Valicor AMP – 14 – 01

Letter of Intent

January 13, 2014

Ohio Development Services Agency
RE: Edison Advanced Manufacturing Program

Advanced Membrane Technology for Reprocessing of Dilute Wastestreams

Valicor Environmental Services (VES) is a Cincinnati-based employee-owned LLC with an industry-leading position in fluid purification, recycling, and on-site chemical management solutions for industrial and alternative fuel operations. The company began with a single employee and has grown to 250 employees with over $100M in sales. In 2013 it was voted by Enquirer Media Top Workplace. Through 15 years of growth, Valicor has demonstrated competitive commercial product development and commercialization in a wide range of applications and industries such as industrial fluid recycling, alternative fuel purification, and ethanol corn oil extraction.

Problem Statement
With more than 25 different soap and detergent manufacturers in the State of Ohio a significant quantity of off-specification product streams and dilute soap waste is created. These effluents are currently solidified by the addition of sawdust or other bulking agent and disposed of in landfills. This is an environmental problem as some of the landfills are approaching capacity. Incineration is another disposal option, but it leads to air pollution and emission of toxic compounds such as dioxins. Hence, a scalable and economic alternative needs to be developed and commercially implemented.

VES has partnered with Procter and Gamble the eighth largest company in the United States by market capitalization with 135,000 employees worldwide, manufacturing operations located throughout Ohio, and their headquarters based in Cincinnati. Valicor processes 30,000 gallons of off specification and wash soap per day from our proposed manufacturing partners Proctor & Gamble, Sun, Unilever, and Colgate. Valicor seeks to develop a new manufacturing industry of soap and detergent reprocessing through upgrading of dilute waste streams through proven advance manufacturing technologies.

With our team of scientists we have developed an advanced membrane technology to repurpose this waste stream to create a value added product. Our technology will provide a lower cost, more environmentally and economically sustainable option than current practices. The projected capital cost for the implementation of this technology is $800,000 with a pay back in approximately one year of operation. The technology is proven and the market is developed. Valicor is proposing to partner with the PolymerOhio, an Edison Center to aid in the scale up of this technology for commercial soap applications. In addition, Valicor is requesting $400,000 from the Edison Advanced Manufacturing Program with over $400,000 match from Valicor to off set the cost of commercial scale implementation of the cross-flow membrane technology.

Goals and Objectives

Goal 1: Valicor has designed, tested and piloted a cross flow filtration technology to process dilute soap streams for repurposing. The first goal will be commercial implementation of this novel technology at 15,000 gal/day and generation of engineering scale data for deployment of additional systems.

Goal 2: The second goal will be to expand market size through obtaining waste from other companies. The plant capacity will be increased to ≥30,000 gal/day.

Technical Approach and Work plan

Cross flow filtration is a mature technology that is currently applied in many industries for product separation and concentration. Examples include fermentation products (e.g., antibiotics, vaccines, and enzymes), milk and dairy products, sugars/sweeteners, beverages (e.g., beer, wine, and fruit juice), and pharmaceuticals. This technology will be gainfully applied for processing dilute soap streams into useful products.

