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To: amtech
Subject: AMTech Comments

AMTech Personnel

Attached please find the response to the subject questionnaire submitted by Enginuity, LLC on behalf of the United States Investment Casting Initiative team.

Very truly yours.

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RESPONSE TO NIST REQUEST FOR INFORMATION ON HOW TO STRUCTURE PROPOSED NEW PROGRAM: ADVANCED MANUFACTURING TECHNOLOGY COSORTIA(AMTech); Docket No. 110620345-1331-02

I. Introduction

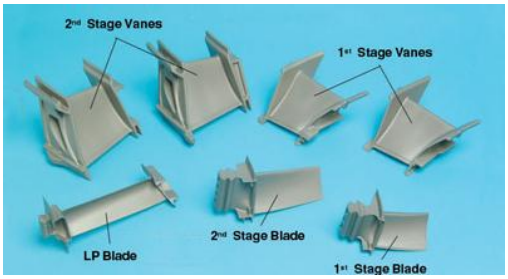
This response is being submitted by Ernie Kerzicnik, President, Enginuity, LLC on behalf of the **United States Investment Casting Initiative** team with members from the Government, casting suppliers and original equipment manufacturers.

II. Background

The investment casting industry, represented primarily by Precision Castparts Corporation (PCC) and Howmet Castings, a subsidiary of Alcoa Corporation, has been collaborating with original equipment manufacturers and the Government in support of developing innovative manufacturing technologies for use by the aerospace defense, commercial aviation and gas turbine power generation industries. The collaboration is a joint effort that includes PCC, Howmet, and representatives from the aerospace industry including Boeing, Northrop-Grumman, Lockheed, GE Aviation, Pratt & Whitney, Rolls Royce and Honeywell and the Air Force.

The turbine engine industry (NAICS 333600) exported over $21B worth of goods in 2007, providing a positive trade balance. However, market share has been reduced 20% over the last 25 years. The turbine engine industry of America continues to depend on high technology to improve performance and increase efficiency to provide power to aircraft, transportation and power generation. The erosion of U.S. market share demands ongoing investment in innovative in the critical manufacturing technologies to preserve America's defense technical superiority against this strongly growing foreign competition. This castings industry primarily produces complex titanium and superalloy castings used in structures and rotating components of current and future defense and commercial applications(aerospace and industrial gas turbines). This United States Investment Casting Initiative has prospered in the past by working in a collaborative manner with suppliers, OEMs and the Government under sponsorships primarily from DARPA and the USAF Manufacturing Technology Division. Evolving requirements have even placed a stronger demand for the need to accelerate this collaborative approach.

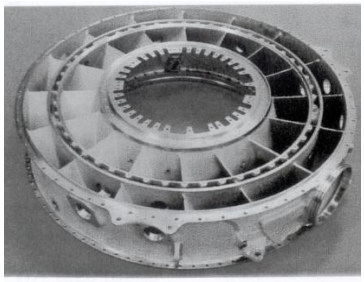
Castings are used in engines and airframes primarily to reduce manufacturing cost and/or increase performance. Nickel alloy castings are used in high temperature applications where extreme complexity precludes the affordable use of forgings and fabrications. Titanium castings are used in more moderate temperature applications where parts are large and where cost and weight are issues. Typical applications such as turbine nickel superalloy airfoils and titanium mainframes are pictured in the figures below.



Howmet Castings
an Alcoa business

ALCOA

PCC Structurals, Inc.



Innovative designs for increased performance and efficiency are outpacing the manufacturing technology to cost effectively produce them. The ability to meet DoD and commercial aviation and industrial gas turbine demands for such complex cast components in legacy and advanced engines and airframes is being compromised by the inability of the casting supply chain to produce the advanced components within the quality, delivery and cost requirements. The casting supply chain can be rejuvenated to meet these ever-increasing demands for U. S. security interests.

To help satisfy this need GE Aviation (GEA), Rolls Royce (RR), Pratt & Whitney (P&W), Boeing, Lockheed Martin Aeronautics, PCC, Howmet, Honeywell, the Air Force and others have joined together to begin to work these issues with an objective of increasing throughput and yield while reducing cost by a factor of 2X or greater. The team, reactivated early in 2005, has defined and pursued an aggressive plan comprised of several technology areas of interest. Select programs, e. g. digital radiography for aerospace and industrial gas turbine castings has been progressing for several years now and is on a path to successful implementation. Other inspection and casting technology projects have also been activated using leveraged Government funding sources.

