Final Report of the Committee to Review Proposals to the 2011 Ohio Third Frontier Wright Projects Program (OTF WPP)

Committee to Review Proposals to the 2011 Ohio Third Frontier Wright Projects Program (OTF WPP)
Aeronautics and Space Engineering Board
Division on Engineering and Physical Sciences
NATIONAL RESEARCH COUNCIL
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This report has been reviewed in draft form by A. Thomas Young, Lockheed Martin Corporation (retired), in accordance with procedures approved by the Report Review Committee of the National Research Council. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

Although Dr. Young provided many constructive comments and suggestions, he was not asked to endorse the conclusions or recommendations, nor did he see the final draft of the report before its release. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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May 13, 2011

James Leftwich
Director
Ohio Department of Development
77 S. High Street
Columbus, OH 43215-6130

Dear Mr. Leftwich:

This letter details the work and transmits the final report of the Committee to Review Proposals to the 2011 Ohio Third Frontier Wright Projects Program (OTF WPP). This activity was supported by a contract from the Ohio Department of Development (ODOD) with the National Academy of Sciences and was performed under the auspices of the National Research Council's (NRC's) Aeronautics and Space Engineering Board (ASEB). The NRC is committed to providing elected leaders, policy makers, and the public with expert advice based on sound scientific evidence. For this study, the committee appointed to conduct the review was asked not only to exercise scientific judgment but also to focus on commercial viability and job creation as key considerations. This is the ninth year the NRC is reviewing proposals for the Third Frontier Commission (TFC).

Program Objectives

The purpose of the WPP is to provide support for the OTF goal of building strong research capabilities within the state's colleges and universities that support the needs of Ohio industry. The program offers grants for capital equipment that will benefit entrepreneurial and commercial purposes in the short term and contribute to the training and education of the workforce in the long term. The program requires collaborations led by Ohio universities and colleges in partnership with Ohio businesses to further the near-term (within 3 years) commercialization of new technologies or capabilities. Additionally, the Request for Proposal (RFP) states, "Teams with strong commercialization structures are preferred over Projects without access to the commercial market. Any commercialization that results must benefit Ohio through investment, sales, job creation, and/or business capitalization."[1]

Scope of Engagement

For the 2011 WPP, a total of 24 proposals were submitted, 23 of which passed an administrative review by ODOD and were evaluated by the committee. Proposals spanned the five opportunity areas

[1] Request for Proposal, p. 9.

identified in the program's RFP: Advanced Materials; Biomedical; Advanced/Alternate Energy; Instruments, Controls, and Electronics; and Advanced Propulsion (Table 1).

This report provides the committee's assessment of all of the received proposals. The committee recommends that the TFC consider funding 3 of the 23 proposals; these 3 recommended proposals make a strong case that they would achieve the goals and purpose of the WPP, including job creation. The total amount of state funds requested by the recommended proposals is $7,536,257. The committee notes that the quality of the proposals submitted to the 2011 program appears to have declined from competitions in previous years, as evidenced by the committee's recommendations falling well short of the funds available for the program.

TABLE 1 Wright Projects Program Proposal Distribution by Opportunity Area

Advanced Materials	Biomedical	Advanced/ Alternate Energy	Instruments, Controls, and Electronics	Advanced Propulsion	Number of Proposals
x					6
	x				2
		x			4
			x		4
				x	1
		x	x		1
		x	x	x	2
x	x				1
x	x	x			1
x			x	x	1

Review Methodology

Committee members were recruited based on their familiarity with the subject areas of the 23 proposals to be evaluated and for their experience with business practices, technology transfer, venture capital, and economic development. The committee was chaired by T.S. Sudarshan, president and CEO of Materials Modifications, Inc. The committee comprises a combination of working engineers, academics, and business executives; two are members of the National Academy of Engineering, and one is a member of the National Academy of Sciences. The committee roster appears on page v, and biographical sketches of the committee members can be found in Appendix D.

Based on criteria and proposal requirements specified in the RFP, ASEB staff developed an evaluation worksheet (Appendix C) to help guide the initial evaluation of the proposals. Committee members were then assigned 3 to 7 proposals to review. For each proposal, committee members were designated as primary or secondary reviewers for the purposes of guiding committee discussions at the first meeting. Each proposal was evaluated by at least four committee members before the committee's first meeting.

The committee held its first meeting in Irvine, California, on March 3-4, 2011. At that meeting, the primary and secondary reviewers used the worksheets they completed to lead the rest of the committee in a discussion of the strengths and weaknesses of each of the 23 proposals. Because of their subjective nature, the evaluation worksheets were used only to guide discussions. Based on those discussions, the committee selected 11 proposals by consensus for further examination at the committee's

second and final meeting. The committee also developed a list of follow-up questions that addressed areas of concern for each of these 11 proposals. These questions were sent to ODOD, who forwarded them to the lead applicants prior to the second meeting. At the close of the first meeting, all committee members were asked to read each of the 11 proposals prior to the committee's second meeting.

At its second meeting in Columbus, Ohio, on April 20-21, the committee interviewed the applicant teams of the 11 proposals selected at the first meeting. Each applicant team was given 25 minutes to address the committee's follow-up questions, followed by 20 minutes of additional discussions led by the committee. The committee subsequently reached consensus on which proposals best satisfied the requirements of the RFP.

Evaluation Criteria and Key Differentiators

The WPP's RFP details the evaluation criteria used by the committee. The evaluation worksheet used to guide the committee's initial evaluation of the proposals grouped these criteria into five broad sections (Appendix C). Some of the included criteria were the following:

- *Technical Merit and Plan.* Are technical and commercial challenges described? How will goals and objectives be met? How will progress be made and measured? Are the scientific objectives original and innovative? Are novel concepts, approaches, or methods employed? What is the scientific and technical feasibility?
- *Commercialization Strategy.* Will the proposal realize near-term commercialization? Does the proposal define the benefits of the proposed approach and explain why the market values these benefits? How will new intellectual property be managed to benefit Ohio-based companies? Is the proof of principle already demonstrated? Does the proposal accurately assess the market and have realistic assumptions about market share that could be captured? What is the needed investment and time to market? Does the proposal have the ability to leverage Ohio's supply chain, existing or emerging?
- *Objectives and Performance Goals.* Are the capital acquisitions and improvements at an Ohio college, university, or nonprofit institution? Will the project have an impact on job creation or retention? Are the forecasts of new jobs, income, and revenue realistic? Are the direct economic impacts identified for each distinct product or platform that will come from state investment?
- *Experience, Qualifications, and Eligibility.* Does the proposal demonstrate commitment of the lead applicant and collaborator(s) to building a sustainable partnership? Is leadership demonstrated in all critical phases? Does the team have relevant organizational experience to perform technical and commercialization work involved? Will the partnership have the capability for commercializing any resulting technology?
- *Budget and Cost Share.* Is the budget justified and adequate to meet proposal goals? Is it adequately explained in the proposal's budget narrative? Is no more than 20 percent budgeted for indirect costs? Is the cost share necessary and reasonable? Are commitment letters provided and sufficiently detailed?

During the course of the study, the committee prepared an overview table (Appendix A) to summarize how well each proposal satisfied the evaluation criteria in each of the above groups. The chart indicates if a proposal *exceeds* RFP requirements, *meets* RFP requirements, or *does not meet* RFP requirements.

Recommendations

The committee recommends that the TFC consider funding three proposals that make a strong case that they would achieve the goals and purposes of the WPP (see Table 2). In terms of the evaluation criteria presented in the RFP, the strengths of these proposals far outweigh whatever weaknesses may be present. Detailed reviews of all 23 proposals appear in Appendix B. The committee was unable to put the proposals in any kind of rank order, as they are essentially equal in merit and equally deserving of consideration for funding.

TABLE 2 Proposals Recommended for Funding Consideration, Ordered by Proposal Number

Proposal	Title
11-409	Integrated Ultrasonic Additive Manufacturing and Laser Machining for Realization of Novel Smart Structures
11-420	Solar-Durability and Lifetime Extension Center
11-427	Improved Human Health by Commercial Development and Deployment of Innovative Ohio Sanitation Technology: Heat/Ozone Biomedical Technology to Produce Safe Eggs

Two of these three proposals are recommended with caveats: 11-427 warrants consideration for funding only if ODOD can confirm, through receipt of a revised letter of commitment, the amount of cost share to be provided by Egg Tech; and 11-409 warrants consideration for funding only if Fabrisonic submits a letter of commitment and the applicant team clearly identifies and commits to using Ohio-based manufacturers for the UAM-LM systems.

The three recommended proposals are summarized as follows:

- *Integrated Ultrasonic Additive Manufacturing and Laser Machining for Realization of Novel Smart Structures (11-409)* involves integrating three different cutting-edge technologies to develop an advanced manufacturing technology that has the potential to assist in advancing the field of smart structures. The objective is to build on the success from a previous Wright Project in hopes of bringing a new range of smart materials to the commercial market. The proposed work is well thought out and well planned. Every aspect meets the specific requirements of the RFP. The proposed work has merit, and the details presented make a compelling case of how the proposed technology will be commercialized.
- *Solar-Durability and Lifetime Extension Center (11-420)* seeks the establishment of the Solar-Durability and Lifetime Extension (S-DLE) Center at Case Western Reserve University. The S-DLE Center will use specific expertise in the Case School of Engineering to develop real-time and accelerated protocols for exposure to solar radiation and related environmental impacts on solar technologies. Post-exposure optical and thermo-mechanical measurements will aid in the development of quantitative prediction models of the major degradation mechanisms in the bulk of the device, as well as the inherent interfaces between dissimilar materials that are critical for device performance and, at the same time, particularly susceptible to degradation. The proposal meets or exceeds all of the requirements of the RFP. There is a critical and urgent need for solar specific durability and lifetime evaluation capabilities to help in the development and commercialization of new solar components and systems. The results of this collaboration should lead to an acceleration of product development and commercialization for the Ohio companies that are part of the proposal. Additionally, the committee notes that this center can lead the way for the establishment of standards for solar durability testing and may attract future investment from other states or companies.

- *Improved Human Health by Commercial Development and Deployment of Innovative Ohio Sanitation Technology: Heat/Ozone Biomedical Technology to Produce Safe Eggs (11-427)* aims to demonstrate the large-scale commercial viability of OSU's heat/ozone technology for the pasteurization of whole eggs. The heat/ozone technology is the only technology to date that has been able to maintain sensory and functional performance while meeting the stringent requirements of the 1999 U.S. Egg Safety Action Plan, a federal mandate requiring that whole eggs be pasteurized and thus free of *Salmonella enteritidis* bacterium, a serious health hazard. The proposal exceeds all of the requirements of the RFP. The strengths of this proposal include the fact that Ohio is a producer of a significant share of eggs for the U.S. market, the applicants are a strong, committed team comprised of experts in all the key areas, there is a clear market need for eggs produced by a pasteurization method that produces guaranteed safe eggs with the desired performance and sensory characteristics, the heat/ozone technology is already FDA-approved, first-to-market position is imminent, and its communication and management approaches will keep the project on track. The committee believes that the team, if successful, may be able to generate significant additional private capital investment, creating the potential for a number of future jobs at all levels.

All of the remaining 20 proposals scored substantially lower than the three proposals listed above *when ranked against the criteria and requirements specified in the WPP's RFP*, and they are not recommended for consideration under the current year's program. This does not necessarily mean that the proposals lack merit or should not be funded as part of some other program sponsored by the TFC, the State of Ohio, or the federal government. For example, *Advanced Simulation Center for Driver and Vehicle Communications (11-451)* has excellent technical goals and objectives but is lacking in its commercialization strategy and concrete job creation. There is no clearly identified commercializable product, and there is a lack of a well-defined link to job growth within the funding term of the grant. Given the importance of job creation and commercialization to the WPP's RFP, the committee could not recommend the proposal be considered for funding, even though it is an otherwise excellent concept. The specific strengths and weaknesses of all the WPP proposals are included in the individual reviews in Appendix B.

The committee wishes to thank the State of Ohio for the opportunity to review these proposals and to provide its recommendations as to which of the proposals best meet the requirements set forth in the RFP.

Sincerely,

T.S. Sudarshan, *Chair*

cc: Michael H. Moloney, Director, Aeronautics and Space Engineering Board

Appendixes

A Overview Table
B Individual Summary Evaluations
C Evaluation Worksheet
D Biographical Sketches of Committee Members
E Biographical Sketches of Staff and Other Contributors

Appendix A
Overview Table

This table was prepared by the committee to summarize how well each proposal satisfied the evaluation criteria of the Request for Proposals (RFP) for the 2011 Ohio Third Frontier Wright Projects Program.

Key	
E	Exceeds Requirements of the RFP
M	Meets Requirements of the RFP
D	Does Not Meet Requirements of the RFP

Proposal (Lead Applicant)	**Technical Merit and Plan**	**Commercialization Strategy**	**Objectives and Performance Goals**	**Experience, Qualifications, and Eligibility**	**Budget and Cost Share**	
Recommended						Caveat
11-409 Integrated Ultrasonic Additive Manufacturing and Laser Machining for Realization of Novel Smart Structures (Edison Welding Institute)	**E**	**E**	**M**	**E**	**M**	Needs a letter of commitment from Fabrisonic and the applicant team must clearly identify and commit to using Ohio-based manufacturers
11-420 Solar-Durability and Lifetime Extension (S-DLE) Center (Case Western Reserve University)	**M**	**E**	**M**	**E**	**M**	N/A
11-427 Improved Human Health by Commercial Development and Deployment of Innovative Ohio Sanitation Technology: Heat/Ozone Biomedical Technology to Produce Safe Eggs (The Ohio State University)	**E**	**E**	**E**	**E**	**E**	Needs letter of commitment from Egg Tech with explicit indication of cost share commitment

Proposal (Lead Applicant)	Technical Merit and Plan	Commercialization Strategy	Objectives and Performance Goals	Experience, Qualifications, and Eligibility	Budget and Cost Share	
Not Recommended						Key Weaknesses
11-404 Enabling Flexible Fabrication and Robotic Assembly through Agile Manufacturing (Ohio Northern University	**D**	**D**	**D**	**M**	**M**	Lacks clear pathway to commercialization and long-term plan for sustainability; and technical uncertainties
11-406 Rapidly Deployable, Wide-Area Sensor System for Security Operations (RD-WASS) (University of Dayton)	**M**	**D**	**D**	**M**	**D**	Does not fully realize path to commercialization; failed to emphasize key aspects of technology; not suited for WPP funding, considering other types of funding available for projects of this nature
11-407 Developing Advanced Materials Forming Capability for Automotive and Aerospace Structures (Edison Welding Institute)	**M**	**D**	**M**	**M**	**M**	Did not convey sufficient market pull; did not have an Ohio stamping manufacturer speak of a need for this technology
11-408 Commercialization of Advanced Materials Modeling and Characterization Methods (The Ohio State University)	**D**	**M**	**M**	**M**	**E**	Questionable technical merit; project largely based around acquisition of equipment, which does not fulfill requirements of RFP
11-410 Center for the Smart Electrical Grid (The Ohio State University)	**M**	**D**	**D**	**M**	**M**	Did not adequately address technical issues associated with scale-up of technology; uncertainties surrounding finances of collaborators; lack of clearly defined long-term commercialization strategy
11-416 Center for Advanced Energy Storage Interoperability (The Ohio State University)	**D**	**D**	**M**	**M**	**M**	Further definition concerning performance goals and the interaction of team participants is necessary; last-minute addition of FIAMM and lack of participation by Nexergy during the committee's second meeting leave a number of questions regarding the viability of the project
11-418 Cryogenic Engineering and Device Laboratory for Medical and Energy Applications (The Ohio State University)	**D**	**D**	**M**	**E**	**M**	High-level technical deficiencies (i.e., inability to reconcile wind-turbine and NMR applications and technologies); lacks clear commercialization strategy

Proposal (Lead Applicant)	Technical Merit and Plan	Commercialization Strategy	Objectives and Performance Goals	Experience, Qualifications, and Eligibility	Budget and Cost Share	
11-419 Center of Excellence for Bio-refining: Bio-derived Polymers, and Fuels and Advanced Materials (University of Toledo)	**M**	**D**	**D**	**M**	**M**	Unrealistic commercialization plan and objectives, given considerable technology challenges in the timeframe of the RFP
11-421 Light Vehicle Manufacturing Commercialization Center (The Ohio State University)	**D**	**D**	**D**	**M**	**M**	Unrealistic technical plan in allotted RFP timeframe; uncertain market demand; uncoordinated commercialization strategy; uncertain sustainability
11-422 Orthopaedic Device Commercialization Accelerator (Austen BioInnovation Institute of Akron)	**D**	**D**	**M**	**M**	**M**	Technical plan lacking in crucial details; no clear path to commercialization; did not address how project would overlap with other polymer expertise within the University of Akron
11-423 Clean Energy Vehicle Charging Station with Grid Interface (University of Akron)	**D**	**D**	**D**	**D**	**D**	Commercial partners do not appear to have significant enough of a role in commercialization strategy or general stake in the project; questionable applicability of technical approach to commercial opportunity
11-426 Smart Grid Proving Ground and Commercialization Infrastructure (Youngstown State University)	**D**	**D**	**M**	**M**	**M**	Fails to document specific commercialization performance and jobs creation in a 3- to 5-year timeframe; submission to a future WPP competition might merit funding if specifically documented markets and jobs potential could be more of the focus of the proposal
11-431 Porous Structures for Biomedical and Environmental Applications (University of Toledo)	**M**	**D**	**M**	**E**	**M**	Technology is not advanced to the point where it can be realistically commercialized within the timeframe of the RFP
11-432 High Frequency Active and Passive Electronic Devices and Sensors (The Ohio State University)	**D**	**D**	**D**	**M**	**M**	Weak technical plan; uncertainty about commercial viability of product, considering how narrow the market is; unrealistic objectives and performance goals

Proposal (Lead Applicant)	Technical Merit and Plan	Commercialization Strategy	Objectives and Performance Goals	Experience, Qualifications, and Eligibility	Budget and Cost Share	
11-434 Commercialization of High Speed Imaging Camera Technology for Laser Radar Vibrometry (University of Dayton)	**D**	**D**	**D**	**M**	**E**	Unlikely that technology can be developed within the RFP timeframe to be commercialized; overall doubts of commercial viability; disconnect between equipment acquisition and commercial success
11-437 Research, Development and Commercialization of Micro Air Vehicle Platforms in the Miami Valley (Wright State University)	**M**	**D**	**D**	**M**	**M**	Unlikely that technology can be developed within the RFP timeframe to be commercialized; unrealistic commercialization strategy and performance goals
11-441 Addressing Commercialization Barriers through the Development of a Smart Grid Test Facility (Cuyahoga Community College)	**D**	**M**	**D**	**D**	**M**	Concerns over long-term technical feasibility not adequately addressed; objectives and performance goals too vague
11-442 Development and Commercialization of Revolution Mill-Turn Machine Tools Using Open Architecture Controller for Aerospace/Aviation Complex Part Manufacturing (TechSolve, Inc.)	**D**	**D**	**D**	**D**	**D**	Serious technical deficiencies; vague commercialization strategy; lack of expertise in a key area on applicant team; unrealistic budget
11-451 Advanced Simulation Center for Driver and Vehicle Communications (The Ohio State University)	**M**	**D**	**D**	**E**	**M**	No clear link between proposal and job creation; no well-defined product to commercialize
11-453 Supporting Commercialization in Ohio's Photovoltaics Industry: Acquisition of a Second Ion Mass Spectrometer (University of Toledo)	**M**	**D**	**D**	**M**	**M**	Weak rationale for need to acquire equipment that can be accessed by interested parties elsewhere; lack of substantial commercialization strategy

Appendix B
Individual Summary Evaluations

Summary evaluations of the 23 proposals to the 2011 Ohio Third Frontier Wright Projects Program (OTF WPP) are given below. Proposals were evaluated according to criteria given in the Request for Proposals (RFP).

