure 3** is an example of the types of services that RTI provides in support of technology commercialization, and which we suggest could be the basis for developing service offerings that M-TACs could provide.

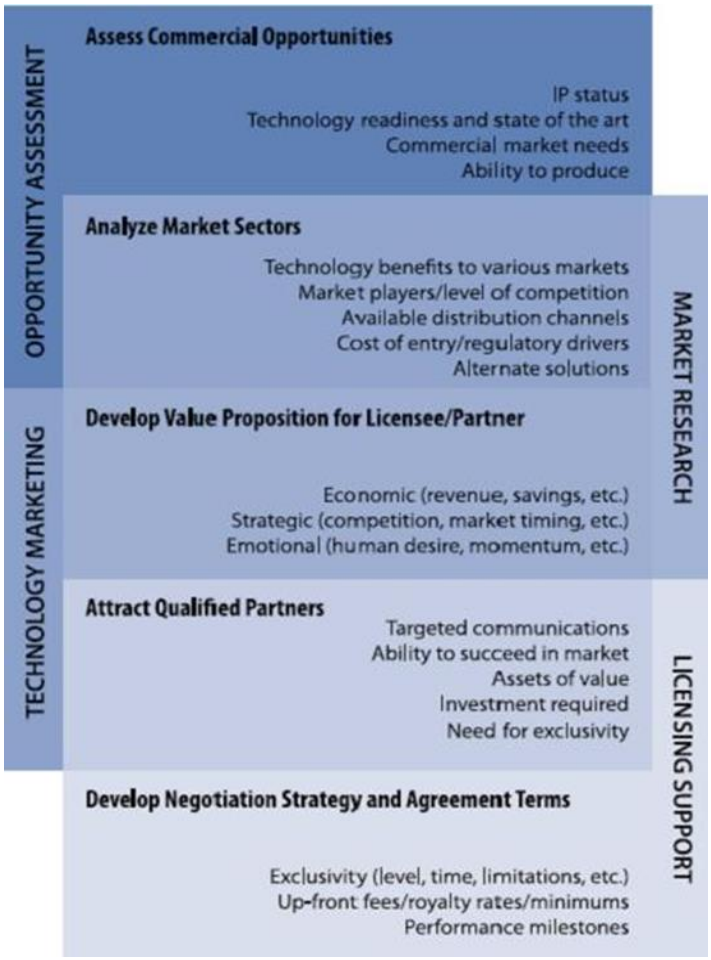

Figure 3: Possible M-TAC services in support of technology commercialization

Source: RTI International

- Complementary services: MEP Centers currently offer a variety of services, often with lean manufacturing and process efficiency services at their core. Their mission is to serve the growth needs of the entire SMM, not just in technology adoption but also in sustainability support for green manufacturing, assisting with exporting, providing workforce development, and connecting SMMs to supply chain sales opportunities. While some MEP Centers provide technology development, scouting, and market intelligence services, for M-TACs to effectively augment and leverage the existing MEP network, they should not seek to replicate or significantly duplicate the MEP Centers. We recommend that M-TACs focus only on the technology adoption needs of the SMMs and develop deep expertise in fewer service areas. For example, individual M-TACS could be responsible for deep knowledge and networks in a given technology area (e.g., robotics) or industry sector (e.g., medical) and rely on sister M-TACS to be networked and collaborative to provide broad system coverage. In addition, because MEP Centers are typically funded in part by their states, their services are limited to meeting the needs of the SMMs in those states. By design, M-TACs should be highly flexible to provide services across geographic boundaries.

2. M-TAC roles relating to supply chain needs

- Supply chain focus is one way, an especially effective way, for the M-TACs to develop and build upon deep knowledge and networks to be effective in a technology acceleration role. Focusing on a specific industry sector and supply chain will require the M-TACS to cross geographic boundaries and to build partnerships with MEP Centers and other organizations in regions where clusters exist within the target sector or supply chain. The M-TAC role would be to develop expertise and connections surrounding their particular industry to facilitate the transfer of technology. For example, the medical device industry has very specific Food and Drug Administration regulations that must be met throughout the course of technology development, but the automotive industry is focused on technologies that must meet entirely different requirements for cost and integration.
- M-TACs must connect to large original equipment manufacturers (OEMs) and prime contractors because they play a key role in creating the market demand and requirements necessary to create the opportunities for SMMs. OEMs are at the top of the supply chain, and their needs are a critical driver for the SMMs that supply to them. M-TACs can work with OEMs to clearly define their needs and quantify the potential business opportunities for meeting those needs. Because not all OEMs are located in the US, M-TACs need to also cross international boundaries to establish OEM relationships. Note that this could lead to more exporting activity.
- M-TACs can also be the "voice of the SMM supply-chain community," communicating the collective needs, issues, and ideas back to the OEMs. Innovation often comes from the supply chain and is born out of problems created by customer demands. Communicating these issues and ideas for solutions back to the OEMs will encourage open innovation. Thus, M-TACs can play a vital role in ensuring two-way communication up and down supply chains.
- In the course of developing their connections within a given supply chain, M-TACs should include industry associations and professional societies as part of their network, and should look to these organizations to assist with industry contacts and services.
- Instead of focusing the M-TACs by industry supply chains, NIST could consider focusing them by technology area and supporting value chain. This would help to align the M-TACs with technology development coming from the NNMI network from a technology commercialization perspective (goal 2), and would also help to deploy advanced manufacturing technologies into SMMs so they can more innovatively and efficiently produce products (goal 1). For example, an M-TAC focused on additive manufacturing technology will have established networks within the value chain that include additive manufacturing equipment manufacturers, contract manufacturing houses, 3D modeling and simulation software companies, distribution companies, installers and trainers, and users (typically early adopters of the technology that includes OEMs). This M-TAC could educate SMMs on the ROI of implementing additive manufacturing technologies already available to industry (such as stereolithography or metal powder bed fusion systems) and assist SMMs deciding to implement these existing technologies (goal 1). This M-TAC could also work with