This team maintains focus on pre-competitive issues including core quality, inspection methodology, and modeling/simulation to increase yield, allow increased component complexity, and improve basic casting practices. Justification has been made for this effort under completed or scheduled assessments and value stream analyses. The team works well by having a trusting partnership between the Government, OEMs and the suppliers. Over $29M of high priority projects have evolved; nonetheless, the challenges are even more demanding as the requirements and the adversarial global competition increases at a faster rate. The NIST AMTech program can provide a crucial balance between immediate needs currently being pursued by the US Investment Castings Initiative and the long-term major leaps in advanced technology to meet next generation requirements.

The manner of collaboration demonstrated by this team over the years is an excellent model of the Government and industry can work together for the benefit of the United States and its people.

III Questions/Reponses

Question 1. Should AMTech consortia focus on developments within a single existing or prospective industry, or should its focus be on broader system developments that must be supplied by multiple industries?

Response to Question 1. AMTech even if focused on a single industry will require a broad discipline of technologies to achieve the maturity needed for implementation. In addition, integration of technologies into a system cannot be overlooked if successful implementation is the ultimate goal. Therefore, limited funds require that NIST select critical areas within the industrial base which are anticipated to be crucial for future expansion of economic growth. Participants in AMTech should have a vested interest in its success.

Question 2. Who should be eligible to participate as a member of an AMTech consortium? For example, U.S. companies. *i.e.*, large, medium, and/or small; institutions of higher education; Federal agencies; state, local, and tribal governments; and non-profit organizations?
Response to Question 2. Participants should be limited to U. S. companies unless there is a compelling reason that participation of a foreign source could result in a net benefit to the industrial base. Companies or organizations should not be restricted, because, solution technologies can come from some of the most unlikely sources. The actual leader of an effort could be any of the candidates mentioned above, but they truly must be a "leader" that is respected by the other participants in the program.

Question 3. Should AMTech place restrictions on or limit consortium membership?
Response to Question 3. Consortium membership should be limited to participants who can play a constructive role. However, information dissemination should not be limited within the US industrial complex. The member need not to be a recipient of the funding but needs to add value.

Question 4. Who should be eligible to receive research funding from an AMTech consortium? For example, U.S. companies *i.e.*, large, medium, and/or small; institutions of higher education; Federal agencies; state, local, and tribal governments; and non-profit organizations?
Response to Question 4. Funding should be provided only to U. S. companies and institutions of higher learning. Government agencies can provide its own funding to serve as a leveraging vehicle for the entire program effort.

Question 5. What criteria should be used in evaluating proposals for AMTech funding?
Response to Question 5. The following criteria should be used: 1) Addressing critical areas within the industrial base which are anticipated to be crucial for future expansion of economic growth; 2) Proven past performance to innovate, collaborate and implement advanced technologies; 3) Endorsements from major companies which would be anticipated to be the users of the technology advancements; and, 4) technology dissemination plans.

Question 6. What types of activities are suitable for consortia funding?
Response to Question 6. Activities should be associated with manufacturing development of science and technology innovations in an integrated and coordinated environment, thereby addressing the ability to cost effectively produce and deliver the technology to the end user. These activities should include a constructive plan for implementation. Initial focus should be on TRL 3-5 with plans for going beyond to implementation. Maturation beyond TRL 5 could be funded by other sources. Manufacturing Readiness Levels(MRLs), a system to assess manufacturing maturity should also to be evaluated for each effort.

Question 7. Should conditions be placed on research awards to ensure funded activities are directed toward assisting manufacturing in the U.S.?
Response to Question 7. In general – YES.

Question 8. What are ways to facilitate the involvement of small businesses in AMTech consortia?
Response to Question 8. The technology roadmaps are an effective tool to highlight areas which may best be served by a small business. It is recommended that these topics be put forth in SBIR solicitations if not part of this project. Also, opportunities for networking small businesses and users has proven to create unexpected opportunities. The Navy SBIR office, for example, holds an annual Opportunities Days and the Advanced Manufacturing Propulsion Initiative host semi-annual reviews for which 20% of the attendees are small businesses.

Question 9. What are best practices for facilitating the widest dissemination and adoption of knowledge and technology through consortia?
Response to Question 9. Knowledge is best shared if documented in a well organized and simple to use format. Documenting the result in final report is good to prove to others that key issues have been thoroughly addressed. However, concise data rich documentation is required for the user to have quick access to the engineering and technical data required to use these activities as a springboard to focused development. These should be available on an appropriately protected website for collaboration and information exchange, possibly DOD Techpedia-like.