Recommended

11-409 Integrated Ultrasonic Additive Manufacturing and Laser Machining for Realization of Novel Smart Structures (Edison Welding Institute)

11-420 Solar-Durability and Lifetime Extension (S-DLE) Center (Case Western Reserve University)

11-427 Improved Human Health by Commercial Development and Deployment of Innovative Ohio Sanitation Technology: Heat/Ozone Biomedical Technology to Produce Safe Eggs (The Ohio State University)

Not Recommended

11-404 Enabling Flexible Fabrication and Robotic Assembly through Agile Manufacturing (Ohio Northern University)

11-406 Rapidly Deployable, Wide-Area Sensor System for Security Operations (RD-WASS) (University of Dayton)

11-407 Developing Advanced Materials Forming Capability for Automotive and Aerospace Structures (Edison Welding Institute)

11-408 Commercialization of Advanced Materials Modeling and Characterization Methods (The Ohio State University)

11-410 Center for the Smart Electrical Grid (The Ohio State University)

11-416 Center for Advanced Energy Storage Interoperability (The Ohio State University)

11-418 Cryogenic Engineering and Device Laboratory for Medical and Energy Applications (The Ohio State University)

11-419 Center of Excellence for Bio-refining: Bio-derived Polymers, and Fuels and Advanced Materials (University of Toledo)

11-421 Light Vehicle Manufacturing Commercialization Center (The Ohio State University)

11-422 Orthopaedic Device Commercialization Accelerator (Austen BioInnovation Institute of Akron)

11-423 Clean Energy Vehicle Charging Station with Grid Interface (University of Akron)

11-426 Smart Grid Proving Ground and Commercialization Infrastructure (Youngstown State University)

11-431 Porous Structures for Biomedical and Environmental Applications (University of Toledo)

11-432 High Frequency Active and Passive Electronic Devices and Sensors (The Ohio State University)

11-434	Commercialization of High Speed Imaging Camera Technology for Laser Radar Vibrometry (University of Dayton)
11-437	Research, Development and Commercialization of Micro Air Vehicle Platforms in the Miami Valley (Wright State University)
11-441	Addressing Commercialization Barriers through the Development of a Smart Grid Test Facility (Cuyahoga Community College)
11-442	Development and Commercialization of Revolution Mill-Turn Machine Tools Using Open Architecture Controller for Aerospace/Aviation Complex Part Manufacturing (TechSolve, Inc.)
11-451	Advanced Simulation Center for Driver and Vehicle Communications (The Ohio State University)
11-453	Supporting Commercialization in Ohio's Photovoltaics Industry: Acquisition of a Second Ion Mass Spectrometer (University of Toledo)

OTF WPP 11-409
Integrated Ultrasonic Additive Manufacturing and Laser Machining for Realization of Novel Smart Structures
Edison Welding Institute, Inc.

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$100,983	$1,484,672
Capital Funds	$1,551,987	$168, 298
Subtotal	$1,652,970	$1,652,970
TOTAL	$3,305,940	

This proposal, led by the Edison Welding Institute (EWI), involves integrating three different cutting-edge technologies to develop an advanced manufacturing technology that has the potential to assist in advancing the field of smart structures. The objective is to build on the success from a previous Wright Project in hopes of bringing a new range of smart materials to the commercial market. Collaborators for this proposed work are Solidica; The Ohio State University (OSU); the Boeing Company; Veloycs, Inc.; Polytec, Inc.; Honda R&D Americas, Inc.; Dukane; and Parker Aerospace.

Detailed Review:

- **Technical Merit and Plan**

This proposal aims to combine three cutting edge technologies—Ultrasonic Additive Manufacturing (UAM), Smart Materials, and Laser Micromachining (LM)—to create a manufacturing technology that has the potential to create novel solutions to engineering problems. The proposal builds on the success of a previous Wright Project that led to the development of a very-high-power UAM. The problem statement and the plan for research and development of the new technology are clearly addressed and well explained.

The technical plan for this proposal sufficiently addresses the five major objectives of the OTFWPP. This project supports capital acquisition. It will provide OSU with a unique manufacturing system that will allow for expansive scientific and applied research in materials, devices, and structures based on active "smart" materials embedded in metal parts. The technical plan outlines the procedure for commercial market entry. A previous Wright Project that included EWI, OSU, and Solidica created a new Ohio-based entity, Fabrisonic, which was formed to sell UAM systems. The proposed project targets a clear commercialization path of productizing an integrated UAM-LM system to add to Fabrisonic's market offerings. The proposed project has the potential to create wealth in Ohio through the development of a new manufacturing machine. This should lead to new product offerings at Fabrisonic and increased research capability at Ohio nonprofits (EWI/OSU). The proposed project will provide a major, unique capital equipment facility to be shared by OSU and EWI. The unique machine being proposed will be utilized for education of undergraduate and graduate students in a broad range of disciplines, including manufacturing, mechanics, materials science, and applications. Building on existing strengths at OSU in the transportation area, this activity will also spearhead continuing education opportunities for industry personnel. The proposal exceeds the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

If successful, the proposed technology can lead to products (advanced materials; an UAM-LM system) that have significant potential for commercialization opportunity in Ohio. The leader of this proposed project (EWI) and two of the collaborators (OSU and Solidica) have created a new Ohio-based entity, Fabrisonic, which was formed to sell the UAM system that was the product of a previous Wright Project (VHP-UAM). Although Fabrisonic has a vital role in this proposal, there is no official commitment from

this company. There should be a formal letter of support included from Fabrisonic similar to those provided by other collaborators. The proposed project will be part of an integrated commercialization strategy that involves both the previously developed VHP-UAM and the proposed UAM-LM systems. The proposed plan will build on the results of the market studies provided in the previous study for the VHP-UAM system. The role of Fabrisonic is well defined, which is to sell the UAM-LM systems. However, the companies that will actually make the UAM-LM systems are not identified. To be in accordance with the RFP, the applicant team must clearly identify manufacturers in the State of Ohio that will manufacture these UAM-LM systems. If the team can commit to utilizing Ohio-based manufacturers, then the proposal will meet the requirements of the RFP on Commercialization Strategy (otherwise, it will not meet the requirements).

- **Objectives and Performance Goals**

The major goals of this proposal are to provide OSU with a major capital equipment acquisition, expand the research collaboration between industry and academia, demonstrate a significant array of embedded smart materials structures to industrial and government partners, and expand the product offering of Fabrisonic. By year 5, the proposal anticipates that a total of 18 jobs will be created: 6 at Fabrisonic due to increased business and 12 at EWI and OSU due to increased research. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

EWI will serve as the lead on this project. EWI is a national leader in the field of welding and cutting technology and has expertise in the proposed UAM technology, in addition to other solid-state welding processes. EWI pioneered the technology of VHP-UAM that was developed under previous Wright Project proposal 09-017. The selling of the UAM machines and services will be handled by Fabrisonic. The lead and key personnel from EWI, OSU, Fabrisonic, and other collaborators have significant experience and expertise in the respective areas of this project.

The OSU College of Engineering is ranked ninth in the country among public universities and colleges for research and development expenditures. The lead collaborator from OSU has more than 16 years of experience making sustained scientific contributions to the field of smart materials and will serve as the Lead Technical Advisor to the program. The Smart Vehicle Center (SVC) is a National Science Foundation (NSF) Industry/University Collaborative Research Center located at OSU that is devoted to the application of smart materials in commercial structures. This industry consortium, led by OSU, has been active in deploying smart materials in industry.

Solidica will provide engineering and programming support during the design and implementation of the UAM hardware. EWI and Solidica also formed Fabrisonic. The Boeing Company will provide support for the development of the UAM-LM system by applying this technology to materials and systems of interest to Boeing. Boeing will also provide continued input and advice to EWI on various applications in the aerospace industry. Velocys is a wholly owned subsidiary of Oxford Catalyst, Ltd., a U.K. spin-off from Oxford University. The role of Veloycs is to perform testing and evaluation of microfluidic devices made via UAM. Polytec will provide cost-share toward the purchase of a Polytec PSV-400-M4 scanning vibrometer system, which will allow for the characterization of materials during manufacturing. The role of Honda R&D Americas will be to support the purchase of capital equipment and will also provide continued input and advice on potential automotive applications of the technology developed in this proposal. The Aerospace Group of Parker Hannifin GTFSD will apply the technology developed in this proposal to materials and systems of interest to this company. Continued advice will be provided for other applications of interest to Parker. Dukane’s role will be to provide discount pricing of their ultrasonic equipment to be used in the UAM system. In addition, Dukane will provide advice on the use and

application of their Ultrasonic equipment. The proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The bulk of the funds requested in this proposal are for capital expenditures. OSU will receive $719,000 for capital equipment purchases. The operating costs are approximately 6% of the total requested. OSU will provide the bulk of the cost share ($622,588) in the form of graduate tuition, federal grants, and labor overhead reduction. An additional $267,500 will be provided by the OSU-led NSF SVC, which consists of SVC membership fees and a student fellowship. Some project team members will provide cash cost share ($168,298) toward capital equipment purchase (Honda, Polytec, and Dukane). Others will provide in-kind cost share ($594,584), ranging from application specific research (Boeing and Parker Hannifin) to engineering services (Velocys and Solidica). The amount and types of cost share are reasonable for this effort. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The proposed work is well thought out and well planned. Every aspect meets or exceeds the specific requirements of the RFP. The proposed work has merit and the details presented make a compelling case of how the proposed technology will be commercialized. Prior success with research, development, and commercialization of a similar technology under a previous Wright Project is very positive. The committee recommends that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program, provided that Fabrisonic submits a sufficient letter of commitment to ODOD and that the applicant team commits to using Ohio-based manufacturers for the UAM-LM systems.

OTF WPP 11-420
Solar-Durability and Lifetime Extension Center
Case Western Reserve University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$3,063,272
Capital Funds	$2,384,755	$0
Subtotal	$2,884,755	$3,063,271
TOTAL	$5,948,026	

The proposal seeks the establishment of the Solar-Durability and Lifetime Extension (S-DLE) Center at Case Western Reserve University (CWRU). The S-DLE Center will use specific expertise in the Case School of Engineering to develop real-time and accelerated protocols for exposure to solar radiation and related environmental impacts on solar technologies. Post-exposure optical and thermo-mechanical measurements will aid in the development of quantitative prediction models of the major degradation mechanisms in the bulk of the device, as well as the inherent interfaces between dissimilar materials that are critical for device performance and, at the same time, particularly susceptible to degradation. The ultimate goal of the S-DLE Center is to create a state-of-the-art Ohio facility for developing and demonstrating better solar and environmentally exposed products through prolonged service life and the creation of industry standards based on this body of work. The collaborators in this proposal include three Ohio-based companies that are trying to develop solar specific products: Q-Lab has test equipment that can do accelerated environmental testing, which solar manufacturers can use in product development and certification; Xunlight26 is working on the development of a new solar conversion technology; and eQED is developing a micro-inverter for solar modules. Other collaborators that are not Ohio-based include DuPont Photolvoltaic Solutions, which manufactures films used in encapsulating solar modules at a plant in Ohio; and Underwriters Laboratory, which is active in defining solar module testing standards.

Detailed Review

- **Technical Merit and Plan**

The technical merit of the S-DLE Center itself meets the requirements of the RFP on Technical Merit and Plan. The center would seem to have very limited technical risk in terms of its ability to set up and perform durability and lifetime testing and research activities. With the exception of the Q-Lab test apparatus, it would appear that all other test equipment is standard in the industry. The technical merit of this proposal rests heavily on the background of Dr. French (the project's director) and the overall capabilities of CWRU. The long-term usage of the laboratory in a fee-for-service mode seems plausible. The two issues that the laboratory may face from a technical perspective are the timelines required to establish new solar specific standards and resource constraints as test apparatus are consumed in long-term tests. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The proposal outlines seven potential products that will benefit from the use of the S-DLE Center and therefore accelerate their commercial market entry. The Q-Lab weathering instrument is the most tangible product in terms of commercial readiness given that it is trying to transition into the solar market based on commercial success in other industry verticals. The timing for the Xunlight26 and Dupont products, accounting for five of the seven outlined products, are difficult to evaluate given their stage of technical readiness. It is clear that Xunlight26 and Dupont products will benefit from the findings and durability tests performed by the laboratory in terms of providing third-party data for customer evaluation. The commercialization strategy of the S-DLE Center is also enhanced by the interest from other entities and Ohio-based companies that could ultimately work with the center on their own projects. Hitron,

Energizer, and Replex Plastics all have products whose commercialization efforts could be helped by the S-DLE Center. The proposal exceeds the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The proposal is clear on the capital acquisition and the long-term use of the equipment for educational and applied research. The proposal outlines job creation and personal wealth through new and improved product sales by four of the five collaborators. The forecasted employment and revenue numbers are balanced between lower-risk prospects in DuPont and Q-Lab and higher-risk prospects driven by the early stage of technology and company formation of both Xunlight26 and eQED. The higher-risk forecasts are not unexpected as both companies are start-ups. The creation of the S-DLE would help with the future funding requirements (assuming positive technical progress is made) of Xunlight26 and eQED. Overall, the forecasts are realistic in a success scenario. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The experience and qualification of the lead applicant, CWRU and Dr. French, is evident in the strong collaborator support and the strong interest by companies and research institutions to be associated with the S-DLE going forward. The ability for the collaborators to commercialize any resulting technology developed or proven at the S-DLE is high. Dupont and Q-Lab should be able to bring their products to market without significant changes to or investments in their businesses. Xunlight26 and eQED, both start-ups, will face tougher challenges that will only be overcome with strong technical results that will entice further investments in their companies. The proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The proposal requests $2.88 million in state funds, of which $2.38 million (83%) will go for equipment and facilities renovation at CWRU. The collaborators will provide $3.06 million in the form of cost share. There is no unrestricted cash cost share in this proposal. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

This proposal, for the establishment of the Solar-Durability and Lifetime Extension (S-DLE) Center at CWRU, meets or exceeds all of the requirements of the RFP. There is a critical and urgent need for solar specific durability and lifetime evaluation capabilities to help in the development and commercialization of new solar components and systems. CWRU can play a unique role in developing these capabilities with the support and collaboration of both existing and new companies in the solar field. This durability center will round out the cluster of other projects and companies in and around Ohio in which the Third Frontier has invested. The results of this collaboration should lead to an acceleration of product development and commercialization for the Ohio companies that are part of the proposal. Additionally, the committee notes that this center can lead the way for the establishment of standards for solar durability testing and may attract future investment from other states or companies. The committee recommends that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-427
Improved Human Health by Commercial Development and Deployment of Innovative Ohio Sanitation Technology: Heat/Ozone Biomedical Technology to Produce Safe Eggs
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$498,532	$701,052
Capital Funds	$2,500,000	$2,769,000
Subtotal	$2,998,532	$3,470,052
TOTAL	$6,468,584	

In 1997, Egg Tech, Ltd., a partnership comprised of the three largest egg producers in Ohio—Weaver Brothers Poultry, Hemmelgarn and Sons, and Hertzfeld Poultry Farms, Inc.—obtained an exclusive license for OSU's heat/ozone technology for the pasteurization of whole eggs. Egg Tech produces one third of the total state's market share of whole eggs; and Ohio ranks second in the nation in this highly competitive market. With a pooled private investment of several million dollars from competing companies and successful federal grants, Egg Tech has advanced the invention through imagining, incubating, and demonstrating phases of growth. The heat/ozone technology is the only technology to date that has been able to maintain sensory and functional performance while meeting the stringent requirements of the 1999 U.S. Egg Safety Action Plan, a federal mandate requiring that whole eggs be pasteurized and thus free of *Salmonella enteritidis* bacterium, a serious health hazard. The Food and Drug Administration (FDA) has approved the technology even though it has not yet been scaled up for commercial use. A prime objective of this project is to demonstrate the large scale commercial viability of this process. For this project, OSU is collaborating with Ohio BioProducts Innovation Center (OBIC), a Wright Center of Innovation; Egg Tech, Ltd.; Xigent Automation Systems, Inc.; Weaver Brothers Poultry; and Hemmelgarn and Sons.

Detailed Review

- **Technical Merit and Plan**

There are several key technical challenges that have slowed down market entry of this heat/ozone process. At present, there is a need to demonstrate a sustainable, profitable, commercial-scale process under actual production conditions in an Egg Tech facility. To accomplish this, the team's researchers must attain an efficiency of one truckload per 10-hour shift to drive down egg pasteurization costs, demonstrate the process on a production scale, generate the necessary economic data to attract additional investment, optimize the parameters of the egg handling and heat/ozone-processing to minimize egg cracking to less than 1%, and demonstrate consumer acceptance and preference for heat/ozone processed eggs compared to unprocessed and to heat-only-pasteurized eggs through OSU sensory tests and marketing. The list of technical challenges is thorough, and the challenges described are appropriate and achievable, since approaches to overcoming the challenges are well considered. The rack design of the Egg Tech Beta-1 system readily facilitates its scale-up to the Beta-2 version (more racks to accommodate more eggs), and optimization of the process variables to decrease the amount of cracking from less than 2% to less than 1% were determined in the laboratory during the last 4 months. The proposal exceeds the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

This proposal's key commercialization challenges are to produce a high-volume, efficient heat/ozone process machine (Beta-2) for mass production, establish the customer base needed to purchase high volumes of pasteurized eggs, and meet the expected demand for the Beta-2 machine once the Egg Safety Action Plan is enforced. The commercialization team's plan is to first pursue the high-volume restaurant

chain and institutional consumer markets; these efforts can be accomplished with existing Egg Tech partner sales personnel. Reasonable penetration of the institutional and food service markets in Ohio and surrounding states should be achieved in 2012-2013. Assuming a successful entry into the institutional and food-service market, Egg Tech will move into the retail (grocery) market in Ohio and later in adjacent states. The value proposition of this proposal is worthwhile, since financial projections of the heat/ozone process indicate that all the collaborators associated with this proposal—the Egg Tech partnership, Xigent and its suppliers—can expect an excellent return on investment, with OSU receiving royalties paid in association with an exclusive licensing agreement. The value of the proposal is also worthwhile because hospitals, nursing homes, and food-service companies need to use and serve eggs that are guaranteed to be safe from bacterial contamination. Since these key end-users also want eggs that look, taste, and perform similarly to non-pasteurized, uncooked, and Davidson eggs, the value proposition is high, and the markets are likely to be receptive to eggs produced by the heat/ozone method. The proposal exceeds the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The proposal's projections for the number of machines marketed by Egg Tech are based solely on anticipated market demand and disregard the very real possibility of FDA enforcement of the Egg Safety Action Plan, which would greatly increase the number of sales over what the proposal predicts. Egg Tech has established its target market at 60% of all institutional shell eggs (nearly 4 billion shell eggs) and 20% of all retail eggs (nearly 9 billion shell eggs), for a total of 13 billion shell eggs. Funding from the WPP is not sufficient to achieve the target, because even with WPP funds, the proposal envisions that by 2016 the Egg Tech process will only touch 7.8 billion eggs per year, or 16.5% of the 47.1 billion shell eggs distributed through retail and institutional markets and 60% of its target market. Efforts to capture an additional 40% of the 13-billion-eggs target will be funded by Egg Tech's revenues from egg sales. Accelerating the commercialization of the heat/ozone-process technology via WPP funding will generate significant value to the State of Ohio in the form of additional jobs, new revenue from the sale of pasteurized eggs and heat/ozone process machines, and expanded research and development activities. By 2016, the accelerated plan is expected to create 446 jobs, revenue totaling $374 million, and $312,000 per year in royalties to the State of Ohio for each machine sold. These projections are a stretch, but they can be achieved if 47 Beta-2 machines are operating by then, a feat that seems possible if the first Beta-2 systems are produced on time and Xigent is as efficient in manufacturing them as the company's president, Joe Moreno, indicated. Xigent has been planning for scaling-up Beta-1 to Beta-2. The proposal exceeds the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

Not only have Egg Tech and OSU scientists demonstrated a long-term commitment in time and money to this program, but they have also aligned themselves with top-quality support service firms—Xigent, A to Z Research, CMA Marketing, and Dinsmore & Scholl—in order to maximize their chance of commercial success. Demonstrated leadership by OSU's Food Innovation Center, clear commitment to commercialization by Egg Tech and Xigent, management of the overall project by the OBIC, regular teleconferences among team members, strong support from high-quality legal (i.e., intellectual property and regulatory) groups, and a past record of efficient project management are evidence that all aspects of this project will be well managed. There is significant potential for leveraging additional funding, because both the U.S. Department of Agriculture and the FDA have placed high priority on the technology described in this proposal and have significant funds to invest in technologies that enhance the quality or extend the shelf life of foods post-harvest. The proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The ratio of cost share to state funds is 1.16, which shows the commitment of its non-OSU participants to the project. Capital equipment will be purchased using 83% of state funds, and indirect costs will be covered by 15% of operating expenses from state funds. The cost share is necessary and reasonable, and all of it is in cash. To achieve a quick move to market entry, all funds obtained will be spent in 2 years, rather than in the usual 3-year period allowed. Oddly, even after Egg Tech was told in March to provide a letter clearly stating the amount of their financial commitment to the project, the letter presented to the committee on April 21 by Egg Tech did not specifically state its financial commitment. Except for this oversight, which is expected to be easily corrected, the proposal exceeds the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The strengths of this proposal include the fact that Ohio is a producer of a significant share of eggs for the U.S. market, the applicants are a strong, committed team comprised of experts in all the key areas, there is a clear market need for eggs produced by a pasteurization method that produces guaranteed safe eggs with the desired performance and sensory characteristics, the heat/ozone technology is already FDA-approved, the first-to-market position is imminent, and the project has communication and management approaches that will keep it on track. Its weaknesses include the lack of a letter of commitment from Egg Tech detailing its financial stake in the project and a 100-fold error in the calculation of the size of the yearly royalty due to OSU for machine sales. This error, although easily corrected by the applicant team, was unexpected because the group's other financial projections involving more complex calculations were more carefully presented. There exists a potentially enormous opportunity for the rapid transfer of this technology to other states and countries; hence, the economic benefit of building these machines could be significant in the long term. The committee believes that the team, if successful, may be able to generate significant additional private capital investment, thus creating the potential for a number of future jobs at all levels. Extension of this technology to other food products could also be viable. The committee recommends that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program, provided that Egg Tech submits a revised letter of commitment that clearly states the amount of its commitment to the project ($2,989,297, according to budget form 3A in the proposal).