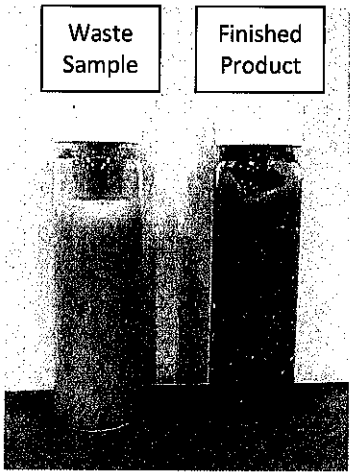


Figure 1: Representative waste sample and finished product

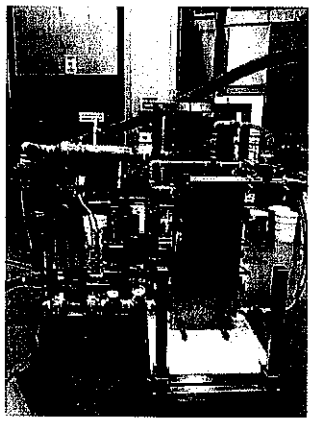


Figure 2: Pilot Scale Membrane System

Briefly, in cross flow filtration, the feed is passed across the filter membrane at positive pressure relative to the permeate side. A proportion of the material which is smaller than the membrane pore size passes through the membrane as permeate or filtrate; everything else is retained on the feed side of the membrane as retentate. With cross flow filtration the tangential motion of the bulk of the fluid across the membrane causes trapped particles on the filter surface to be rubbed off. This means that a cross flow filter can operate continuously at relatively high solids loads without binding. Valicor has demonstrated the efficacy of cross flow membranes for implementation in dilute waste streams. The soap concentration contain approximately 5–10% soap product, we are able to concentrate the material 4 fold to create a finished marketable product. Valicor will engage the Polymer Ohio Edison Center in the scale up of the cross flow membrane technology. A team of chemical engineers and technicians lead by a program manager with over ten years experience at Valicor will using pilot-scale data to design, engineer, and install a commercial scale system. Total installed cost is estimated at $400,000 for each 15,000 gal/day commercial system. System performance of the commercial scale will be compared with that of the pilot system. Rigorous engineering scale data will be generated which will facilitate efficient deployment of additional systems.

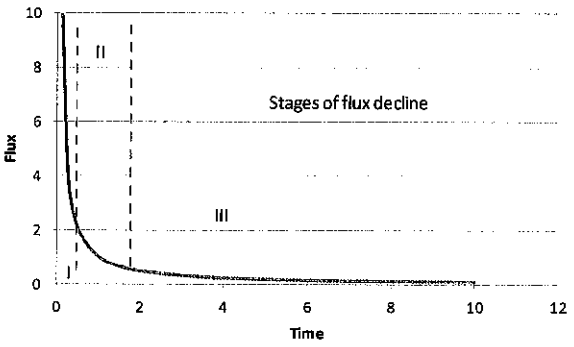
Technical and Operational Barriers of Cross Flow Membranes

Flux decline, down time, process control are operational issues when dealing with cross flow membranes. The model presented below will be correlated with experimental observations to

understand the flux decline. The resistance-in-series model, outlined below, can be used to evaluate fouling and guide cleaning protocols such as backwashing and gas sparging.

$$J = \frac{TMP}{\mu(R_M + R_r + R_{ir})}$$

Where J is permeate flux, TMP is transmembrane pressure, μ is permeate viscosity, and R is total resistance, R_m is hydraulic resistance of the clean membrane; R_{ir}, is fouling hydraulic resistance; and R_r is hydraulic resistance due to reversible phenomena (such as concentration polarization and/or reversible deposition). Fouling is defined as irreversible deposition onto the membrane surface or in the membrane matrix, such as adsorption and internal pore blocking. R_m and R_{ir} can be calculated from pure water permeate flux. Total resistance, which is the sum of R_m, R_r and R_{ir}, can show which terms are key players in flux decline. It can also illustrate whether the adhesion of solutes occurs preferably in the external region (R_r being higher) or in the inner part of the membrane–within the pores (R_{ir} being higher).



Concentration polarization and irreversible deposition are major problems that effect flux decline. The former is often associated with stage I of flux decline which occurs early in the process (within seconds or minutes) and is characterized by a rapid drop in membrane flux. However, adsorption also contributes to this initial flux decrease. If the membrane used is easily deformable, as many polymeric ones are, membrane compaction can also be contribute to initial flux suppression. Stages II and III of flux decline are due to fouling. Stage III shows an asymptotic decline and is a result of further deposition and compaction of the foulant layer.

Maturity of the Technology/ Market Acceptance

As mentioned earlier, cross flow filtration is a mature technology widely practiced in many industries. By analogy, its application to concentrate waste soap streams can be deemed mature as well. The finished product has increased market acceptance due to reduction in bacterial growth and the decrease in transportation cost. Valicor has secured both international and domestic customers for the concentrated soap product. Letters of intent from the buyers of the repurposed soaps are secured for the full proposal.

Project Impacts

The project will create a new manufacturing market that decreases disposal costs for the Ohio based soap manufactures while decreasing the environmental impact of soap production. The application of this project by Valicor estimates will produce over $1.5 million in annual revenue in Phase 1 and will increase the number of jobs created in the manufacturing sector. Additional $1.5 million in annual revenue in Phase 2 is expected with deployment of the second membrane system.

Valicor will measure success of the proposed project by delivering a membrane based system that has a membrane life is ≥1 year, down time is ≤10%, and a process can be run reliably and reproducibly. In addition, the product specifications required by purchasers are met or exceeded and all produced product is sold. Using revenue generated during the project, expand the plant to receive larger waste soap streams.