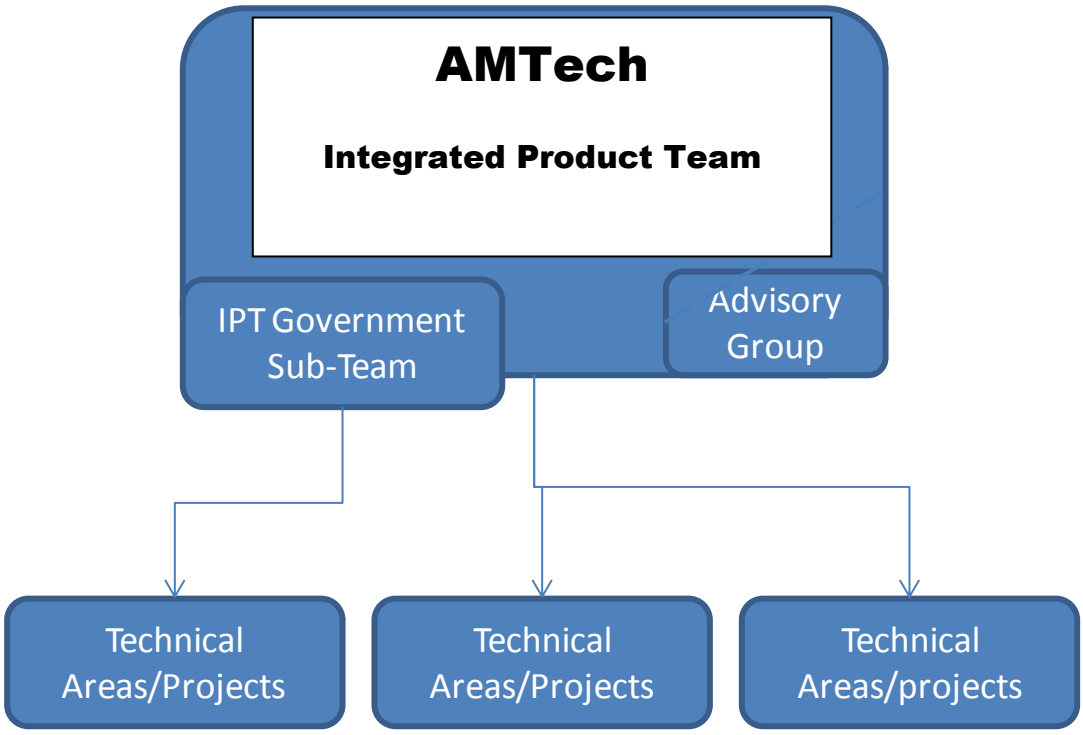
Question 10. While it is expected that the research efforts of AMTech consortia (including participants from the Federal, academic, and private industry sectors) will take place largely at the pre-competitive stage in the development of technologies, the generation of intellectual property is possible, and even likely. What types of intellectual property arrangements would promote active engagement of industry in consortia that include the funding of university-based research and ensure that consortia efforts are realized by U.S. manufacturers?
Response to Question 10. The arrangements for the development and use of intellectual property need to be clearly defined. The Metals Affordability Initiative (MAI) effort can serve as one good example. The Air Force's Advanced Manufacturing Propulsion Initiative(AMPI) could serve as another good example. In other cases, the developer was obligated to provide a licensing option for others interested in the technology, thereby retaining the invention rights.

Question 11. Would planning grants provide sufficient incentive for industry to develop roadmaps and initiate the formation of consortia? If not, what other incentives should be considered?
Response to Question 11. No, if there is value in working pre-competitive technologies, companies will come together and invest their employees time to jointly develop the roadmaps in order to reap future technical benefits. Industries which cannot bring themselves to work together in a precompetitive environment are unlikely to work common issues or share technology developments and therefore, must be excluded from this activity. The Government can play a key role in coordinating initial discussions as well as provide needed funding.

Question 12. Should each member of an AMTech consortium be required to provide cost sharing? If so, what percentage of cost sharing should be provided?
Response to Question 12. Cost sharing can be considered in proposal evaluations, but in these difficult economic times, cost sharing to any great degree is unrealistic.

Question 13. What criteria should be used in evaluating research proposals submitted to an AMTech consortium?
Response to Question 13. Proposals should be evaluated on technical merits(30%), potential growth for the U. S. economy(30%), soundness of the technical approach and project management plan(25%) and qualifications of the personnel, past experience and cost share(15%). Careful attention should be given to the validity of major claims concerning the proposed effort.