OTF WPP 11-404
Enabling Flexible Fabrication and Robotic Assembly through Agile Manufacturing
Ohio Northern University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$1,100,000
Capital Funds	$2,500,000	$1,900,000
Subtotal	$3,000,000	$3,000,000
TOTAL	$6,000,000	

This proposal concerns the development of technology solutions of vision-equipped robotic systems for use in an agile manufacturing system. The objective is achieving fast configuration and set-up for an agile manufacturing system. Ohio Northern University (ONU) will collaborate with American Trim LLC, Motoman, Inc., Ohio Energy & Advanced Manufacturing Center, and the Edison Materials Technology Center.

Detailed Review

- **Technical Merit and Plan**

The proposal aims at development and commercialization of an agile manufacturing system based on ideas of flexible fabrication and vision-equipped robotic assembly of products that will be piloted at American Trim. The proposed work builds on the principal investigator's experience with NASA and synergistically combines the skills and resources of the industrial collaborators. However, specific details on the proposed research and development work and the direct link to commercialization impact are quite unclear. The proposal lists several technical challenges without offering specific details or plans for addressing these challenges in a cost effective way. This proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The value proposition of the proposed work is to impact the production of robotics systems for agile manufacturing cells. However, the proposal does not allow a quantitative assessment of how the proposed solutions directly influence the proposed commercialization. The proposal fails to convincingly argue why the commercialization could not be undertaken without a major influence by the proposed academic research. The proposal does not meet the requirements of the RFP on Commercialization Strategy and Potential.

- **Objectives and Performance Goals**

The proposed work includes major capital acquisitions and improvements at ONU. It is anticipated that the long-term use of capital will promote educational and training programs for technical workers and undergraduate students. However, the project does not convincingly demonstrate or sufficiently detail a direct impact on job creation and retention, nor does it support the creation of new companies that will substantially promote wealth generation in the State of Ohio. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

ONU will serve as the project lead. The project manager has extensive management experience at NASA's Jet Propulsion Laboratory and at ONU. In addition, a technical lead has been assigned by ONU

to develop the proposed agile manufacturing system. Further, the commercialization lead, from American Trim, will coordinate the commercialization of products emerging from implementing the agile manufacturing system. The representatives of ONU and its industrial collaborators are well qualified to undertake the proposed work. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The proposal seeks operating funds to support staff and students. ONU will provide cost-share funds through reduced indirect costs as well as in-kind faculty and staff support throughout the project period. The bulk of the remaining cost share will be provided largely by in-kind contributions from American Trim, Motoman, and other participants. Surprisingly, Motoman, whose products will be benefit the most from the proposed project, will commit only $350,000 in in-kind support, although it anticipates selling hardware for this project at $350,000. Despite this fact, the proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

While the basic principle underlying the proposed work has merit, the details provided in the proposal do not make a convincing case of how the proposed system would directly impact the commercial activity. The proposal also failed to identify details of possible design approaches and competitive advantages. Further, a broader case of having sufficient research direction and funds to sustain the operation has not been established. The committee notes that a very similar ONU proposal on agile manufacturing (with a different group of industrial partners) was submitted to the 2010 WPP; many of the criticisms in this review are similar to criticisms raised during the 2010 review. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP11-406
Rapidly Deployable, Wide-Area Sensor System for Security Operations (RD-WASS)
University of Dayton—Institute for the Development and Commercialization of Advanced Sensor Technology (IDCAST)

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$3,028,617
Capital Funds	$2,496,0000	$0
Subtotal	$2,996,000	$3,028,617
TOTAL	$6,024,617	

Using existing and near-market-ready technologies developed for military use, the proposal is for the development, deployment, and operation of a sharable, useable, open-air demonstration of a rapidly deployable Wide Area Airborne Surveillance (WAAS) system combined with a Wide Area Ground Surveillance (WAGS) system. These will be combined with local ground surveillance, hazardous materials identification, wireless sensor networks, sensor fusion, and command and control capabilities. Target customers are the Department of Defense, the Department of Homeland Security (DHS), the Federal Emergency Management Agency, and other federal agencies involved in security and transportation, as well as civilian markets, including law enforcement, schools, and retail sites. The project plans to leverage Ohio's strengths in aerospace and defense research and development and to address the specific barriers inhibiting mature products from getting to the market. Proposal collaborators include Persistent Surveillance Systems, Defense Research Associates, The Design Knowledge Company, NoBull Innovation, the Air Force Research Laboratory, and the City of Dayton.

Detailed Review

- **Technical Merit and Plan**

The proposal uses existing and near-market-ready technologies and seeks to build on strengths at IDCAST in sensor engineering and integration, infield operations, and building deployable validation test beds. Similar systems have been deployed in Afghanistan, Iraq, and Juarez, Mexico. The committee sees great value in combining layered sensing with mobility and the capability to rapidly deploy sensors, and the utility of such technology is obvious (e.g., military conflicts, anti-terrorism operations, natural disasters). Although the technology is not especially novel, the committee believes the applicant team has a firm understanding of the technologies involved. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The proposal seeks to address barriers to commercialization of mature technologies created for defense use and open up new opportunities in security of critical infrastructure. There are obvious benefits to transitioning this kind of capability to the civilian world; however, this is the weakest part of the proposal. First, there is no clear commercialization strategy. The proposal describes the market readiness of the components of the system, but there is little evidence that civilian market needs are understood by the applicants. For example, getting local law enforcement to use this system will require addressing considerable interface and jurisdiction issues, including methods of operation and community acceptance. Second, a major strength of this technology and system integration is the rapidly deployable capability. This means that the system could be used in a one-time event (e.g., a football stadium), or when there is a sudden heightened security issue (e.g., a threat to the electricity supply to an urban area). This could be the most important market to address, but it is only mentioned briefly in the proposal and not given enough consideration by the applicants. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

One of the most important performance goals of this proposal is the production of a usable test bed (e.g., in Dayton Tech Town) using rooftop surveillance and other sensors. The plan is for law enforcement to use this test bed; however, the letters of support do not demonstrate a strong interest from the users. The two letters from the Fire Service and Department of Police in Dayton are nearly identical in content, and the level of support is minimal from both ($7,500 and $10,367, respectively). The committee also questions the projected job and revenue growth numbers for this proposal, especially given the amount of testing still required for the system before it can be ready for commercialization, an area of the proposal that the committee has already cited as problematic. Furthermore, objectives and performance are too vague by the committee standards. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The principal investigators are well qualified technically and are within the niches of federally funded research or are producing products for defense markets. Including participants knowledgeable in civilian security markets could strengthen the team. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

AFRL and companies in this area (Persistent Surveillance, The Design Knowledge Company, and NoBull Innovation) all support this effort, and there will be a defense/military market for the products. The project is well leveraged by defense investing, and the project could be greatly improved by working on this aspect. However, as mentioned above, the civilian customers are neither clearly identified nor supportive. It also appears that the bulk of the cost share from collaborators is in the form of personnel working with the University of Dayton. The committee is skeptical that the budget presented in the proposal is sufficient to mitigate potential technical risks in the project over the 3-year time period to accelerate this project towards commercialization. The proposal does not meet the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The project is of merit as it seeks to leverage considerable defense investments in R&D that are useful. There is a natural cluster of well-established companies producing technologies in distributed surveillance. The weakness of the proposal is a lack of clear understanding of the civilian market and insufficient work with potential customers to create a market pull. Furthermore, the applicants failed to emphasize the mobility of the system and its ability to rapidly deploy as a niche market on which to capitalize. Additionally, there are other sources of funding for projects of this nature (e.g., DHS) that are better suited to this type of proposal than the Ohio Third Frontier. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-407
Developing Advanced Materials Forming Capability for Automotive and Aerospace Structures
Edison Welding Institute, Inc.

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$404,394	$1,463,121
Capital Funds	$1,239,700	$358,500
Subtotal	$1,644,094	$1,821,621
TOTAL	$3,465,715	

The objective of this proposal, led by Edison Welding Institute, Inc. (EWI), is to develop hot press forming (HPF) for use with many new materials that include titanium and magnesium alloys and high-strength alloyed boron steels. Since Ohio has numerous Tier 2 suppliers to the major automotive manufacturers, the objective of this proposal is to strengthen and retain the current manufacturing base and prevent erosion of markets or loss of current market share to other states and countries. Since many of the parts to be formed with HPF will be large and the cost to transport these parts will be high, being close to the end user will provide a cost advantage to Ohio manufacturers if many of the parameters related to press forming the new materials are developed at EWI's facility. For this project, EWI will be collaborating with OSU, the U.S. Army, AIDA America, General Motors, Ajax TOCCO, Livermore Software Technology Corporation, Dayton Progress Corporation, Applied Optimization, Inc., American Trim, Honda, Anchor Danly, AK Steel Corporation, RTI, and Boeing.

Detailed Review

- **Technical Merit and Plan**

The proposal is well written and identifies a critical need for Ohio automotive and aerospace manufacturers, especially since many new materials are being introduced through the supply chain. Hot press forming of parts and modeling of the materials parameters associated with the new materials is desirable. The conduct of process simulations and development of optimization processes during the course of this program will help in iterative improvements and develop processing maps and parameters that can optimize the properties. Overall, the proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The committee finds the proposal's commercialization strategy to be somewhat weak and not especially clear, particularly with regard to the continuation of the center after the 3 years of state funding. There is no clear outline of the role to be played by the partners and how they will allocate their resources to meet the needs of the different groups. It is also not clear if there will be a priority on automotive or aerospace materials. The contributions from the different members to the overall goals and needs of this project are not very clearly identified. The lack of a stamping supplier expressing an overwhelming need for this technology is also questioned. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The objectives of the center are well laid out, although the performance metrics are not easily quantifiable. It is also not clear if the models that will be developed will be unique and available only to specific companies, available to all current and future members, or available to other materials manufacturers that are not from the state of Ohio. Nor is it clear how the center will be compensated for

any of this information. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The teams in this proposal are well qualified technically to handle the subjects described and will be able to contribute significantly to the overall goals and objectives, as well as the success of the center. The addition of training programs that will support the long-term goals for sustainability of the manufacturing enterprises is particularly desirable as the knowledge needs to be disseminated widely to retain the infrastructural base. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The budget and cost share aspects of the proposal are reasonable. The participation of the automotive manufacturer is helpful in strengthening the cost share aspects of the proposals. The bulk of the funds requested in this proposal are for capital expenditures. AIDA will receive $680,000 for capital equipment purchases, and the U.S. Army and General Motors will provide cash in the form of purchased services or project work. Other companies involved in this effort will provide in-kind cost share ranging from application specific research to engineering services. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

This proposal is to create a center at EWI to develop hot press forming as a technique for the extended use of AHSS steels and titanium alloys that are now being evaluated by several of the automotive and aerospace manufacturers. The center would serve as the location where stamping manufacturers would optimize their process technology for their parts prior to setting up their own infrastructure. Extensive modeling and educational outreach to the suppliers is planned. Ohio has a large automotive base and Tier 2 suppliers that are affected by the competition from other states for the supply of lighter and stronger parts to the major automotive manufacturers. The state has more than 100 stamping suppliers and has the need to maintain its existing base of suppliers so as not to lose these manufacturing-related jobs. A number of jobs may be in jeopardy if the shift in technology does not occur fairly soon. The committee is uncertain about the nature and urgency of this threat, which is not easy to quantify. The lack of a stamping manufacturer at the interview further raises questions on the need for such a center to be created by EWI. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-408
Commercialization of Advanced Materials Modeling and Characterization Methods
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$3,010,417
Capital Funds	$2,500,000	$105,000
Subtotal	$3,000,000	$3,115,417
TOTAL	$6,115,417	

The proposal describes a program where computer modeling of advanced materials will be developed, refined, and commercialized. The general objective is to minimize cost and turnaround time in developing advanced improved materials, as well as providing a means for optimizing these materials according to specific applications. The models themselves will be refined by reference to data obtained by two state-of-the-art high-resolution diagnostic tools, which represent the major capital expenditures of this proposal. The first is an FEI Osiris scanning transmission electron microscope (STEM) with an integrated dispersive X-ray spectrometer, and the second is an FEI Magellan scanning electron microscope (SEM). These instruments will be retained by OSU and made available for outside use after the termination of the proposal. The collaborators are the Air Force Research Laboratory; Wright-Patterson Air Force Base; TIMET Titanium Metals Corporation, based in Henderson, NV; and GE Aviation, based in Cincinnati, Ohio.

Detailed Review

- **Technical Merit and Plan**

First, while some software appears to have already been developed, at least some fraction (possibly major) of the software is not as far along and will require time to complete, as evidenced by a stated need for further refinement. In support of this, the committee notes that data obtained by the capital equipment is intended to be used to establish, or at least improve, some of these models. With typical software development times, this indicates a timeframe that is inconsistent with the requirement of commercialization within the 3-year length of the project.

Second, modeling of complex materials is not trivial. This problem may never be completely solved for polycrystalline materials, such as metals and alloys, or photovoltaics, where performance depends on trace amounts of defects or impurities. Some degree of accuracy is necessary, but there is no mention of current capabilities. Without such data, or some indication that present capabilities meet current needs, there is no assurance that the programs will be commercially viable. The use of neural networks to expedite development indicates that the models are not entirely based on first principles but have a significant empirical component.

Third, two closely related organizations already exist within OSU: the Center for Accelerated Maturation of Materials and the Institute for Materials Research. Given its major materials presence, OSU must already have diagnostic capabilities that are related or even equivalent to what is being requested. The proposal provides no information about these administrative units and existing capabilities, in particular how the proposed equipment improves on what is already in place.

Finally, although commercial products are planned, the primary purpose of the proposal appears to be to acquire the abovementioned two pieces of capital equipment, which does not fulfill criteria in the RFP. Therefore, the proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

Commercialization will be done under the auspices of an organizational unit called "The Operation," which will be created within OSU specifically for this purpose. Its functions are to perform market analysis, market the modeling technology to potentially interested parties, and arrange for sales and licenses as appropriate. The management functions themselves will be outsourced to a suitable company or other commercializing unit following responses to a Request for Proposals. Eventually the plan is to spin off the facility to become a separate legal structure or company. One of the metrics of success is a spin-off of this nature. The proposal meets the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The objectives include developing and refining predictive models for allowing the properties of complex materials to be modeled and later commercial licensing, marketing for and generating licensing arrangements with target companies, and leveraging the capital investment and preliminary results into research contracts for future work. Progress will be measured by comparing it against expectations listed in the proposal, such forming the requisite administrative units, installing equipment, securing additional SBIR (Small Business Innovation Research) funding, and selling software and/or licenses. To the extent that the software will actually be available, the stated objectives and performance goals are reasonable. The proposal could have benefited from a more detailed and thorough discussion of the intended job creation and the project team's planned approach to managing issues and concerns surrounding intellectual property. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The project director, Dr. Hamish Frazer, has a distinguished research record and has had prior experience directing similar projects. He also has connections with various funding agencies and appears to be well qualified to carry the project forward. He will be assisted by an experienced microscopist, who is equally well qualified to manage the capital equipment requested. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The amount requested is consistent with the requirements of the RFP. Initial expenses will go to establishing The Operation. The cost of the two requested instruments is approximately $3.5 million, and these will be ordered on a consistent time scale. The major fraction ($3.010 million) of the $3.115 million cost share will be provided as cash by the four principals, specifically the Air Force Research Laboratory, GE Aviation, Timet, and OSU. The proposal exceeds the requirements of the RFP on Budget and Cost Share.

<u>Summary of Review and Recommendation</u>

While the goals are worthwhile, the committee has a number of serious concerns regarding the timelines, whether or not the approach will succeed as planned, and the size of the existing market. Given the proposal's weaknesses mentioned above, the committee feels that this is more appropriate for NSF Materials Research Science and Engineering Centers (MRSEC) funding. The committee encourages the principal investigators follow this path. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-410
Center for the Smart Electrical Grid
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$445,743	$1,184.120
Capital Funds	$2,052,302	$1,313,925
Subtotal	$2,498,045	$2,498,045
TOTAL	$4,996,090	

The proposed Center for the Smart Electrical Grid, led by OSU, seeks to develop a smart electrical grid test bed to be used to assist Ohio companies in developing and commercializing new advanced energy products. OSU is collaborating with Greenfield Solar Corp., Rockwell Automation, Liebert Corp., Edison Materials Technology Center (EMTEC), EDG, Inc., American Electric Power, and The Dayton Power & Light Co. on this project. Additional partners will be involved by growing the Ohio solar power supply chain by using the grant funds and corresponding investment by these collaborators in Ohio. The center will realize a self-sustaining revenue stream from the power generated, from ongoing consulting and research projects supporting commercialization of smart grid products, and from contracted testing performed employing the smart grid.

Detailed Review

- **Technical Merit and Plan**

The technical plan is well stated for the near term, but the focus on short-term commercialization partners leaves out a specific long-term use plan for the facility. There is some uncertainty as to whether the test stands are being built in a sufficiently generic manner so as to have a broad-based use that will generate the self-sustaining revenues stated in the proposal summary. The past experience of the partners indicates their ability to further develop the facility and achieve sustainability based on a subscription model. The technical efforts to create the center are well documented and the committee is in agreement that the overall project is well designed and staff is capable and highly competent. This proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

Greenfield Solar is the key commercial partner that needs a scaled-up environment to technically validate its technology while also reducing the total cost of its products. Aggressive price points are key to its success. There are significant risks in all new ventures, but Greenfield does have product in use and has raised substantial outside funding in its latest round. Momentum toward commercialization is significant, and it is possible that Greenfield's product will create the economic activity and jobs needed to justify the program's investment. On the other hand, Greenfield would need an additional $8 million in funding, which leads to great uncertainty for success in the near future. Since there are also significant technical scale-up risks, the job creation figures as written are speculative. Other listed users, such as Liebert, will potentially create jobs, although this is not documented specifically in the proposal. This proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The design goals as stated are adequate for the short-term task, but without specific clients to populate the center, and without a specific jobs focus, this is not a compelling plan for the WPP. Commercial partnerships with pathways and strategies for bringing technologies to market have not been identified.