the National Additive Manufacturing Innovation Institute to identify groundbreaking research that meets critical industry needs, and find companies interested in licensing and commercializing these technologies (goal 2). The M-TAC's established value chain network will be a resource that they can tap into for feedback on commercial need viability, and may contain potential licensees to commercialize the technology.

3. Potential business models for M-TACs

- Financially sustainable business models are market-driven. An organization will pay money only if it benefits in some way. RTI does not recommend any one business model, but offers the pros and cons of the following three models for NIST's consideration:
    - A fee-for-service–based business model works, but it may limit the M-TAC in providing its infrastructure role of being a connector between technologies at research organizations and companies that are capable and willing to commercialize them. At issue is that no one organization is willing to pay for the infrastructure. Companies looking for technologies to meet their specific needs will pay for technology scouting services. Research organizations looking for companies to license their technologies will pay for market intelligence services. One way around this is to charge a slightly higher fee and put that money toward infrastructure.
    - Another model that may be better suited to the M-TACs is the sliding-scale membership-based model. If the M-TACs were focused by supply chain, the members of the supply chain may be interested in contributing toward a membership fee as long as they derive benefit from being a member. This model requires careful planning and dedicated personnel to constantly communicate activities and value. But this approach ensures that members are highly vested, not just in a single project or service, but in the support that M-TACs can bring across the value chain to ensure that it is successful for all.
    - A third model for M-TACS to consider is to receive some of their compensation in the form of success fees or a percentage of certain transactions. This could offer a path toward long-term sustainability, but might also make the M-TACs overly selective in the types of projects they choose to undertake. Careful consideration regarding incentives, conflict of interest, and federal policies would be needed if this model were chosen.
- Intellectual property (IP) ownership issues can be a challenging subject for industry. IP often provides the basis of the value for many technology-based products. Obtaining ownership rights to the IP is an important consideration that companies make when investing their money in a membership-based collaborative. Now, with the change in IP law in the US to first-to-invent, companies may be even more concerned about disclosure to others and ensuring their IP rights. A typical model for a membership-based organization that develops IP is that members share ownership of jointly developed IP. However, if the M-TAC role is just to connect and facilitate technology acceleration, there will be little IP development within the bounds of the membership organization. In the case of a fee-for-service model,

contracts established at the beginning of each project should stipulate the IP ownership. In some cases it could be that the hiring organization fully owns any IP developed on their behalf, and in others, it could be a shared model. Regardless of the working model chosen for IP, the M-TACs will need to have the capacity to understand and help address IP issues.

4. M-TAC performance and impact metrics

- M-TAC performance and impact metrics should be tied directly to their goals. For example, if their goal is to increase the growth of the SMMs that they serve, then M-TACs should compare revenue of the collective SMMs before and after they were served by the M-TACs (allowing for sufficient time to permit product development, testing, and market entry). If their goal is to increase the transfer of US-funded technology developed in federal laboratories and universities, then activity and financial measures from these organizations that are already collected (such as number of licenses, percentage of licenses generating royalties) should be compared pre- and post-M-TAC involvement. However, as a coordinator and connector of value chains or as domain experts that provide awareness and connectivity to SMMs, M-TACs must ensure that metrics will account for their role in this capacity. Metrics could include the number of SMM-to-OEM connections made, the percentage of resulting deals from those connections, meeting revenue targets for membership, etc. Given the unique role M-TACs are intended to play, a unique set of success metrics will be required.

5. Other critical M-TAC issues for NIST to consider

- In our experience, few SMMs have the capability to commercialize early-stage technologies from research organizations (goal 2). If the M-TACs proceed with this goal, then it will be critical to carefully characterize what it takes for SMMs to be successful at technology development and commercialization. Further, the M-TACs will then need to be able to identify and assess SMMs for these characteristics to ensure success. In order to show success for the program it will be especially critical in the beginning to ensure that the M-TACs are focusing their resources and efforts on companies with the ability to successfully commercialize technology.
- It is likely that larger numbers of SMMs will be interested in adopting enabling new technologies for their in-house use (goal 1). M-TACs may want to start here to show greater impact and quick wins as they establish their presence, providing ROI education and connecting companies to workforce training and capabilities for technology implementation. Then, once the industry networks and technology connection capabilities of the M-TACs are pressure-tested and established the M-TACs will have a foundation for more proactive goal 2 efforts.