Question 14. What management models are best suited for industry-led consortia?
Response to Question 14. The AMTech program should be managed by an integrated product team(IPT). A subset of members of the IPT should serve as an Advisory Council. These are primarily the end users of the eventual products. The government representatives can form the Government sub-team which can oversee areas of intellectual property concerns until licensing agreements can be created. Leaders of collaborative technical activities are accountable to the IPT. IPT team membership would include representatives of the product manufactures, selected customers and interested Government parties. The IPT also should include an overall independent facilitator so that leadership is not driven by the agenda of one company and has access to all technical and financial information regarding the progress of the AMTech efforts in the consortium. A descriptive chart is shown below.



Question 15. Should the evaluation criteria include the assessment of leadership and managerial skills?
Response to Question 15. The evaluation criteria should include an assessment of leadership and management skills. These skills are keys to proper management of complex technical programs.

Question 16. Should limitations be placed on the duration of consortia?
Response to Question 16. There should be no limitation on the duration of the consortia. The **United States Investment Casting Initiative** team has generally been together for over 20 years. However, the consortia must at least last through the anticipated term of the AMTech.

Question 17. How should an AMTech consortium's performance and impact be evaluated? What are appropriate measures of success?
Response to Question 17. Performance must be measured as the projects proceeds such as the evaluation of MRLs and TRLs at go/no-go decision points, the ability to meet technical milestones based on the technology roadmap and critical elements to reduce the risk and meet objectives. Impact to the industrial base will not be able to be measured until 5 to 10 years after implementation. Therefore, the impact can be projected and implementation for certain products can be confirmed. It is typically difficult to prove that a certain technology increased the number of jobs and that it was not just a contributing factor.

Question 18. What are the problems of measuring real-time performance of individual research awards issued by an industry-led consortium? What are appropriate measures of success?
Response to Question 18. Periodic reviews or "gate level" reviews should be held to assess progress. Various techniques could be used including adherence to goals and scheduled events. If it is determined that the effort is not leading to a successful conclusion, the effort should be terminated and remaining funds should be transferred into the AMTech funding pool and used for other more worthy projects.

Question 19. How should the NIST AMTech program be evaluated?
Response to Question 19. The AMTech program should be evaluated in a manner no different than other Government sponsored programs, i. e. the Government should assess the benefits and the return on its investment as it impacts the U. S. economy and resulting employment. AMPTech can measure the R&D cycle time and document improvements, they can measure the innovations which have been introduced and they can project growth as these technologies are integrated into a variety of products. AMTech may also be able to measure spin-off technologies, benefits not directly intended, but facilitated by the pre-competitive research.

Question 20. What are lessons learned from other successful and unsuccessful industry-led consortia?
Response to Question 20. There have been several highly beneficial industry-led consortia, e. g. the **United States Investment Casting Initiative** and **MAI.** Clearly defined goals and metrics have been a key to success including the trust and interaction of the total value chain. Industry-led consortia which have worked well include formations of centers of excellence. These efforts have idealistic objectives but are generally not managed well and do not have

proper industry participation. Consortia that involve more than one Government agency have also not worked well due to conflicting government agency priorities; however, if properly constructed, such efforts can be successful when common objectives and a good trusting working relationship exists.

Question 21. How can AMTech do the most with available resources? Are there approaches that will best leverage the Federal investment?
Response to Question 21. AMTech has limited resources to try and do too much. It should focus on a few specific industry sectors and try and leverage its funds with other ongoing programs in different agencies such as those mentioned in the response to Question 20. AMTech needs to identify the technology sectors to target and understand the body of work currently being performed and ensure that funded efforts fill the technology gaps to push the technology and the manufacturing forward in an integrated manner.

Question 22. How should AMTech interact with other Federal programs or agencies?
Response to Question 22. AMTech should join in discussions with ongoing programs of mutual interest. There is already a NIST representative who has joined participation in the **United States Investment Casting Initiative** team discussions.

Question 23. What role can AMTech play in developing, leading, or leveraging consortia involving other Federal agencies?
Response to Question 23. AMTech leadership should establish a meeting and invite interested parties such as those mentioned previously to better understand AMTech's plans and potentially begin exchanging ideas of mutual interest. They can put before them the challenge to work with NIST to achieve specific technical/manufacturing milestones of common interest.

IV Point of Contact

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