As a test bed alone, its goals are reasonable, but there are no demonstrated needs from committed customers. This proposal does not meet the requirements of the RFP on Performance Goals and Objectives.

- **Experience, Qualifications, and Eligibility**

The team has the experience needed to make this a successful project. This is a very competent and experienced team with deep resources. The timeframe to accumulate resources and to build the center, though, may not coincide with the market timing of Greenfield. The committee believes that the center concept is a good one, but less complex and more developed products with better pathways to market for its future clients that it needs. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

Cost shares are within the guidelines of the RFP. Private cost shares are reasonable, and they indicate buy-in to the project from the collaborators. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

Designation of this center as a Smart Grid is out of place. As a commercial "risk mitigation test stand," as stated in the proposal, this proposal merits some future consideration. The proposal states that a place to test performance in a balanced-system real-time environment is critical to commercialization efforts for Ohio companies. The committee agrees that there is a significant need for such a facility to assist in the acceleration of bringing products to market. The center does address technical and market needs in a critical economic cluster that is well suited to exploit the current supply chains in Ohio. Grid-focused products fit into a large number of niches and companion products with-in the Solar PV industry. The specific jobs-creation goal of the proposal, though, does rest on the success of Greenfield Solar. It is here where the proposal misses the mark. The lack of other options for substantial direct jobs creation is where this proposal fails to achieve the standard of a successful proposal. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-416
Center for Advanced Energy Storage Interoperability
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$2,915,626
Capital Funds	$2,500,000	$435,000
Subtotal	$3,000,000	$3,350,626
TOTAL	$6,350,626	

The proposed Center for Advanced Energy Storage Interoperability combines various aspects of Ohio's automotive industry with large-format and large-pack advanced battery systems design and control utilized in electric vehicles and large-scale lithium-ion batteries to develop and demonstrate next-generation large-scale distributed energy storage. The center further intends to work cross-industry with key participants in Ohio's electric vehicle, stationary energy storage, and UPS sectors to develop several compelling pathways ranging from commercially available lead-acid systems to large-scale lithium ion systems for UPS applications. The direct investment will deploy distributed-energy storage devices in one or more locations across a campus environment, with meter collars or smart meters to measure instantaneous demand and an energy management network layer to allow the system to match peak energy use from distributed locations to distributed energy storage/sources in other locations. Collaborators on the project include CAR Technologies, LLC; Nexergy; Edison Welding Institute; and Carina Technology, Inc.

Detailed Review

- **Technical Merit and Plan**

The technical requirements for the proposed concept are well-defined in the proposal. The proposed effort integrates a number of complimentary technology elements and appropriately identifies critical interconnections between them. Specifically the proposal calls for the selection and deployment of a stationary energy storage module that leverages advanced lithium ion batteries, identifies and integrates a complimentary battery management system, specifies and deploys a purpose-built intelligent control network for demand/response applications, uses the configuration to evaluate performance and value in distributed energy storage applications, and demonstrates the value of interconnection of distributed generation and energy storage sources. The proposed effort differs from the recently funded Center of Excellence in Energy Storage Technology, because it focuses on large-scale (100 to 2,000 kW) stationary applications of interest to the electric utility industry rather than small-scale (12 to 54 kWh) pack energy storage systems for vehicles. However, the proposal team has not settled on which type of chemistry to utilize in the battery, meaning that the technical lead for some of the core research and development effort is not finalized (it could be Nexergy, Venturi, or FIAMM). As such, the proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The project brings together commercial partners having expertise in diverse battery pack manufacture with those providing energy management solutions and power generation and energy storage to meet the needs for emerging energy storage applications. The proposed effort seeks to generate $50 million in annual sales at Ohio companies within 5 years of the project award with more than 150 direct jobs created. It appears that the proposed center could substantially benefit the commercialization efforts of existing industry.

Important intellectual property will likely be created as a result of this project, and the applicants suggest a mechanism to address its treatment. The project is anchored by Nexergy, with interest in developing large-format battery systems and experience in developing and manufacturing battery packs; Venturi North America, with experience with battery pack development and integration; Toshiba, a known battery manufacturer; CAR Technologies, a developer and provider of intellectual property; Emerson, a supplier of energy management solutions; Carina Technology, a provider of energy communications; and AEP, a utility. While all of this is fairly positive, the committee was surprised and confused by the insertion of FIAMM into the mix of partners after proposal submission. While the committee believes the change probably made sense for the applicant team, such a major late-stage change calls into question the strength of the partnership and the ultimate commercial viability. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The objectives and performance goals for the proposed program could use some additional clarification. The project envisions a direct growth of 80 jobs over 3 years and 150 new jobs over 5 years, which may be somewhat aggressive. While the project targets deploying large-format energy storage modules, a large format BMS, and an intelligent control network, and demonstrating energy management and storage applications and renewables integration, additional specificity regarding these goals would further strengthen this proposal. The committee viewed the uncertainty of the battery cell and pack collaborator, and therefore the uncertainty of the job creation potential in Ohio, as a risk. The proposal also lacked clarity regarding intellectual property management and related issues. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The team appears to be well-qualified to execute the work plan presented in this proposal, however the management plan lacks detail regarding the control and execution of programmatic activities. Further definition regarding the roles of the various participants and the nature of their interaction would add clarity to the proposal. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The overall budget appears to be adequate in meeting the performance objectives of the proposed effort. The cost share called out in the proposal is in the form of cash. The letters from Nexergy and Carina identify the cost share as being related to allied product and/or market development activity but not necessarily specific to activities germane to the proposed center. Additional clarity would be advantageous. Despite this, the proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The proposed effort seems to meet a significant need in bringing together a wide array of technologies and commercial activities that can support the development and deployment of large-scale energy storage systems. The proposed effort brings together a strong team to collaborate on these critically important energy storage systems. Further definition concerning performance goals and the interaction of team participants would further strengthen this proposal. Clarification of the roles and participation of key manufacturers such as Venturi and FIAMM, as well as further definition of the use of funds as part of the cost share for Nexergy and Carina, would create a much more compelling case. The last minute addition of FIAMM and lack of participation by Nexergy during the committee's second meeting leave a number

of questions regarding the viability of the project. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-418
Cryogenic Engineering and Device Laboratory for Medical and Energy Applications
The Ohio State University

Proposal Summary

This proposal intends to develop an OSU-based center for cryogenics, including design, modeling, and test bed capabilities for the development of cryogenic systems for biomedical research, clinical imaging, and energy applications.

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$499,999	$2,225,000
Capital Funds	$1,725,000	$0
Subtotal	$2,224,999	$2,225,000
TOTAL	$4,449,999	

The lead institution is OSU (test bed facility), and the key collaborators are Eden Cryogenics (compact He reliquifiers, cryostats, cryogenic RF coils), M2M Imaging (cryogenic RF coils), HyperTech Research (magnet coils, cryostats, wind generators), and Global R&D (magnet coils).

Detailed Review

- **Technical Merit and Plan**

The plan proposes the development and testing of systems critical to cryogenic applications that span both biomedical research (including clinical imaging) and environmental/energy applications for power generation. With OSU as the primary institution for technology development and testing, there is clear alignment between this aspect and commercial applications with market need. Furthermore, the collaborators in this proposal appear capable of implementing product commercialization. However, the objectives and requirements of the wind-turbine and NMR applications are technologically so disparate that it is not possible to make a compelling case for both in the space available. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The commercialization plan lacks detail, particularly regarding the relevant market shares for the individual products. Most of what passes as downstream commercialization describes a sales force, not manufacturing or technical-support scale-up. Potential conflicts involving intellectual property might be better addressed by more clearly assigning for inventions and improvements using a model of singular intellectual property assignment and rights of first refusal for exclusive licensing rather than joint ownership. The capital requirements for commercializing downstream products need more detail and the venture funding sources are suggested but not cited. In addition, in the committee's view, the proposal seems to be trying to enter too many markets and does not sufficiently argue that the team will be able to overcome the various barriers to these markets. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The development is clearly aligned with downstream commercial applications, both services and products. The projected economic impact is reasonable, including the creation of jobs in the years to come, and the development plan to achieve market entry is well defined. However, the proposal needs further details for the market overview, specifically in the investment/time-to-market sections. The development of the OSU facility to include systems design, modeling, and thin-film integration will provide OSU with core technology and skills for both research and training of a potential workforce. The proposal lacked clarity regarding how the team would manage and handle intellectual property concerns

and issues. Despite the missing details, the committee determined that the proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

OSU leverages existing material sciences programs within the university as well as the Superconductivity Testing Center and the Center for Superconducting and Magnetic Materials; furthermore, OSU has a track record for translating laboratory research into commercial systems. The collaborators Eden, HyperTech, Global, and M2M appear to be well-positioned to support both product development and downstream commercialization. Key personnel have been identified as specific project managers, with Dr. Sumption (OSU) in the leadership position as manager and lead investigator for the overall program. The proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The capital equipment request is designated for the lead institution (OSU) to build out the Cryogenic Test Bed, FEM Laboratory, and Thin Film Device section, along with associated renovation and staffing costs. The $109,000 OSU cost share is enabled by SBIR, ARRA, and DOE funding with a small component from unrecovered overhead; the majority of the external cost share comes from collaborators HyperTech ($1 million) and Global Research ($500,000) via existing DOE and NIH grants. The ratio of cost share to state funds is 1.0; 78% of state funds will be used for purchase of capital equipment, and 20% of operating expenses from state funds will be used for indirect costs. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

In this proposal, the partners leverage manufacturing capabilities with the existing expertise and capabilities in OSU to address commercial needs in cryogenics, the use of superconductivity technology to improve energy efficiency of wind turbines, and opportunities to improve NMR. However, the objectives and requirements of the wind-turbine and NMR applications are technologically so disparate that it is not possible to make a compelling case for both in the space available. A better strategy would have been to focus on the research-laboratory needs for the cryogenics technology and on one compelling commercial application, for example NMR. This would have made it much easier to present the case for competitiveness and provide a more thorough evaluation of market potential and barriers to access. The committee does not recommend this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-419
Center of Excellence for Bio-Refining: Bio-derived Polymers, Fuels and Advanced Materials (CEBR)
The University of Toledo

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$347,507	$2,520,079
Capital Funds	$2,652,493	$560,000
Subtotal	$3,000,000	$3,080,079
TOTAL	$6,080,079	

This proposal seeks funds to form a Center of Excellence for Bio-refining: Bio-derived Polymers, Fuels and Advanced Materials (CEBR) that will develop technologies to convert non-food biomass feedstocks efficiently, and thus cost-effectively, into high-value-added products by incubating and then developing platform technologies that will give rise to polymer precursors and advanced materials. Housed at and led by the University of Toledo, the center will work to solve the key technical challenges to the commercialization of bio-derived products with collaborators PolyOne Corporation, a world leader in polymer processing and compounding; SuGanit Systems, a small company focusing on transitioning novel biomass conversion technologies; the Center for Innovative Food Technology (CIFT); and the Edison Technology Center, a nonprofit advisory group for biological and advanced materials.

Detailed Review

- **Technical Merit and Plan**

The main goals of this proposal are to provide a forum for industrial and academic participants to solve the technical challenges related to the commercialization of non-food-derived bio-polymers and materials between industrial and academic participants and to establish a research and product development platform at the University of Toledo focused on testing and development of polymer precursors and blends, catalytic conversion of bio-renewables, and incorporation of bio-derived chemicals into value-added products.

Key technical challenges to the commercialization of bio-derived co-products are economic conversion of renewable feedstocks, such as agricultural waste or algae, to platform chemicals; green synthesis of monomers, specialty chemicals, and additives from these platform chemicals; and development, compounding, and processing validation of bio-derived polymers and co-products to replace petroleum-based sources. Specific objectives that will be undertaken to overcome these challenges are establishing clusters with biochemical, chemical, and polymer processing capabilities from laboratory to pilot scale along with the analytical infrastructure to support commercial bio-derived product development; developing economic ways of converting renewable feedstocks (lignocellulose and algae) to platform chemicals; green synthesis of monomers, specialty chemicals, and additives from platform chemicals; and developing, compounding, and processing validation of bio-derived polymers and co-products with first efforts focused on polycarbonate and elastomer-based products. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The proposal includes a statement that the total global market for bio-polymers is expected to grow at a rate of more than 25%, with an expected market of nearly 3 million tons by 2015. This growth is driven by increasing concerns for the environment and a consumer demand for green products. While packaging has historically represented the largest market for bio-polymers, such as PLA, the proposal states that high growth is anticipated for bio-derived polymers that can compete with current polymers in the

automotive, medical, and electronics fields; however, to date the penetration of bio-polymers into these performance-demanding markets has been negligible. PolyOne is a global company regarded for its innovation capabilities, but is very busy providing products to revenue-generating customers. Because PolyOne is the sole company responsible for commercialization of the bio-derived polymers resulting from the center's efforts and because platform chemicals developed through the various bio-refinery efforts are expected to be commercialized by licensors to be named in the future, it is hard to believe that commercialization of any products, company spin-offs, or expansion of product lines will be accomplished in the near future. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The proposal states that the bio-products to be developed by the CEBR, in conjunction with its industrial partners, will produce markets for value-added chemicals from the bio-refineries; that the CEBR's efforts will lead to the generation of key structure-property-processing data that is critical to designing polymer compounds for targeted applications; and that kinetic data for reactive extrusion will enable transition by PolyOne from the incubation to the demonstration and market entry stages. However, there is no technical basis given to justify these claims when so many other groups have not been successful. Although the proposal states that a demonstration facility planned for 2012 for cellulosic ethanol will lead to the need for at least 7 employees at an average salary of $60,000, projection of the total job creation for a project that involves such a broad market is also difficult. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

All the academic, research, and commercial groups (PolyOne and SuGanit) involved in the project have extensive experience in their specific areas of expertise. PolyOne, a publicly traded, global company, offers a comprehensive array of specialized polymer materials, tailored services and end-to-end solutions and is often considered the collaborator of choice for the development of new materials for commercial uses. With revenues in excess of $2 billion in 2009, it provides more than 35,000 products to 10,000 customers. PolyOne has recently developed and expanded its reactive extrusion laboratory and bench-scale and pilot-scale reactive extrusion capabilities for use in the development of bio-based polymers and composites. PolyOne has also launched bio-based plasticizer and bio-polymers products into a larger number of applications. SuGanit has developed and licensed a technology platform to convert biomass into second-generation ethanol (cellulosic ethanol) and other renewable products. Its innovation lies in the ionic liquid pretreatment of biomass and the fermentation process, a short process that does not require high temperature or pressure and makes it possible to convert both C5 and C6 sugars into ethanol using off-the-shelf enzymes and yeasts. The company is preparing to build its first demonstration-scale production biomass facility (40 tons/per day in 2012). For the past 15 years, CIFT has worked with hundreds of companies in the agriculture and food manufacturing sectors to provide technical solutions to merging challenges and market opportunities. The Edison Technology Center has extensive knowledge about the latest technologies in the polymers and advanced materials sector, including bio-products, and will provide access to human resources, funding opportunities, and other support services to the other partners in this project. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The ratio of cost share to state funds is 1.03; 88% of state funds will be used for purchase of capital equipment, and 20% of operating costs from state funds will be used for indirect costs. The cost share is necessary and reasonable; however, all of it is provided in-kind and includes $1,387,610 from the

University of Toledo, $1 million from PolyOne, $45,000 from CIFT, and $375,000 from SuGanit. The commitment letters from PolyOne, CIFT, and SuGanit state their financial commitment to the project. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

With the many challenges related to development of bio-polymers for commercial use, the probability that any of the products derived from the effort will have a significant industry and economic impact within 3 years is very low. Significant amounts of money at both research centers and companies have been expended on programs similar to that described in the proposal; however, the risk factors stated in the proposal are too general and do not take into account that most previous efforts have either failed outright or have not yet delivered on even the limited commercial results promised. With so many projects described and the sources of bio-derived products so diverse, the proposal reads like a hope that a product will result. Although the approach of compounding bio-derived polymers with traditional polymers is a good idea, and PolyOne states that it will use the bio-materials produced for commercial applications, its commitment to that plan appears to be casual, since its cost-share is in-kind rather than in cash. Therefore, the committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-421
Light Vehicle Manufacturing Commercialization Center
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$3,000,000
Capital Funds	$2,500,000	$0
Subtotal	$3,000,000	$3,000,000
TOTAL	$6,000,000	

The Office of Sponsored Programs at OSU, together with collaborators American Trim, Cutting Dynamics, Honda of America, the Transportation Research Center, Nanomaterial Innovations, Ltd., and Techman Sales, Inc., is proposing the creation of a new Light Vehicle Manufacturing Commercialization Center (LVMCC) as part of a larger initiative to organize and launch a larger Center for Optimized Light Structures (COLS) within the already well established Center for Automotive Research (CAR). The primary goals of the LVMCC would be to reduce the cost of highly optimized vehicles of the future by developing new, affordable, and scalable manufacturing processes to make next-generation assemblies and sub-assemblies that incorporate multiple materials; by translating lessons learned and methods developed for aircraft applications that utilize lightweight frames and increasing amounts of polymer-based composites to improve strength-to-weight ratios; by driving down unit production costs by positioning multi-material solutions in higher volume applications; and by reducing the weight (and thereby the system's carbon footprint) of automotive assemblies and sub-assemblies.

Detailed Review

- **Technical Merit and Plan**

The committee cited several readily apparent technical and commercial challenges. Much of this proposal for the LVMCC discusses the broader, and as yet not launched, COLS. The COLS was to have also included development of alternative propulsion platforms—this key element of COLS is apparently not funded. While there may be a need for lighter-weight automotive assemblies and sub-assemblies, the committee does not see how this approach, with this level of resources, has realistic prospects for development and demonstration of innovative, new multi-material technology within the 3-year timeframe as required for WPP funding. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The proposed LVMCC commercialization plan leverages assumed early success in other, non-automotive applications (for example, aircraft seating). While collaborators have an extensive range of process capability, the committee has serious doubts about the LVMCC's ability to establish and then sustain sufficient revenues with the proposed approach. In addition, the lack of clearly identified committed users or customers calls the commercialization plan and related job creation into question. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The committee does not see the projections for the number of successfully developed applications and multi-material technology solutions as achievable. In particular, the fact that consortium members would independently address specific market opportunities, with presumably independent performance measures, is a source of concern. This proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

Through the CAR and multiple related initiatives, OSU and this set of collaborators has clearly demonstrated a long-term commitment in time and money to this program. This proposal comes with a solid and well-structured management plan and suggests a strong relationship between the lead applicant and the collaborators. This proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The ratio of cost share to state funds is 1 to 1, with 42% of funding to be used for the purchase of capital equipment and only 2.8% of state funds to cover indirect costs. $3 million of OTF WPP funding is requested to purchase $2.3 million of new equipment and match the remainder of a total of $3 million in LVMCC-collaborator cost share contributions. The collaborator cost share consists primarily of human capital charged with development and commercialization of the new technologies.
The committee does not see this approach as viable, but the proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

Overall, this proposal does not meet the requirements of the RFP in several areas—particularly in the areas of commercial viability, sustainability, and job creation in Ohio. Simply stated, it is not clear that enough demand has been identified to assure ongoing commercial viability within the 3- to 5-year timeframe required by the RFP. Accordingly, the committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-422
Orthopaedic Device Commercialization Accelerator
Austen BioInnovation Institute in Akron

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$491,096	$2,366,088
Capital Funds	$2,288,500	$600,000
Subtotal	$2,779,596	$2,966,088
TOTAL	$5,745,684	

This application proposes the purchase of equipment for the creation of the Orthopaedic Device Commercialization Accelerator. The Austen BioInnovation Institute in Akron (ABIA) has teamed with the University of Akron to create core facilities that will aid in the development and testing of prototypes of orthopaedic devices. The proposal requests funds for a direct metal-laser sintering (DMLS) system and an AMTI hip simulator to be housed within ABIA for the purposes of building and evaluating prototypes of (mostly) metallic devices and requests funds for a biological construct printer (nScript) and equipment to create a polymer-focused tissue engineering facility at the University of Akron to build and evaluate polymer-based orthopaedic devices. The proposal focuses on the commercial development of five proposed devices that span the orthopaedic market (pediatric spine, sports medicine, adult reconstruction, and fracture fixation). Commercial collaborators include PolyOne, Orthohelix, and the Orthopaedic Research Laboratories.

Detailed Review

- **Technical Merit and Plan**

The proposal would provide Ohio with facilities to build and test prototypes of both metallic and polymeric orthopaedic devices. The facilities for building and testing metallic-based prototypes would reside at ABIA, while the facilities for building and testing polymeric prototypes would reside at the University of Akron. Further testing capabilities would be provided by the Orthopaedic Research Laboratories. The development and commercialization of five orthopaedic devices are planned that represent different domains of the orthopaedic implant market. The proposal does not make clear which of the collaborators would be responsible for the development of each of these five implants, nor is it clear the extent to which any of the implants have already been designed and tested. The Pocket Plate described in Table 1 of the proposal resembles an existing technology already marketed by OrthoHelix, and funding for this technology may have been awarded last year through the OTF Biomedical Program (Proposal title: *Mini/Mega MaxLock Extreme Orthopedic Implants*). The non-invasive spine implant adjustment system is similar to technology also funded last year through the OTF Biomedical Program award to SpineForm (Proposal title: *Clinical Study and Commercialization of an Idiopathic Scoliosis Growth Modulation System*). How or whether these planned devices differ from the devices already funded is not explained in Section 2.4 of the proposal. It is not clear that the money for the DMLS might be better spent by simply contracting with an existing facility to produce prototypes. Due to the lack of clarity in the section describing the initial projects to be undertaken, the proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

It is not clear which of the collaborators in this proposal will be working on each of the initially planned projects and, as a result, the commercialization plan cannot be evaluated fully. It is unclear which institution will hold the intellectual property for each of the devices or whether the intellectual property will be held jointly in some instances. Two of the devices (the bone to tendon/ligament healing disk and the ACL &PCL accelerated healing graft sleeve) represent combination devices that include biologics and

or drugs. The 510K approval process is becoming more rigorous, and combination devices such as these will likely require more complicated FDA-approval processes. For these devices, more data will likely have to be submitted in order to gain approval than for more traditional devices. No provisions are made in the proposal to address these issues. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

Objectives and performance goals do include educational and training activities and the expected job creation numbers are delineated. Market analysis has been performed, and the numbers presented are reasonable. The proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The proposal describes a collaboration of highly qualified investigators and demonstrates the commitment of ABIA to create a sustained partnership between their nonprofit institution, academia, and private companies. The management plan may require multiple principal investigators rather than just one, and this should be considered. The letters of collaboration demonstrate that the end-users of the implants (orthopaedic surgeons) are willing to participate in the development of the devices. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

Cost sharing is described by each of the partnering institutions, although it is not clear how the personnel budget for OrthoHelix and PolyOne will be spent. In particular, it is not clear whether these personnel would be hired to work specifically on the initial projects proposed or if these personnel would be dedicated to working in one of the two prototyping and testing labs at ABIA and the University of Akron. The WPP's RFP requests performance data on prior OTF awards—OrthoHelix (and ORL) was awarded 2010 OTF funds, and PolyOne was the recipient of an OTF Innovation Load Program—but no progress for either group was reported. The ratio of cost share to state funds is 1.07; approximately 82 percent of state funds will be used for the purchase of capital equipment, with the remaining 18 percent for operational costs. While the RFP allows for up to 20 percent of state operation funds to be used for indirect costs, the proposal only dedicates around 17 percent for indirect costs. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

This proposal describes the creation of a commercialization accelerator for orthopaedic devices that would provide small companies and academic institutions with the necessary facilities to develop and test new implants. The qualifications of the collaborators are strong and their experience represents one of the strengths of the proposal. However, the proposal did not contain enough information to properly evaluate the path the partners will take to develop and commercialize the five proposed initial devices, and it was not clear how this proposal might overlap with additional polymer expertise within the University of Akron or with the existing centers, such as the Ohio State Biodynamics Laboratory and the Cleveland Clinic for Spine Health. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-423
Clean Energy Vehicle Charging Station with Grid Interface
The University of Akron

Proposal Summary

The University of Akron has partnered with Recharge Power, LLC, to submit a proposal focused on development of a DC 20 kW fast-charging station for clean-energy vehicles. The stated commercial target is the valet-served commercial-parking industry. Support is offered from C-PV manufacturer Greenfield Solar for sales of their systems.

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$391,912	$522,437
Capital Funds	$1,199,132	$1,068,607
Subtotal	$1,591,044	$1,591,044
TOTAL	$3,182,088	

Detailed Review

- **Technical Merit and Plan**

While fast charging of clean-energy vehicles is a potentially paradigm shifting concept, especially considering the possibility of charging vehicles in just minutes, the identified niche of the valet-served commercial-parking industry is not a compelling one. The technical plan is detailed; however, there are significant questions regarding the applicability of this technical approach to the commercial opportunity. The addition of solar renewables to the fast-charging concept distracts from the stated focus of the project. Major issues of battery heat transfer and battery lifetime in a fast-charge scenario are not addressed to any degree. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

Involvement from the commercial collaborators in the commercialization strategy is insufficient. The proposal does not mention the competitive environment in this field. The proposal does not accurately assess the complexity of market dynamics and has unrealistic assumptions about market share that could be captured, potential customers, and competitors/competing products. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The proposal objectives as written are a blend of (1) designing a fast-charging system to serve the commercial-valet-parking sector, (2) designing affordable fast chargers for plug-in hybrid and battery electric vehicle owners, and (3) integrating renewable electricity into the grid and vehicle charging system. These objectives are not clearly defined and are often mixed together in the proposal. Issues of battery lifetime and battery overheating in a fast-charge scenario are not addressed in the proposal beyond stated integration with a battery management system, while less critical issues such as transformer overheating and local over-capacity are addressed. The stated goals of development of a level 1 DC charger do not relate well with the integration of renewables as given in the proposal body. The long-term use of the capital is entirely related to the renewable power systems aspect of the proposal and the building of a laboratory at the university and is not well integrated with the fundamentals of fast charging of electric vehicles in the targeted commercial sector. The numeric targets given for job creation and for economic impacts are not well justified. The commercialization strategy and target for job creation relies on $1 million of external funds, yet these funds are not presently committed nor are sources identified.

The proposal's forecast of the economic impacts for this project is not realistic. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The collaborators have the expertise and experience to successfully carry out the technical aspects of the proposed project, and the commercial collaborators have the capability to carry out commercialization. The proposal's management plan is not addressed in any degree, but only refers to the absence of hiring future business personnel. Additionally, the roles of the various collaborators are not appropriate for the effort and cost share proposed. While the individuals are clearly experienced and qualified, the proposal fails to address the specific management of the project, and thus does not meet the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

With regard to the total budget of $3 million, a $50,000 commitment from Recharge ($25,000 cash; $25,000 in-kind) appears inadequate for the role they would need to play in commercialization efforts. The cost share from the university is listed as cash cost share, but in reality this is mostly restricted in-kind cost share. A congressional earmark and contract research are listed as being a source of university cost-share funds, but no details are given on the nature of these funds or how much of these sources would be dedicated to this specific project. While the university's cost share appears adequate as listed, there is only limited cost share provided by the commercial partners who would necessarily have the bulk of the commercialization effort. The proposal does not meet the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The proposal's team appears to be capable; however, the balance of work between team members does not appear to be appropriate. Commercial partners should be taking on a more significant part of the development and commercialization effort. The stated goals for development of a fast DC charger are independent of integration with grid renewables. Issues regarding integration with the battery management system, battery lifetime, and potential battery overheating are not addressed. The identified consumer niche is not compelling, and competition in the field is not identified nor acknowledged. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-426
Smart Grid Proving Ground & Commercialization Infrastructure
Youngstown State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$470,364	$851,056
Capital Funds	$1,585,609	$1,335,184
Subtotal	$2,055,973	$2,186,240
TOTAL	$4,242,213	

The focus of this proposal is the build-out of dual "smart" power platforms for evaluating grid compatibility and readiness of commercially focused energy solutions with a representative distribution circuit and distributed-energy resources connectivity. Targeted for build-out at the Tech Belt Energy Innovation Center (TBEIC) in Warren, Ohio, the TBEIC Test Laboratory represents one of several initiatives across the state to service the emerging geographic clusters of advanced energy activity so critical to the future of Ohio's competitive position in the global market.

Collaborative partners are FirstEnergy, Case, Youngstown State University (YSU), Tri-C, the University of Akron, American Electric Power (AEP), Rockwell Automation, NASA Glenn Research Center, JumpStart, MAGNET, NorTech, and the Electric Power Research Institute (EPRI). These relationships provide future commercializing clients with a range of grid-readiness evaluation capacities for both the utilities and commercializing companies, an "on ramp" onto the grid for alternative and renewable devices; and a robust, region-wide communications connection.

Detailed Review

- **Technical Merit and Plan**

The technical plan is well stated for the near term, but the focus on the short-term commercialization partners neglects plans for the longer-term use of the facility. The technical plan needs time and clarity to determine if the test stands are being built generic enough to have a broader-based use to later generate the self-sustaining revenues as suggested in the summary. There is also concern about the proper coordination and management of the numerous partners involved. This is a start-up organization, and it is currently short on commercial clients, relative to the services it is proposed to provide. It is administratively top heavy and lacks a clear plan as to how to provide all the services necessary to create sufficient documented jobs activities within the RFP's time period. This proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The major disclosed jobs creators in the plan are MegaJoule and Intwine, both young companies. Both companies do appear to have products with the capability to go to market in the future. However, the larger client, MegaJoule's, financing plan is highly speculative and involves multiple rounds of financing. The use of MegaJoule's hybrid ultra capacitors in this grid is of some unique interest and provides new ground for study in a system with real-time response needs. Given the technical, market acceptance, and financing uncertainties, there are significant and unacceptable risks to the jobs creation as stated in the proposal. Intwine, the second client mentioned, follows the same pattern of being early market with significant job growth potential but without a path or timeline clearly documented in the proposal. The pathways and strategies to market for these clients are not well defined. This proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The stated project goals are to reduce barriers for the client companies in order to gain access to major electric utilities. The applicants propose that this will create early dialogue, direction, and feedback to maximize their client's commercialization efforts for improved product relevancy, speed to market, customer adoption, and an accelerated transition to the growth and sustainability stage. In the total, that part of the plan would indicate a fair chance for success. However, it is not apparent how the longer-use goals and sustainability will be achieved, although some of the early goals appear to be readily achievable. This proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The partners and technical participants are well qualified for the planning and implementation of this proposal. However, the committee believes it is too early in the organization's development to create client jobs with the specificity sufficient to justify the investments proposed. Despite this, the proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The proposed cost share is within the stated guidelines. Private cost share is small but still indicates buy-in to the project relative to the size of the start-up companies. $1.2 million of the cost share is a building which, although necessary, is large relative to the size of the proposal. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

A smart-grid proving ground, as stated in the proposal, is an excellent concept and goal. Inclusion of both a small, distributed grid and a home network grid test stand are definitely paths to provide a clearer understanding of the interoperability of different elements and subsystems to be included in future electrical networks. This test bed appears to be an important tool for the smaller company to test and learn from in an operational environment. The proposal states it is a place to test performance in a balance of system and real-time environment that is critical to commercialization efforts. The committee agrees with the applicants that there is a significant need to accelerate bringing these products to market, but the committee notes that the proposal fails to document specific commercialization performance and jobs creation in a 3- to 5-year timeframe. The committee believes that a proposal submitted to a future OTF WPP competition might merit funding if specifically documented markets and jobs potential could be more of the focus of the proposal. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-431
Porous Structures for Biomedical and Environmental Applications
University of Toledo

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$392,835	$1,388,317
Capital Funds	$1,025,000	$200,000
Subtotal	$1,417,835	$1,588,317
TOTAL	$3,006,152	

This proposal, led by the University of Toledo, aims to strengthen the capabilities of two different research groups focusing on porous materials to develop commercial products through the purchase of new equipment. One group, consisting of the University of Toledo and its commercial partner X-Spine, will focus on porous materials for orthopedic applications, while the second group, consisting of Wright State University and its commercial partner MetaMateria, will focus on the development of porous materials for environmental applications. These teams have a track record of working together and propose to further their collaboration by working specifically on the commercialization of new porous materials. The equipment requested includes a micro CT scanner, nucleofactor, a bioindentor, and histology equipment for the University of Toledo and an X-ray diffraction machine, surface area and pore size analyzer, thermo-mechanical testing system, and a high-performance liquid chromatography (HPLC) system for Wright State University.

Detailed Review

- **Technical Merit and Plan**

The proposed consortium would provide a concentration of expertise in Ohio dedicated to porous materials, which may provide Ohio with a competitive advantage in this field. The equipment purchases proposed would augment existing capabilities at both academic institutions. The committee questions the extent to which these two institutions will collaborate in the early years. Although there are plans for the equipment to be shared, the committee would have liked to see more integration between the groups and a stronger linkage between the two application areas. It appears that the materials that are proposed to be developed are innovative and have potential, although porous materials for both biomedical and environmental applications are being developed at other institutions in the United States. While the proposed materials may have advantages over existing materials, the committee is concerned that both markets are crowded, and penetration into these markets will be difficult. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The fact that the partners will work on multiple applications (biomedical and environmental) of porous devices is viewed as a strength of the proposal. The market opportunity for both applications is favorable, although the committee would have liked more information on the commitment of potential customers. To capitalize on the expertise of each team, it is important that the academic and commercial partners work together to develop and commercialize the proposed products. There is concern that the time to commercialization for the biomedical materials is underestimated, and that these materials cannot be commercialized in the timeframe of this grant. Further, there is concern that the commercialization of at least some of the environmental materials are far enough along that the equipment purchased by this grant will not be necessary. Both commercial partners will require outside investment to build new manufacturing facilities, and more information about the possible sources of these funds should have been outlined. The proposed biologic materials to be developed under this proposal have the potential to be approved by the FDA, but the expected timeline for doing this is not clear. More information is needed to

assess the intellectual property protection for the already-developed materials. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

This proposal does involve major capitol acquisitions for two Ohio universities, and it can reasonably be expected that these acquisitions will promote the education and training of students and will enhance multiple research programs. The jobs to be created are mainly at X-spine and MetaMateria but the project is dependent on outside investment to build the manufacturing facilities; therefore, near-term job creation is unlikely. Despite this concern, the proposal meets the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

Drs. Goel and Kirschman have both been identified as coordinating the commercialization of the biomedical materials. Dr. Elahinia has been listed as coordinating the additive manufacturing effort, but this work is not clearly outlined in the proposal. Despite the fact that the roles of some of the team members are not clearly delineated, the experience of the team overall, as demonstrated by their track record of research, development, and in some cases commercialization of devices, is one of the strengths of the proposal. The proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The two commercialization partners have demonstrated reasonable cost-sharing to the consortium. MetaMateria will provide around $60,000 per year in personnel, about $1,000 in travel expenses, and more than $15,000 per year in materials supplies and testing, to total $80,000 per year. X-Spine will provide about $50,000 per year in personnel, $2,000 per year in travel, and $15,000 per year in materials, supplies, and testing, to amount to $200,000 over the 3 years covered by the grant. The university partners are providing faculty salary, student tuition, cash (Wright State), and unrecovered facilities and administrative (F&A) costs as cost sharing. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

Both commercial partners have porous materials on the market and thus have experience with the research, design, and commercialization of these materials. The materials that are proposed to be developed under this proposal build upon the existing technology in a logical fashion. The academic partners have many years of experience in the design of these materials and are well qualified. The proposed materials do have a niche, but the market share that can be captured by these materials is unclear as both application areas have significant competition. The biomedical materials are not far enough along in their development to be commercialized within the timeframe of the WPP. Both commercial partners will require investment to build manufacturing capabilities in order to commercialize these materials, and not enough information has been provided to assess the likelihood that this will happen within the required timeframe. The proposal may have been stronger had it focused on just one direction (environmental or orthopedic application) or if it had been submitted as two separate proposals. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-432
High Frequency Active and Passive Electronic Devices and Sensors
The Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$2,251,429
Capital Funds	$2,500,000	$750,000
Subtotal	$3,000,000	$3,001,429
TOTAL	$6,001,429	

The Center for Emergent Materials (CEM), a National Science Foundation (NSF) Materials Research Science and Engineering Center (MRSEC) based at OSU, is seeking funds to procure a focused ion beam system for patterning submicron features and other related equipment (precision alignment vacuum hot press tool, spectrometer, and a radiation-tolerant optical cryostat) to create a supply chain in Ohio for THz industries with collaborators Lake Shore Cryotronics, Inc.; Traycer Diagnostic Systems; and TeraView, Ltd.

Detailed Review

- **Technical Merit and Plan**

The technical plan includes installation of key capital equipment and hiring of five support personnel in an existing NSF MRSEC center at OSU. This will allow the CEM to create a vertical supply chain for commercializing existing technologies at two small companies. The capital equipment to be procured will be used in lithography CAD (computer-aided design) work and for test patterning and characterization of filters. This instrumentation could also be secured through an existing NSF MRI (major research instrumentation) program that requires only a 30% cost share, as opposed to the 1:1 cost share required by OTF WPP. The proposal does not state why other available federal funding avenues have not been explored to acquire this equipment. The projects this equipment would support are well defined, and the team provides a good discussion of how this investment will help these two companies and some discussion about what other uses might be pursued. However, the committee was not convinced that the applicants could build a strong enough foundation to produce THz filters that exceed in quality those currently produced by non-Ohio companies. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

QMC, a Cardiff University spin-off in the United Kingdom, currently provides the bulk of THz filters, far exceeding Lake Shore's current capabilities for band-pass precision and efficiency. Like QMC, Lake Shore hand-produces THz filters, except that the Lake Shore products involve a simple single-layer design. QMC products are known for their high-precision and, with no real in-class competition present, seem to be expensive. Lake Shore hopes that equipment housed at OSU will allow it to test platforms, use multi-layered techniques, and scale up its production capabilities. The THz market seems to be rather narrow in scope, and the market assessment failed to demonstrate significant market pull. The proposal also did not address the cost advantage the applicant will have if Lake Shore were to be successful in matching the specifications of the QMC product, especially when supply will be exceeding demand. THz technologies are bulky and/or expensive and to date cannot adequately address the application needs of commercial markets. The longer-term commercialization and competitiveness strategy beyond entry was not developed. Furthermore, California-based Raytheon, which has been investing in THz technology, still seems to be unsure of how it may fit into the business. It has made no commitment to this project, but noted that it "may" purchase products developed as a result of this project, but only if the technology

achieves performance criteria to be established solely by Raytheon. Agilent, also a California-based company, was equally noncommittal. Neither company is a collaborator on this proposal.

Some of the requested equipment is available at the AFRL Materials Laboratory. Since the value of the proposition is to establish a solid THz supply chain in Ohio, the committee was surprised to see no mention of, nor any intention to access the Materials Laboratory facilities on the part of Lake Shore and Traycer Diagnostics. This is particularly surprising given their geographic proximity to one another. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The overall objectives of the project are to develop THz Filters, spectrometers, and develop a THz supply chain in Ohio. The project plan provided well-defined technical tasks, timeline, and deliverables (in terms of procurement, production of processed FPAs, modeling of double perovskite oxides, and ultrahigh magnetic resonance of magnetic materials), with clear roles and responsibilities. The committee was not convinced that successful execution of their well-structured technical plan would result in successfully meeting the commercialization objectives. The technical goals were not clearly linked to competitive success. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The principal investigator on this proposal is Dr. Nitin Padture, director of CEM. He and his colleagues are qualified to lead, manage, and deliver on the project. Professor Padture, in particular, has more than 20 years of experience in tailoring advanced ceramics, composites, and coatings for mechanical, thermal, and optical properties and characterization of 1-D and 2-D functional nanomaterials. His research has been supported by both government and industry. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

Lake Shore, which claims to benefit from a possible expansion of the THz market, volunteered a cost-share in the form of equipment discounts that CEM will receive from Lake Shore. Traycer, another Ohio company, will provide TeraView (a U.K. company) with $250,000 of the proposal for a $500,000 system that has been discounted 50%. The discounted 50% is then claimed to be a TeraView contribution to the project. The review committee was not convinced that the industrial partners have been completely sold on the project and its promised return on investment. The cost match from OSU is $1.4 million in the form of personnel and fringes and $840,000 in the form of unrecovered indirect costs. The committee would have liked to have seen more cash and a stronger commitment from the end users. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The THz market is growing and has potential for Ohio. The team has the technical and management capacity to become a much more significant player in the evolution of this technology and its potential paths to commercialization. Unfortunately this proposal does not yet demonstrate a strong enough case in terms of market projection and partner commitments for the OTF WPP program to invest at this time. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-434
Commercialization of High Speed Imaging Camera Technology for Laser Radar Vibrometry
University of Dayton

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$2,368,900
Capital Funds	$1,800,000	$0
Subtotal	$2,300,000	$2,368,900
TOTAL	$4,668,900	

This proposal requests funding to develop and commercialize a near-infra-red (NIR) laser Doppler vibrometry imaging system at the University of Dayton's Air Force Center of Excellence in laser radar. By mapping the amplitude, frequency, and phase of mechanical vibrations on the surface of a sample, vibrometry imaging can generate a digital map or vibrational signature of a sample object. Target markets for this technology, once it has been developed and calibrated, may include automotive and aerospace manufacturing, structural analysis, fault detection, target recognition, seismic monitoring, oil exploration, and subterranean tunnel detection. The primary objectives of this project are to develop the imaging camera and then to apply the camera (image capture) system to vibrometry in application specific configurations. The Air Force Research Laboratory will be providing personnel cost share as well as experiences gained in end-user military applications. The list of collaborators include Etegent (with expertise in vibrometry and remote sensing), L3-Cincinnati Electronics (with expertise in infrared imaging), RNET (with expertise in read-out integrated circuit), and DRS (with expertise in automatic target recognition). With Wright Project funding, the University of Dayton Air Force Center of Excellence proposes to create 80 new high-tech jobs in 5 years and will enable Ohio to become the center for laser radar vibrometry equipment.

Detailed Review

- **Technical Merit and Plan**

The committee identified several key technical and commercial challenges, each of which appears to be a critical factor for the project's success. Essentially, this proposal buys equipment and covers the cost of development of a series of application-specific configurations of the developmental camera, flash scanning, image/data capture, and interpretation algorithms. Success in each of these areas must be achieved within the constraint of available resources before each configuration can be demonstrated to prospective customers. The first 3 years of the program are dedicated to development and demonstration. With successful demonstration, market entry (which is not funded in this proposal) would be attempted in years 3-5. This proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

With market entry slated for years 3-5, availability of additional private or federal investments are required to affect transition of the to-be-developed technology to partner companies. While there may be military applications for this technology, the committee has serious reservations regarding overall commercial viability: It is not clear that commercially viable applications can be developed; and, even if they are, it is not clear that Ohio will benefit from successful commercialization. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

While this technology is apparently very well developed in defense applications, the committee does not see how acquisition of this equipment and execution of this plan could lead to significant commercial success in the proposed 3- to 5-year time horizon. The 80 high-tech job projection in years 3-5 is apparently dependent on a substantial amount of additional funding and the ongoing commitment of collaborators, and the longer-term use of capital is not adequately addressed. Perhaps this equipment could also be used to train students and employees and for additional research and development activities. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The Air Force Center of Excellence at the University of Dayton has access to what is apparently a well developed and demonstrated scanning, imaging, and vibrometry technology. This, combined with the experience of the collaborators, indicates very impressive reach and breadth of experience. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The ratio of cost share to state funds is 1.03, with 38.6% of the project funds to be used for purchase of capital equipment, and <1% of state funds as indirect costs. The split between direct and in-kind seems reasonable. Thus, the proposal exceeds the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The committee saw this proposal as deficient relative to requirements of the RFP in several areas, particularly in technical merit, commercial viability, and job creation in Ohio. Simply stated, it is not clear that the all-important vibrometry sensor camera can be developed and that the commercial viability can be demonstrated within the 3-5 year timeframe required in the RFP. Accordingly, the committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-437
Research, Development and Commercialization of Micro Air Vehicle Platforms in the Miami Valley
Wright State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$500,000	$1,280,060
Capital Funds	$2,500,000	$1,719,940
Subtotal	$3,000,000	$3,000,000
TOTAL	$6,000,000	

A Wright State University team, the Ohio Center of Excellence for Micro Air Vehicle Studies, in collaboration with local companies with whom the center has existing relationships, Mound Laser and Photonics Center, Inc., and ATK Advanced Systems, with strong support from the Air Force Research Laboratory (AFRL) air vehicles directorate (RB), proposes to build on existing capabilities and infrastructure to establish a state-of-the-art technology development center on micro air vehicles (MAV) at WSU. The proposed center will focus on developing and transferring innovative technologies to industrial partners and assisting those partners in developing and commercializing breakthrough MAV technologies. The equipment to be purchased in combination with existing facilities is designed to help create an integrated platform for analysis and micro-manufacturing. The commercialization project is to develop and commercialize a single-use, autonomous MAV platform based on a flapping wing design, with mesh networked collaborative capability.

Detailed Review

- **Technical Merit and Plan**

The proposal states four primary research and development objectives: (1) design of MAVs based on computational fluid dynamics; (2) MAV prototyping, including power and propulsion; (3) autonomous MAV flight; and (4) high-efficiency power systems. The team plans to extend past work in modeling insect flight to design and test full-scale flappable wings, but the proposal provides no detail on the CFD models to be used. The Wright State team has made excellent progress in building and testing small MAV platforms. The transmission and gearing part of the proposal is especially strong. However, it is important to consider that a critical piece of this proposal, a state-of-the-art microlaser sintering tool, is also the most expensive one. Although a not-yet-commercial German product was mentioned, no discussion was devoted to alternatives, especially from U.S.-based suppliers. In addition, while the committee believes the graphene nanocomposite electrodes can be a promising research path to explore for MAV energy storage, the power section seems to be still in the imagining stage, with many problems to be resolved before a working prototype could be developed. The committee also believes the vision challenges and communication issues require further explanation.

Finally, the team uses an impressive facility, the Vicon arena at AFRL to demonstrate autonomy. This is a promising route to determining the stability and controllability of MAV prototypes in parallel with onboard avionics development. The committee believes the team can demonstrate autonomous flight in the Vicon laboratory during their 3-year project, but are not confident the avionics can be carried onboard or that the vision system will provide the needed data, particularly in un-engineered indoor (or outdoor) environments. The proposal meets the requirements of the RFP on Technical Merit and Plan, but has several gaps that would need to be addressed if the team submitted the proposal in a future round.

- **Commercialization Strategy**

The commercialization project is to develop and commercialize a single-use, autonomous MAV platform based on a flapping wing design, with mesh networked collaborative capability, focused on defense and homeland security markets. The primary initial customer is clearly the Air Force, as indicated in the proposal. The Air Force, and more generally the Department of Defense (DOD), are currently committed to flapping-wing MAV platforms, so this proposal is responsive to the needs and desires of DOD. However, the commercial future of these platforms is less certain and treated very superficially in the proposal. Other technologies are potentially strong competitors for the end user. For example, small unmanned helicopter (rotary wing) MAVs remain a strong competitor to flapping designs, and to date the small helicopter MAV has been more easily controlled and is able to carry somewhat higher payloads than equivalent flapping MAVs. The proposal would have benefited from a discussion of how alternative MAV designs such as helicopter MAVs factor into competitiveness for a customer base beyond DOD. Their cost estimates ($2,000 unit cost) are unsupported, and commercialization plans are vague beyond the Air Force commitments. The proposal refers to the probable creation of a new spin-off company, but only after they solve the Air Force challenges. The proposal has great promise, but does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

In the 3-year target window, this remains a very early stage project and the committee believes the proposal team is seriously underestimating the translational challenges. In each of their four primary objective areas, the proposal does a good job of identifying key technical challenges and approaches to solving them. However, the committee identifies several important gaps as noted above. The proposal would have been greatly strengthened by providing estimates for avionics payload capacity, indicating a mass budget for even the small components (video, microprocessor, inertial measurement unit) planned for use, indicating power draw for these components, and scoping the communications requirements, challenges and potential resolutions. This is a design-in-progress but size/weight/power considerations are critical and must be more clearly addressed. The proposal does not convince the committee that what they plan could actually be done within the project timeframe. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The team assembled is very good, combining expertise in MAVs with advanced manufacturing and research—laser-based microfabrication—and partnering with a primary customer (AFRL) and a large aerospace and defense contractor with key systems expertise and key contacts and reach into DOD target markets. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The budget appears to be adequate for the task at hand, and the match meets RFP requirements. Company match is modest and in-kind ($385,000), but the Air Force interest is very strong ($840,000). The commitment letters provide clear documentation of collaborators' cost share. The equipment purchased would help give WSU a strong micro-manufacturing prototyping position, which would not be exclusive to MAV development. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

The committee finds many positive aspects to this proposal, but feels that significant weaknesses in project objectives and performance goals and in their commercialization strategy need to be addressed. In particular, the committee does not believe that the team could produce a commercial product within the 3-year timeframe and feels that competitors are not carefully addressed, cost estimates are unsupported, and important questions remain regarding size/weight/power considerations. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-441
Addressing Commercialization Barriers through the Development of a Smart Grid Test Facility
Cuyahoga Community College

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$456,500	$1,456,000
Capital Funds	$990,000	$0
Subtotal	$1,446,500	$1,456,000
TOTAL	$2,902,500	

The proposal is focused on developing a test facility at Cuyahoga Community College that can be used by various product development partners to evaluate new technologies related to smart grid and smart home implementation. Project partners include ADI Wind, a developer and manufacturer of wind power generation equipment, and Intwine Energy Networks, a developer of components for home energy management. IGEN Laboratories will partner with the team to manage and market the test bed, and Summit Energy Services will provide training and advice. The facility will function as a development facility as well as a worker training center for various emerging industries. The group also proposes to develop and deploy education and job-training programs related to the critical aspects of smart grid deployment and alternative energy technologies. This activity builds on the Cuyahoga Community College's rich history in training workers in the areas of solar energy, wind energy, and fuel cells.

The project would create a working prototype of an integrated smart grid, organized around a smart home, which allows for research, commercial development, and key educational benefits. The test bed will connect multiple, highly variable generation sources and will have common usage nodes as may be found in a smart grid.

Detailed Review

- **Technical Merit and Plan**

The technical requirements for the proposed concept are not well defined in the proposal. Although the proposal defines a series of activities to be undertaken, the technical plan is not particularly well detailed with regard to the specific items to be addressed, how they will be addressed, and what the measurable parameters of success may be. As a result, it is unclear how the proposed project will increase the likelihood of commercialization. Furthermore, there are some technical inconsistencies with how the elements of the proposed test bed match the proposed smart home. For example, the proposal notes that the long range plan is to test ADI's wind turbine component on site and suggests that these turbines may have an output on the order of 100 kW. However, the load capacity of the home is at least an order of magnitude less than this level. In addition, the proposal calls out 3-4 kW/day, which is neither a power nor energy unit. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The proposal includes contributions from four key partners: Intwine, ADI Wind, Summit Energy Services, and IGEN. The structure and content of the proposed smart grid test facility appear to match up well with the commercial needs of Intwine. The assistance of IGEN further strengthens the concept, particularly with regard to the possibility of long-term sustainability. The fit of ADI's product to the test facility is unclear, however, due to a mismatch in product scale. It appears, nevertheless, that ADI's commercial prospects are significant, particularly for military applications. The proposal does not contain much information regarding the participation of Summit Energy Services. The proposal could also be strengthened by demonstrating more complete understanding of eventual customer needs and performance requirements for prospective products.

The applicants assert that the project is self-sustaining in that the annual cost of running the project and test bed will be offset by income generated from additional partners testing their technology within the test bed environment. More substantiation would further strengthen the proposal.
The proposal meets the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

While a top-level objective of creating 100 jobs over 3 years is very specific, sub-objectives called out in the proposal appear to be quite general. The proposal would be strengthened with the addition of more specific objectives and metrics, as touched upon in the evaluation of this proposal's commercialization strategy. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

Cuyahoga Community College and its partner Intwine are uniquely qualified to address the needs outlined in the proposal. The inclusion of ADI Wind, a manufacturer of wind turbine components having a focus on military markets, appears to be less strong of a fit given the focused proposed effort. The scope and extent of participation for Summit Energy Services is not clearly identified. It appears that operation of the facility is outsourced to a third party, which may limit the development of an institutional memory at Cuyahoga in test bed management. The proposal would also be strengthened by the inclusion of an individual having significant experience in the integration of components into electric grids. The proposal does not meet the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The overall budget appears to be adequate in meeting the performance objectives of the proposed effort. The project cost share appears to be necessary and reasonable, and the letters of commitment sufficiently detail the nature and amount of collaborator cost share. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

While the proposed effort seems to meet a significant need for educational and test facilities to support the development of technologies and student training for smart-grid systems, the proposal falls short in making a convincing case for the technical methods employed. Furthermore, project objectives are not sufficiently detailed to demonstrate a pathway to success, nor is a compelling case made for how this project will transition to successful commercialization. The committee saw this as a patchwork proposal trying to make different parts of a puzzle fit together irrespective of the shape of the pieces. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program. However, the committee recognizes the importance of this field of research and recommends that the applicants address the comments put forth by the committee and try again in future OTF competitions.

OTF WPP 11-442
Development and Commercialization of Revolution Mill-Turn Machine Tools Using Open Architecture Controller for Aerospace/Aviation Complex Part Manufacturing
TechSolve, Inc.

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$403,846	$3,226,834
Capital Funds	$1,751,000	$0
Subtotal	$2,154,846	$3,226,834
Total	$5,381,680	

The intent of the proposal submitted by Tech Solve, Inc., on behalf of itself, the University of Cincinnati, Y-12 National Security Complex, and GBI Cincinnati is to evaluate a next-generation mill-turn device for aerospace and aviation manufacturing. The advantages of the new design include improved tool life, dynamic responsiveness, and better part finish. The areas of emphasis lie in areas that have in the past provided major problems for next-generation aircraft and aircraft engines, including machining of ceramic matrix composites and polymer matrix composites such as those currently in use on the Boeing 787, namely very-high-modulus/strength graphite fiber in a polymer matrix such as an epoxy resin.

Detail Review:

- **Technical Merit and Plan**

The proposal deals with a serious problem in the use of advanced composites for aerospace application, mainly the cost of finished parts. Unfortunately, no preliminary work is provided by the authors as to whether milling can be used to shape composites, and the committee is not convinced that milling is an appropriate shaping technique for composites. The committee believes that this proposal is very early in the research and development stage, and found the overall technical plan too focused on modeling and not on a focused product. The proposal does not meet the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

It appears as though the organizations involved in this proposal are primarily from the metallurgical field, in particular the design of improved milling. There do not appear to be any organizations that have as their primary focus the design of improved milling equipment that have applications specific to high-performance components. This latter point may very well represent a fatal flaw in the proposal. Vagaries in the commercialization strategy further weaken this proposal, despite some important foundational elements to commercialization like patents and joint agreements with collaborators. The applicants do not make the case that this product could be commercialized within the 3- to 5-year timeframe provided by the RFP, especially given the technical shortcomings noted by the committee in describing the proposal's technical merit. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The proposal does not provide a meaningful evaluation of these issues. Rather than provide concrete goals, it merely states desired staffing and revenue levels over the course of a number of projected out-years. There is no strategy to be implemented, and the committee does not find staffing and sales numbers to be sufficient in the absence of strategic goals. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

This proposal is lacking in at least one important area, namely, experience in properties and behavior of advanced CMC and PMC composites. This may very well be another fatal flaw in this proposal. The proposal does not meet the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The proposal budget is unrealistic in light of the above comments. There is every indication that more resources will be required to deal with technical challenges that go beyond the 3-year timeframe of the funds. In addition, commitment letters are inconsistent in the level of support and detail about their involvement in this project. The proposal does not meet the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendations:

Although the proposal attempts to address a serious issue in the manufacturing of advanced components and composites, the committee found key deficiencies in almost every area of evaluation. The committee is not convinced that this proposal is technically ready, and technical shortcomings more often than not translate into funding problems further down the research-to-market road. Moreover, the applicant team lacks crucial expertise—in advanced CMC and PMC composites—which, the committee thinks, makes overcoming technical problems even more dubious. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

OTF WPP 11-451
Advanced Simulation Center for Driver and Vehicle Communications
Ohio State University

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$250,000	$757,647
Capital Funds	$910,000	$600,000
Subtotal	$1,160,000	$1,357,647
TOTAL	$2,517,647	

The proposal seeks to establish an advanced simulation center for driver and vehicle communications to address the risk of cognitive overload and "driver distraction" of multi-tasking drivers. This OSU center will be used for designing and implementing vehicle instrumentation panels and in-vehicle information systems that can be used safely by the driver without resulting in erratic driving behavior and possible vehicle crashes. Honda R&D Americas (HRA) has been identified as the primary research and development collaborator and beneficiary of the center, while Wright State University, OSU, Panasonic, Alpine, Denso, SEA Ltd., and Nationwide Insurance have been identified as secondary R&D collaborators.

Detailed Review

- **Technical Merit and Plan**

The proposed center at OSU will provide a means for HRA to evaluate designs for new vehicle instrumentation panels and systems to meet the Alliance of Automobile Manufacturers (AAM) driver distraction requirements; provide motion and dynamic cues needed for accuracy of simulation not possible anywhere else in Ohio; create opportunities for involvement of Ohio-based automotive supply chain manufacturers such as Weastec, Alpine, Denso, and Pioneer; and foster OSU-Honda, WSU-Honda, and OU-Honda joint R&D projects. The proposed center is of demonstrated interest to HRA, as it might contribute to HRA's basic research to define and measure "easy to use" and any associated level of distraction and allow HRA to be an active partner with the Department of Transportation (DOT) and National Highway Traffic Safety Administration (NHTSA) in defining any future regulations. The center will provide essential evaluation tools and expertise necessary for integration of displays and entertainment/communication amenities (infotainment) that are expected to be part and parcel of future cars. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The commercialization strategy needs further refining, since the end product is the center itself, which in turn is key to infotainment products and subsequent integrations that are yet to be developed and optimized. There are two other university-based simulation facilities in Ohio, both of which seem to have limitations, because they offer only one degree of freedom and offer no vehicle access. HRA does not currently have ongoing collaborations with either of these two academic institutions, but it is quite possible that these may be used for future early stage testing where motion/dynamics is less critical. The support letters from WSU and OSU use too many identical sentences, including one that stresses complementary focus, yet one of these institutions goes on to state that its facility does cover all of what is proposed and perhaps even more. Currently, Honda uses a facility in California and incurs $100,000 per month in expenses for its various driver simulation needs. The center is expected to guarantee Honda at least 10 weeks of access for conducting tests per year. The proposal claims to serve the purposes of Ohio-based automotive supply chain manufacturers, including Honda's Tier 1 suppliers, but it identifies only a few of them and does not include commitment letters from any. The letter from Nationwide

Insurance is lukewarm at best. The case has not been made in the proposal as to how and where this Center will create new jobs, but the committee is convinced that the center can open doors for newer markets and possibilities as well as new jobs. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

The project will result in procurement of a RealTime Technologies, Inc., simulation hardware and software package, as well as equipment (with six degrees of freedom) for biometric measurement, followed by a phase of setting up, interfacing, and calibrating the hardware and software for the center. Goal 1 is to have the center configured to run pilot tests to optimally meet the needs for HRA-proposed testing, while Goal 2 will involve developing a standardized protocol for testing Honda vehicle instrumentation panels and systems to meet AAM driver distraction requirements, performing usability testing, exploring mental workload under concurrent task conditions, and incorporation of these into new products. The most significant flaw of this proposal is that other than the increase in positions at the center itself, it does not provide or project how many new jobs may be created at either Honda or Honda's Tier 1 suppliers because of this project. The committee would have liked to see more flushed-out job creation figures but does not doubt that the center would eventually create new jobs both directly and indirectly. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The applicant team brings experts with superb expertise to the project, including principal investigator Dr. Janet Weisenberger, senior associate vice president for research at OSU. Her research expertise on multisensory integration of information in simulation environments is relevant to the project. Most of the day-to-day aspects of this project have been distributed across several individuals, including Don Stredney, director of the Interface Laboratory at Ohio Supercomputer Center. The committee feels that the inclusion of a social scientist is an additional strength for the proposal. The commercialization strategy as well as the job creation aspect of this proposal remains problematic, but the management plan, strength of collaboration, and overall leadership are distinct advantages of the proposal. Thus, the proposal exceeds the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

This project has major cost share coming from OSU in the form of personnel and un-recovered indirect costs from HRA in the form of $600,000 in cash and $303,000 in-kind. Cost share by others is quite small. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

This proposal attempts to address an emerging field of the automotive industry (infotainment) and capitalize on existing capabilities and resources in the State of Ohio. The committee believes this work to be very important as this field will likely continue to grow, but the proposal fails to meet many of the requirements of the RFP, perhaps most importantly in its lack of a clearly identified commercializable product and in its lack of a well-defined link to job growth within the funding term of the grant. A more clearly defined product would have helped this proposal, and the committee would have liked to see more information on what the proposal's prospects are for job creation within Ohio. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program, but hopes the applicants will continue to flush out their proposal and address the committee's concerns in the future.

OTF WPP 11-453
Supporting Commercialization in Ohio's Photovoltaics Industry:
Acquisition of a Secondary Ion Mass Spectrometer
The University of Toledo

Proposal Summary

Proposed Budget		
	State Funds	Cost Share
Operating Funds	$0	$486,858
Capital Funds	$1,875,000	$835,000
Subtotal	$1,875,000	$1,321,858
TOTAL	$3,196,858	

This proposal is submitted by the University of Toledo Wright Center for Photovoltaics Innovation and Commercialization in the Department of Physics and Astronomy. The proposal is for the acquisition of a Secondary Ion Mass Spectrometer (SIMS) for the purpose of supporting and developing the expansion of Ohio's photovoltaics (PV) industry. The SIMS would be housed within the University of Toledo Wright Center for Photovoltaics Innovation and Commercialization. The premise of this proposal is that having this local capability would give the photovoltaics industry of Ohio an advantage in terms of accessing this technology on a more timely basis and at a lower cost by reducing shipping expenses. The private sector collaborators are Ferro Corporation and Solar Spectrum, LLC.

Detailed Review

- **Technical Merit and Plan**

The technical plan of the proposal addresses the need for, and the importance of, SIMS capabilities to the photovoltaics industry of Ohio. The plan further addresses the reasons why the SIMS capability is necessary in the research and development and manufacturing phases, and in improving performance as applied to numerous advanced PV technologies prevalent in the market. The proposal meets the requirements of the RFP on Technical Merit and Plan.

- **Commercialization Strategy**

The committee feels that there is lack of a substantial commercialization strategy and lack of any new intellectual property being created. The purchased equipment would be used in the commercialization strategies of private companies, not of the lead applicant. Additionally, the support letters are written such that 30% of capacity of the equipment is designated for use by the two collaborators, leaving only 70% available for other companies. The committee feels that this significantly weakens the overall benefit to the Ohio PV market as a whole. Finally, there is no evidence of sustainability of the project beyond the 3-year period. The proposal does not meet the requirements of the RFP on Commercialization Strategy.

- **Objectives and Performance Goals**

While the proposal does meet the requirement for capital acquisitions and improvements at a university or college, the committee feels the proposal is not able to substantially demonstrate direct job creation and income and revenue generation. The benefits discussed in this area are ambiguous, indirect, and hard to measure. The proposal does not meet the requirements of the RFP on Objectives and Performance Goals.

- **Experience, Qualifications, and Eligibility**

The program director and other parties involved in this proposal are well qualified. The committee feels that the private sector collaborators are capable and qualified as well. That said, there is no significant

commercialization strategy requiring significant experience and qualifications. Again, the committee feels that the 30% of equipment usage time allocated to the collaborators detracts from the overall goals and objective. The proposal meets the requirements of the RFP on Experience, Qualifications, and Eligibility.

- **Budget and Cost Share**

The budget is appropriate, and the amounts of matching funds are acceptable. There is cost sharing by the collaborators, both in the form of cash and in-kind. The committee feels that the only measurable opportunity of direct revenue benefit to the state of Ohio is missed, since the purchase of equipment is coming from outside the state. The proposal meets the requirements of the RFP on Budget and Cost Share.

Summary of Review and Recommendation

This proposal has technical merit and addresses the need for SIMS equipment. The proposal does not build a strong enough case for the need of this equipment at the Wright Center for Photovoltaics Innovation and Commercialization, since similar equipment can be accessed elsewhere. The committee feels that the commercialization strategy is essentially nonexistent as it pertains to the lead applicant. Also absent are any *direct* and measurable gains in employment, revenue, and income. That said, the proposal is successful in conveying the indirect benefits to the state and the Ohio PV industry at large. The committee feels that the goals of this proposal are worthwhile and that the applicant should pursue funding from a source that may be a better fit for such an initiative. The committee does not recommend that this proposal be considered for funds under the Ohio Third Frontier Wright Projects Program.

Appendix C
Evaluation Worksheet

A. Technical Merit and Plan	GRADE:

1. *Problem Statement*
   a. Technical and commercial challenges described. Will solutions increase likelihood of achieving commercialization?
   b. Description and demonstrated understanding of eventual customer needs and performance requirements.

2. *Project Goals and Objectives*
   a. The goals and objectives and each of the project's related sub-elements are clearly stated.
      a. The goals should cover the near-term commercialization purposes of the proposed Project.
      b. The objectives should be related to the research, development, and demonstration activities that will be performed and how they are expected to provide the evidence and proof needed to carry the technology forward into market entry
   b. Objectives expressed in terms of Level A, Level B, and Level C Metrics (See RFP Appendix A)

3. *Technical Approach and Work Plan*
   a. How will goals and objectives be met?
      a. Proposal should include a comparison of research techniques, methods, and facilities, and equipment with alternatives
      b. Proposal should address key factors for success as well as significant risk factors
      c. Tasks and activities for each area of investigation should be described in terms of objectives, approaches, resources, and outcomes. How will progress will be made and measured?
   b. <u>Technical objectives are original and innovative; novel concepts, approaches or methods are employed.</u>
   c. Proposal should describe how the project:
      a. Can advance beyond previous studies, projects, and commercial efforts
      b. Is scientifically and technologically feasible as supported by research results and findings to date
      c. Will generate the proof necessary to attract additional financial resources required to advance the technology toward successful commercialization.
      d. Involves the base of statewide research capacity that will support the future technological innovations required to fully realize the commercial potential and how those research capacities will be integrated into the research plan.

4. *Deliverables and Schedule* described with tangible milestones for commercialization and technical progress

5. *Long-Term Capital Usage*
   a. A Plan is provided for utilization of the capital equipment beyond the three (3) year time period to enhance other applied research, development, and demonstration programs and that builds educational and training capacity at an Ohio college, university, or nonprofit

B. Commercialization Strategy	GRADE:

1. **<u>Ability to Achieve Market Entry</u>**
   a. Proposal must realize near-term commercialization (within 3 years) with the potential of on-going commercialization opportunities beyond the project period

2. *Value Proposition*. Benefits of the proposed approach are addressed and explanation provided regarding why the market values these benefits.

3. *Management of Intellectual Property (IP)*. How will new Intellectual Property be managed to benefit Ohio-based companies?
   Clear definition of IP status, who controls it, protection from competition, and freedom to operate

4. *Potential for Products*
   a. Proposal identifies focused commercialization opportunities that will have significant industry and economic impacts in the near term (within 3 years) in Ohio (such as production, licensing, spin-off tech)
   b. **<u>The proposed Project must have already achieved at least Proof of Principle</u>**
   c. Technologies or products have competitive advantage over existing and alternative technologies

5. *Size of Opportunity*. Proposal accurately assesses market and has realistic assumptions about market share that

could be captured, potential customers, and competitors/competing products

6. *Degree of Customer Readiness*. Are functionality and market needs realistic? Is there input from potential customers, especially from collaborators who are committed end-users or may be eventual customers?
7. *Investment and Time to Market*. How much money and time is needed to bring the product to market? Is this reasonable?
8. *Receptive Capital Markets.* What's the potential of long-term financing support for growth? **Evidence of interest in this technology by various sources of capital should be provided**
9. *Potential for Leverage*. Define goals and plans for leveraging OTF grant funds with other non-state funds
10. *Ability to Compete Globally*.
    a. Applicants should demonstrate an understanding of the global marketplace and trends, including barriers to market entry
    b. Particular attention should be given to situations where initial markets and major competitors are global, where others have committed major resources to this technology, and where barriers to market entry favor international firms.
    c. How well does the Lead Applicant understand and compete for international business opportunities?
11. *Degree of Sustainable Competitive Advantage*. The proposed project fits within, or can create, an environment which enables Ohio to maintain a leading, competitive advantage (through supply chain, labor base, research, or other asset). Advantage can be created from the IP.
12. *Ability to Leverage Ohio's Supply Chain*. How closely matched is the project with existing or emerging supply chain's capabilities?
13. *Existence of Supporting Workforce*. How closely matched is the labor needs of the project with Ohio's workforce?
14. *Roles and Responsibilities*. Roles and responsibilities of the Lead Applicant and Collaborators in the commercialization process

C. Objectives and Performance Goals	GRADE:

1. Project includes major capital acquisitions and improvements at an Ohio college, university, or nonprofit institution
2. The project's Long-term use of capital should
    a. Promote educational and training programs for technical workers and students
    b. Enhance other applied research, development, and demonstration programs
3. Project demonstrated to have an impact on
    a. job creation (for-profit, not-for-profit, retained);
    b. personal wealth (average salary of jobs created);
    c. new sales of products;
    d. companies created or attracted to Ohio;
    e. follow-on investments and new public or private funding for related research and technical services
    f. talent recruitment; and
    g. enhanced Ohio, national, and/or international recognition
4. The Proposal must contain a realistic forecast of the economic impacts of the project (for 3 and 5 years after start of project), including:
    a. direct employment,
    b. payroll
    c. product revenue
5. Impacts for each distinct product or platform identified. Only direct impacts should be reported

D. Experience, Qualifications, and Eligibility	GRADE:

1. Proposal demonstrates commitment of the Lead Applicant and Collaborator(s) to building a sustainable partnership
2. Leadership is demonstrated in all critical phases, including research, IP protection, regulatory compliance, product development, leveraging of additional funding, and commercialization
3. Team has relevant organizational experience to perform technical and commercialization work involved
4. *Management Plan.* Proposal discusses plans for internal means of communication, coordination of data and

information management, evaluation and assessment of progress, allocation of funds and personnel, and other specific issues relevant to the proposed activities.	
5. *Collaborators and Committed End-Users*. Partnership between the Lead Applicant and all Collaborators must have the capability for commercializing any resulting technology. Collaborators should be committed to the long-term commercialization of the technology and play a role in accomplishing that goal. Teams with strong commercialization structures are preferred over Projects without access to the commercial market.	
E. Budget and Cost Share	GRADE:
1. Is the budget justified in a detailed narrative with the appropriate forms? Is it adequate to meet proposal goals?	
2. *Cost Share (at least 1:1 ratio with state funds)* a. **Is the cost share necessary and reasonable?** b. **What form does it take? Ohio prefers unrestricted cash cost share** c. All Cost Share must be identified in the Proposal by amount, proposed use, source, and method of valuing any in-kind Cost Share to be used.	
3. Wright Capital Funds used solely to acquire, renovate, or construct facilities or purchase equipment that will be property of an Ohio college, university, or nonprofit.	
4. Commitment letters are provided and are sufficiently detailed including an explanation of cost share commitment	

Additional Details can be found in Sections 2.2 and 3.3 of the RFP.

Appendix D
Biographical Sketches

COMMITTEE MEMBERS

T.S. SUDARSHAN, *Chair*, is president and CEO of Materials Modification, Inc. He is responsible for the management and technical development of innovative materials, processes, and techniques and the development of new technologies related to surface engineering and nanotechnology. Dr. Sudarshan has been the recipient of numerous awards and honors, including the Design News Award and R&D 100 for the microwave plasma technique Nanogen and for the Plasma Pressure Compaction technique. He has served on numerous committees of the National Science Foundation, National Institutes of Health, U.S. Army, Michigan Economic Development Council, and ASM International–The Materials Information Society. He has also served on the technical advisory boards of numerous companies over the last two decades. Dr. Sudarshan is the editor of the journals Materials and Manufacturing Processes and Surface Engineering. He is a Fellow of ASM International; a Fellow of the International Federation for Heat Treatment and Surface Engineering; and a Fellow of the Institute of Mining, Metals and Materials, UK. He is also the coauthor of 170 publications, holder of 16 patents, and coeditor of 25 books on surface modification technologies. He previously served on NRC committees that reviewed proposals for the State of Ohio (2008, 2009, 2010); the Committee on Small Business Innovative Research to Support Aging Aircraft; the Committee on Review of the National Nanotechnology Initiative; and two terms on the National Materials Advisory Board. Dr. Sudarshan received his B.S. in metallurgy from the Indian Institute of Technology in Madras, India, and his M.S. and Ph.D. in materials engineering science from the Virginia Tech.

VIOLA L. ACOFF is head and professor of the Department of Metallurgical and Materials Engineering at the University of Alabama. Her research interests are focused on joining of intermetallics, particularly the areas of cold roll bonding and reaction annealing, and the effects of texture on welded and roll bonded structures. She has received the National Science Foundation CAREER Award and has been awarded Best Paper honors by both the American Welding Society (Warren F. Savage Memorial Award) and The Minerals, Metals, and Materials Society (TMS) Symposium on Gamma Titanium Aluminide. Additionally, Dr. Acoff served as chair of the Birmingham chapter of ASM International-The Materials Information Society and chair of the ASM International Joining Critical Sector. She received her B.S., M.S., and Ph.D. in materials engineering from the University of Alabama at Birmingham. She previously served on several NRC committees, including the Committee on NIST Technical Programs Panel on Manufacturing Engineering and the 2006 committee that reviewed proposals for the State of Ohio.

CATHERINE G. AMBROSE is an associate professor of orthopaedic surgery at the University of Texas Health Science Center at Houston. She is also the director of the Biomechanics Laboratory at the University of Texas Medical School at Houston, holds appointments in the biomedical engineering departments at Rice University and The University of Texas at Austin, and is a member of the scientific staff at Shriners Hospitals for Children, Houston. Dr. Ambrose's research interests are in material property assessment for orthopaedic materials including bone, cartilage, ligaments, and tendons; biodegradable materials for orthopaedic applications; diagnosis and treatment of metabolic bone diseases including osteoporosis and osteogenesis imperfecta; and in vitro and in vivo models for orthopaedic applications. She has served on study sections for the National Institutes of Health, and has reviewed grants proposals for the North Carolina Biotechnology Center, The South Carolina EPSCoR and IDeA programs, and the American Osteopathic Association Council on Research. She received her B.S. in mechanical engineering from Washington University and her M.S. in biomedical engineering and Ph.D.

in mechanical engineering from the University of Texas at Austin. Dr. Ambrose has no prior NRC experience.

DAVID E. ASPNES (NAS) is Distinguished University Professor in the department of physics at North Carolina State University. He is also a member of the department of physics of KyungHee University, Seoul, as part of a World Class University appointment by the Republic of Korea. Research interests include metrology and the development of theoretical and experimental methods of analyzing materials, thin films, interfaces, structures, and materials deposition by nondestructive linear and nonlinear optical techniques, for which he has received numerous awards. He is perhaps best known for the development of spectroscopic ellipsometry, which is now widely used in integrated-circuits technology. The major fraction of his career was spent in industry, first as a member of the technical staff of Bell Laboratories, Murray Hill, and later as Head of the Interface Physics Department of Bellcore. He joined the physics department of North Carolina State University, and was named Distinguished University Professor of Physics in 1999. Among other professional activities, he was president of the American Vacuum Society in 2005. He received B.S. and M.S. degrees in electrical engineering from the University of Wisconsin, Madison, and a Ph.D. degree in physics from the University of Illinois, Urbana-Champaign. He has previously served on a number of NRC committees, most recently the Committee on NIST Technical Programs Panel on Manufacturing Engineering (2010) and the Committee on NIST Technical Programs Panel on Chemical Science and Technology (2009).

CAROL CHERKIS is a life sciences industry consultant at NewCap Partners, Inc. With more than 30 years of experience in the life sciences industry, she supports NewCap Partners' efforts by helping its clients in that industry to identify partner companies for M&A, strategic alliances and corporate equity investments. Dr. Cherkis is also the president of BioInfoStrategies, a consulting firm that she founded after a 20-year multi-functional career with The Dow Chemical Company. There her advisory services focus on assisting small and medium-sized, fast growing companies in biotechnology/pharmaceuticals, diagnostics, medical devices, regenerative medicine, biochemical reagents, and the biology-related areas of cleantech (biodetection/instrumentation, and production of fuels, chemicals, and biomaterials from biomass) with assessing the commercial feasibility of their technologies, developing and implementing business strategies, and establishing licensing, co-development, marketing, and distribution alliances. Her client base includes government agencies, startups, and well-established companies. She has and continues to serve as a director on company boards. Recently, her efforts have focused on work with companies and/or government groups in the USA, China, Japan, and Canada. Dr. Cherkis started her career with the Dow Chemical Company. After 10 years as a scientist and research manager, she moved into the business functions and spent the remainder of her Dow career leading customer-focused product development efforts, establishing commercialization alliances, and launching new products. In her last position at Dow, she was the Biotechnology Program Director in the Corporate Ventures Group and had global responsibility for identifying small and medium-sized companies as sources of new technology as well as corporate partners to expedite market penetration of existing and future products. Later, she served as the director of healthcare at Frost & Sullivan. Carol has a Ph.D. in biological chemistry from the University of Michigan Medical School and an A.B. in biology from Bryn Mawr College. She has no prior NRC experience.

JAMES ECONOMY (NAE) is professor of materials science and engineering at the University of Illinois at Urbana-Champaign. Prior to joining UIUC, he was manager of the polymer science and technology department in the research division of IBM, and before that, he was manager of materials science and chemistry of the research branch in the research and development division of the Carborundum Co. During this period, he was responsible for the development of a number of advanced polymers and ceramics, eight of which are commercially available today. He has received the AIC Chemical Pioneer Award (1987), the ACS Phillips Medal (1985), the Southern Research Burn Institute Award (1976), the Schoelkopf Medal (1972) and 14 IR 100 Awards for Outstanding Technical Developments in American

Industry. He was selected as the 1998 winner of the Herman F. Mark Award of the ACS Division of Polymer Chemistry, Inc. He is a member of the MPS-NSF Advisory Board and is past president of IUPAC's Macromolecular Division (1994-98). In January 2001, he received the Paul J. Flory Polymer Research Prize for extraordinary contribution to polymer science and engineering. He is a Fellow of PMSE (2001) and a Fellow of the National Academy of Arts and Sciences (2003). Dr. Economy received his B.S. in chemistry from Wayne State University and his Ph.D. in organic chemistry from the University of Maryland. He has served on numerous NRC committees, including the Panel for Materials Science and Engineering and the Condensed Matter and Materials Research Committee.

PAUL A. ERICKSON is currently an associate professor at the University of California at Davis in the Mechanical and Aerospace Engineering Department. He is also the director of the Hydrogen Production and Utilization Laboratory and the co-director of the UC Davis DOE GATE Center of Excellence. Dr. Erickson teaches undergraduate and graduate courses in thermodynamics, fuel cell systems, internal combustion engines, advanced energy conversion systems, and instrumentation. The emphasis of his research is on energy conversion and hydrogen production for both future vehicles and stationary power applications. Dr. Erickson received his B.S. and M.S. from Brigham Young University and his Ph.D. from the University of Florida, all in Mechanical Engineering. He has no prior NRC experience.

SUSAN HACKWOOD is the executive director of the California Council on Science and Technology and is a professor of electrical engineering at the Bourns College of Engineering at the University of California (UC), Riverside. In 1979 she received the Royal Society Ambassador of Science Award and was invited as a visiting researcher at UC Berkeley and Chalmers Institute of Technology. From 1980 to 1984, Dr. Hackwood was a member of the technical staff at AT&T, Bell Laboratories. From 1983 to 1984, she was department head of device robotics technology research. In 1985, she received the AT&T Bell Laboratories Award for Technology Transfer. In 1984, she joined UC Santa Barbara as a professor of electrical and computer engineering, where she was founder and co-director of the Center for Robotic Systems in Microelectronics. In 1990, Dr. Hackwood became the founding dean of the Bourns College of Engineering, where she has overseen the development of all research and teaching aspects of five-degree programs. Dr. Hackwood's current research interests include multimedia technologies, distributed asynchronous signal processing, cellular robot systems, computer vision, 3D modeling, and image processing. In addition to more than 100 technical publications and 7 patents, Dr. Hackwood is co-editor and co-founder of the Journal of Robotic Systems. Dr. Hackwood received a B.Sc. in combined science and a Ph.D. in solid state ionics from DeMontfort University, U.K. She has previously served on several NRC committees, including the Committee on Competing in the 21st Century: Best Practices in State and Regional Innovation Initiatives and the 2010 committee that reviewed proposals for the State of Ohio. She is a member of the Naval Studies Board.

JAHAN K. JEWAYNI is an independent consultant who has worked as a wealth management advisor with a national financial advisory firm. His practice focuses on advising middle-market companies in the $10 million to $150 million revenue range. Mr. Jewayni has 20 years of experience in finance and operations of companies ranging from start-ups to Fortune-500 companies. His work covers areas such as renewable energy, satellite communications, consumer electronics, commercial real estate, consumer products, and nonprofits. Specifically in the renewables area, he reviews dozens of executive summaries and business plans per year for companies seeking seed capital, growth capital, and advisory services. From these opportunities, a select few are chosen for introduction to middle-market investment bankers. Some of the recent opportunities involved a concentrated solar power company, a small-scale utility solar installation company, and a fund that would build energy-efficient low-income housing communities in developing countries. Prior to his current role, an area of focus in the business arena involved building and rebuilding accounting records for start-ups that grew more rapidly than anticipated. Another assignment involved auditing and reconciling the accounting records between headquarters and dozens of international field offices of an organization. Prior to his work in the financial services industry, Mr.

Jewayni spent more than a decade as a small business owner and financial consultant to small and medium enterprises. He is actively involved with a number of nonprofits and is a board member of Devotion to Children, an organization focused on helping children from economically disadvantaged families. Mr. Jewayni earned a B.S. in accounting from the Robert H. Smith School of Business at University of Maryland and became a Certified Public Accountant in 1995. He has no prior NRC experience.

MATT JONES is a partner at Nth Power. His main focus at Nth Power is on deal origination, due diligence and deal structuring. He has been the lead principal on 10 investments in the areas of materials and nanotechnology, distributed generation and storage and biofuels. He also serves on the board of Tempronics. Prior to joining Nth Power, Mr. Jones was a consultant for Accenture in the utility practice group. He advised clients on market restructuring, cost reduction, risk management and information technology initiatives and he helped create a new organization within an investor owned utility for the purpose of interacting with the deregulated energy market. Mr. Jones received a B.S. in mechanical engineering from the University of California at Davis and an M.B.A. from Duke University's Fuqua School of Business. He was a Keller Scholar at Fuqua and received the V. Glen Winslow Award as the most outstanding graduating man at UC Davis. Mr. Jones has no prior NRC experience.

MOHAMMAD A. KARIM is vice president for research of Old Dominion University. He is North American editor of Optics and Laser Technology, an associate editor of IEEE Transactions on Education, and a member of the Editorial Boards of Microwave and Optical Technology Letters and World Journal of Modeling and Simulation. Dr. Karim chairs the program committees of the International Conference on Computers and Information Technology (ICCIT) and the International Conference on Industrial Electronics, Technology & Automation (IETA) and the publications committee of IASTED International Conference on Robotics and Applications. Dr. Karim is an elected fellow of the Optical Society of America (OSA), the Society of Photo-Instrumentation Engineers (SPIE), the Institute of Electrical and Electronics Engineers (IEEE), the Institute of Physics (InstP), the Institution of Engineering & Technology (IET), and the Bangladesh Academy of Sciences. He is author of 16 books, over 335 research papers, and 7 book chapters and has served as guest editor of 23 journal special issues. The list of his research sponsors include the Office of Naval Research, the National Science Foundation, the US Air Force, the Naval Research Laboratory, the US Army, NASA, the US Department of Education, the Ohio Aerospace Institute, the US Department of Defense, and the Avionics Laboratory of Wright-Patterson Air Force Base. He served as research mentor to over 55 M.S. and Ph.D. students during his career. Prior to joining ODU in July 2004, Dr. Karim served as dean of engineering at the City College of New York of the City University of New York. He received his B.S. Honors in physics from the University of Dacca, Bangladesh, and his M.S. in physics, M.S. in electrical engineering, and Ph.D. in electrical engineering from the University of Alabama. Dr. Karim has no prior NRC experience.

CHESTER D. KOLODZIEJ is the executive director of Freedom Field Renewable Energy, Inc. His 30 years of experience in manufacturing, technology, and distribution spans a broad range of renewable energy, nanomaterials, RFID (radiofrequency identification), and carbon fiber technologies. Mr. Kolodziej has worked with multiple start-ups and has consulted for companies such as Becker Wind Energy, Advanced Composite Industries, NoChemCleaning LLC, Atometrics Micro-Machining, and Materials Modification, Inc. His recent peer-review experience includes committees for the 21st Century Jobs Fund for the State of Michigan, the National Science Foundation, the Development Capital Network (Phase II), and the Fast Pitch Business Plans for the State of Illinois. He received his M.B.A. from Northern Illinois University and his B.B.A. from the University of Wisconsin, Whitewater. Mr. Kolodziej previously served on the 2010 NRC committee that reviewed proposals for the State of Ohio.

LAURA T. MAZZOLA is currently the senior vice president for global initiatives at Wave 80 Biosciences. She has 20 years of experience in the biotechnology industry, from research and

development to the commercialization of platform technologies. Recently, she was CEO of Excellin Life Sciences, a company enabling cell-specific genetic engineering, guiding the enterprise from university spin-out through corporate collaborations and Series A funding. She also founded NanoBioConvergence, a nonprofit seminar series for nanotechnology, and has been an invited lecturer at the Walter A. Haas School of Business of the University of California, Berkeley. Dr. Mazzola was an early employee at Affymax and Affymetrix, developing the high-density array technology that became the revolutionary GeneChipTM product line. She then helped reorient business development at Symyx Technologies through pharmaceutical industry collaborations and licensed their first commercial product, earning the Frost and Sullivan 2002 Market Engineering Technology Innovation Award. She has been a technology analyst for Nature Biotechnology, the California State Senate, the National Institutes of Health, and the National Academy of Sciences. She received a B.A. from Kalamazoo College and an M.S. and Ph.D. in physical chemistry from Stanford University. Dr. Mazzola has previously served on several NRC committees that reviewed proposals for the State of Ohio (2003, 2006, 2008, 2009–chair, and 2010).

JAMES E. McGRATH (NAE) is University Distinguished Professor, Chemistry and Adjunct Professor of Chemical Engineering at the Macromolecules and Interfaces Institute at Virginia Polytechnic Institute and State University (VA Tech). His recent research is directed toward the synthesis and characterization of high-performance matrix polymers and structural adhesives; new composite matrix polymers for possible use in aerospace, such as the proposed high-speed civil transport; new high-temperature polymer thin film dielectrics for computer development; fire-resistant polymers; flip chip encapsulants; proton exchange membranes for fuel cells; and new hydrophilic polymers for lithium batteries. Prior to joining VA Tech, Dr. McGrath served in several positions at Union Carbide Corporation, including research scientist/group leader, project scientist, and senior research chemist. He is a member of the board of directors of ChemFab, Inc., serves on the editorial board of the Journal of Macromolecular Science—Pure and Applied Chemistry, is a member of the board of the Plastics Academy, and is a member of the advisory board for the Center for Advanced Engineering Fibers and Films at Clemson University. He has received several honors and awards, including most recently the American Chemical Society Award in Polymer Chemistry, 2007-2008. Dr. McGrath received his B.S. in chemistry from St. Bernadine of Siena College and his M.S in chemistry and Ph.D. in polymer science from the University of Akron. He has served on a number of NRC committees, including the Committee on High Performance Structural Fibers for Advanced Polymer Matrix Composites. He is currently a member of the Committee on Operational Science and Technology Options for Defeating Improvised Explosive Devices.

TRENT M. MOLTER is an associate research professor and business development officer for the Center for Clean Energy Engineering (C2E2) of the University of Connecticut, whose mission is to be a world leader in fuel cell research, education, and product development so that Connecticut will be the primary global venue for the sustainable energy industry. The Connecticut Global Fuel Cell Center recently received an award from the U.S. Department of Energy to research the effects of impurities on fuel cell performance and durability. Dr. Molter led this team with the focus on improving the reliable performance of proton exchange membrane fuel cells. Dr. Molter also serves as president and CEO of Sustainable Innovations, a Connecticut-based company engaged in the development of products that support human sustainability. He has also been responsible for the development and marketing of new technology for fuel cell and hydrogen applications since 2003. Dr. Molter received his BS in Chemical Engineering from Clarkson University, his MS in Metallurgy from Rensselaer Polytechnic Institute and Ph.D. in Materials Science and Engineering from The University of Connecticut. Dr. Molter has previously served on three NRC committees that reviewed proposals for the State of Ohio (2008, 2009, and 2010).

NABIL NASR is director of the Center for Integrated Manufacturing Studies at the Rochester Institute of Technology. He is also responsible for the strategic and operational leadership of the Golisano Institute for Sustainability (GIS), whose mission is to deliver innovative educational programs in sustainability and

to conduct related world-class research. He founded the National Center for Remanufacturing and Resource Recovery (NC3R) at RIT, a leading source of applied research and solutions in remanufacturing technologies. Dr. Nasr's background is in sustainable production, remanufacturing, clean production, and sustainable product development. Dr. Nasr is the chair of the Organization for Economic Cooperation and Development's (OECD) Advisory Expert Group on Sustainable Production. He also served as an expert delegate with the U.S. Government in several international forums such as the Asia Pacific Economic Cooperation (APEC), United Nations, and the Organization for Economic Cooperation and Development (OECD). He is a member of the Editorial Board of the International Journal of Sustainable Manufacturing, the chairman of the Remanufacturing Industries Council (RIC) and several industry boards. Dr. Nasr received his B.S. in industrial engineering from Helwan University, his M.S. in industrial and systems engineering from Rutgers University, an M.Eng. in manufacturing engineering from Penn State University, and a Ph.D. in industrial and manufacturing engineering from Rutgers University. He currently serves on the NRC Board on Manufacturing and Engineering Design.

ARTHUR L. PATTERSON is the president and CEO at CMC, LLC, a biopharmaceutical contract development and manufacturing organization. Currently, Mr. Patterson has primary responsibility for successful implementation of CMC's business plan, including evolution of strategic alliances and access to required capital for this highly automated manufacturer of biotech and pharmaceutical drug products and devices. Before CMC, he was the founder and president of Biologics, LLC, a manufacturer of modular cGMP compliant clean rooms and other laboratory facilities, and the CEO of Elona Biotechnologies, Inc., a microbial-based contract research organization and cGMP-compliant manufacturer of biologic drug substances. Mr. Patterson has facilitated a host of start-ups and growth-stage companies and raised a total of more than $50 million in new capital for start-up and growth-stage companies. He obtained his B.A. in economics and management services from Duke University and his M.M. in marketing finance from Northwestern University. Mr. Patterson previously served on two NRC committees that reviewed proposals for the State of Ohio (2008 and 2009).

J.W. WHEELER is senior vice president for economic strategies at Thomas P. Miller and Associates (TPMA). He served as the policy lead for development of the Strategic Economic Development Plan for Indiana. Recent projects include development of industry cluster strategies; various base closure and realignment and military transformation projects; energy-related projects in electric and hybrid-electric vehicles, distributed power, and advanced coal technologies; feasibility studies and business plans for business incubators and technology parks; and participation in a variety of health information technology strategy and planning efforts. Prior to joining TPMA, Dr. Wheeler was director of Electricore's Midwest operations where he was charged with developing corporate-university partnerships in advanced technology development. As executive vice president for TechPoint—a merger between Indiana Technology Partnership (ITP) and Indiana Information Technology Association—and as president of ITP, he served as a leader for the statewide technology community's public policy and economic development initiatives (2002-2004) and managed special programs for information technology. Dr. Wheeler received his B.A. in economics from the University of Missouri system and his M.A. and Ph.D. in economics from Rutgers, the State University of New Jersey, New Brunswick. He has previously served on several NRC committees that reviewed proposals for the State of Ohio (2005, 2007, 2008, 2009, and 2010).

STAFF

PAUL JACKSON, *Study Director*, is a program officer for the Aeronautics and Space Engineering Board (ASEB). He joined the NRC in 2006 and was previously the media relations contact for the Office of News and Public Information. He is the study director for a number of ASEB's projects, including proposal reviews for the state of Ohio and the Committee for the Assessment of NASA's Orbital Debris Programs. Mr. Jackson earned a B.A. in philosophy from Michigan State University in 2002 and an M.P.A in policy analysis, economic development, and comparative international affairs from Indiana University in 2006.

LEWIS GROSWALD, a research associate, joined the Space Studies Board as the Autumn 2008 Lloyd V. Berkner Space Policy Intern. Mr. Groswald is a graduate of George Washington University, where he received a master's degree in international science and technology policy and a bachelor's degree in international affairs, with a double concentration in conflict and security and Europe and Eurasia. Following his work with the National Space Society during his senior year as an undergraduate, Mr. Groswald decided to pursue a career in space policy, with a focus on educating the public on space issues and formulating policy.

CATHERINE A. GRUBER, editor, joined the SSB as a senior program assistant in 1995. Ms. Gruber first came to the NRC in 1988 as a senior secretary for the Computer Science and Telecommunications Board and also worked as an outreach assistant for the National Science Resources Center. She was a research assistant (chemist) in the National Institute of Mental Health's Laboratory of Cell Biology for 2 years. She has a B.A. in natural science from St. Mary's College of Maryland.

MICHAEL H. MOLONEY is the director of the SSB and the Aeronautics and Space Engineering Board at the NRC. Since joining the NRC in 2001, Dr. Moloney has served as a study director at the National Materials Advisory Board, the Board on Physics and Astronomy (BPA), the Board on Manufacturing and Engineering Design, and the Center for Economic, Governance, and International Studies. Before joining the SSB and ASEB in April 2010, he was associate director of the BPA and study director for the Astro2010 decadal survey for astronomy and astrophysics. In addition to his professional experience at the NRC, Dr. Moloney has more than 7 years experience as a foreign-service officer for the Irish government and served in that capacity at the Embassy of Ireland in Washington, D.C., the Mission of Ireland to the United Nations in New York, and the Department of Foreign Affairs in Dublin, Ireland. A physicist, Dr. Moloney did his graduate Ph.D. work at Trinity College Dublin in Ireland. He received his undergraduate degree in experimental physics at University College Dublin, where he was awarded the Nevin Medal for Physics.

ANDREA M. REBHOLZ joined the ASEB as a program associate in January 2009. She began her career at the National Academies in October 2005 as a senior program assistant for the Institute of Medicine's Forum on Drug Discovery, Development, and Translation. Prior to the Academies, she worked in the communications department of a D.C.-based think tank. Ms. Rebholz graduated from George Mason University's New Century College in 2003 with a B.A. in integrative studies–event management and has more than 7 years of experience in event planning.

OTHER CONTRIBUTORS

DALAL NAJIB is the Christine Mirzayan Science and Technology Policy Graduate Fellow with the Aeronautics and Space Engineering Board. Dr. Najib recently completed her Ph.D. in space physics at the University of Michigan (AOSS department) on modeling the interaction of non magnetized planets (Mars, Venus) with the solar wind, working with Dr. Andrew F. Nagy. During her doctoral work, she developed

a new 3D multi-fluid MHD model and applied it to Mars and Venus. In parallel, she also completed a Master's of Public Policy from the Gerald Ford School of Public Policy at University of Michigan with a focus on science and technology policy. Dr. Najib received her undergraduate degree in aerospace and aeronautical engineering from Supaero (Toulouse, France). She is interested in space policy, general science and innovation policy, and efforts to promote cooperation between international science communities.

ELLA M.ATKINS is an associate professor in the Department of Aerospace Engineering at the University of Michigan, where she is director of the Autonomous Aerospace Systems Laboratory. She previously served on the Aerospace Engineering faculty at University of Maryland, College Park. Dr. Atkins' research focuses on the integration of strategic and tactical planning and optimization algorithms to enable robust operation in the presence of system failures and environmental uncertainties. She has collaboratively pursued challenging autonomous flight applications for manned aircraft and unmanned aircraft systems (UAS), including the Flying Fish autonomous unmanned seaplane and an emerging flexible wing platform. Dr. Atkins also studies the optimization of and safety analysis in congested airspace, with early efforts in simultaneous non-interfering terminal area airspace planning for runway-independent aircraft and small UAS safety assessment based on maintaining acceptable risk to people and property. Current research is underway to adapt lightweight aerodynamic sensors for small flapping wing micro-air vehicles and to feed back post-stall aerodynamic forces for more precise fixed-wing UAS flight control. Her research has been funded under multiple grants from NSF, NASA, DARPA, and DOD. She is author of more than 75 journal and conference publications and serves as an associate editor for the AIAA Journal of Aerospace Computing, Information, and Communication. She is a member of the NASA Jet Propulsion Laboratory's Deep Space Mission System program review, for which she serves as board chair. Dr. Atkins is past chair of the AIAA Intelligent Systems Technical Committee, an associate fellow of AIAA, and a member of the Institute of Electrical and Electronics Engineers (IEEE). She is also a small, public airport owner/operator (Shamrock Field, Brooklyn, Michigan), a private pilot (Airplane, Single Engine, Land), and an Academy of Model Aeronautics pilot (radio/control). Dr. Atkins holds B.S. and M. S. degrees in aeronautics and astronautics from MIT and M.S. and Ph.D. degrees in computer science and engineering from the University of Michigan. She has served on the NRC NASA Aviation Safety Program Review and the NRC Decadal Survey of Aeronautics (Panel E).