Sustainability
Building off our successful partnership with Procter and Gamble and successful completion of a pilot scale demonstration of dilute waste stream processing technology, Valicor is poised to enter the marketplace and provide this solution to the soap manufacturing industry. In addition, implementation of this technology will potentially increase revenue of the existing process line by 1.5 million dollars per year for each 15,000 gal/day system. This process will add Ohio based manufacturing jobs in the VES facility.

In conclusion, please consider this Letter of Intent from Valicor for the project entitled "Advanced Membrane Technology for Reprocessing of Dilute Wastestreams" for the Edison Advanced Manufacturing Program. Please feel free to contact us if there are any questions.

Sincerely,

Puneet Chandra

Program Manager
Technology Development
Valicor Environmental Services
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Middletown, OH 45044
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AMP – 14 – 02

OHIO FUEL CELL COALITION

Letter of Intent to Submit a Proposal

Edison Advanced Manufacturing Program (AMP)

Lead Applicant: Ohio Fuel Cell Coalition

Anticipated Initial Collaborators:

1. American Trim LLC (Am Trim)
2. Lorain County Community College (LCCC)
3. Catacel
4. DJW Technology LLC (DJW)
5. Mound Technology Solutions
6. NexTech Materials
7. National Renewable Energy Lab (NREL)
8. Ohio Energy & Advanced Manufacturing Center (OEAMC)
9. Proposed - Tech Belt Energy Innovation Center (TBEIC)

Point Of Contact: Patrick R Valente Executive Director
Ohio Fuel Cell Coalition
Lorain County Community College
151 Innovation Dr. Suite 240D
Elyria, Ohio 44035
614-542-7308
pat.valente@fuelcellcorridor.com

Project Title: Ohio Technical Exchange Center

Estimated Funding Request: $385,000

Estimated Total Cash Costs including In Kind: $770,000

Project to be completed in 20 – 23 months

Problem Statement:

The commercialization of fuel cell systems is limited by their high investment cost (first cost); in the range of $3,000 to $5,000 per kW compared to the cost of a gas turbine generator at $800 to $1,000 per kW. The balance-of-plant (BOP) for fuel cells contributes to 50% of the first cost as reported by Battelle Memorial Institute in their U.S. Department of Energy funded cost analysis. Typical BOP components for a fuel cell are: air delivery systems with air compressors, air blowers, flow meters, and valves; fuel delivery systems with fuel pumps, flow meters, valves; thermal control systems with thermocouples, heat exchangers, and coolant delivery systems; and system controls that control the fuel cell system delivery of power to the demand by the application.

The BOP components, because of their very broad technical spectrum, are manufactured by a diverse network of suppliers, identified as the supply chain. The operational challenge to be addressed in the proposed project is the reduction of the first cost of the BOP components by the supply chain.

Our proposed solution is to establish a *technical exchange center* that will make available to the component suppliers the specifications and requirements of the fuel cell system. The *technical exchange* center will increase the number of suppliers receiving the specifications with the result that lower first cost can be achieved through competition and through the identification of common BOP components that can be used by multiple fuel cell manufacturers. The formation of uniform specifications by the technical exchange center will increase the volume of BOP component sales with an attendant reduction in first cost.

As part of our proposed solution, suppliers developing new or alternative BOP components benefit from the technical exchange by understanding the requirements, interacting with the fuel cell manufacturers, and applying alternative and innovative technology to develop low cost BOP components.

The Ohio Fuel Cell Coalition (OFCC) has developed the ground work for the technical exchange over the last three years with three *supply chain meetings* that brought suppliers and fuel cell manufacturers together to discuss their needs. The OFCC has over 60 members which includes fuel cell manufactures and BOP component fabricators.

Project Goals and Objectives:

The goal of the project is to increase the contribution of Ohio fuel cell component manufactures to the commercialization of fuel cell systems by reducing the cost of BOP components incorporated in the fuel cell systems. A concurrent component of this goal is to increase manufacturing jobs in Ohio. One objective of the projects is to collect from fuel cell manufactures an information base that identifies the specifications and requirements for the BOP components for the fuel cell systems. This non-proprietary information will be cataloged and a *technical exchange* information base established.

Another objective of the project is to develop a directory of companies that fabricate BOP products. This directory will be made available to fuel cell manufactures to facilitate the identification of the lowest cost components that satisfy the requirements of the fuel cell manufacturers. Another objective is to establish organized meetings between Ohio based BOP fuel cell suppliers and fuel cell manufactures to promote and increase the exchange of information with purpose of identifying pathways to low cost BOP components.

Technical Approach and Work Plan:

The technical approach is to meet with fuel cell manufacturers and discuss their needs and requirements. A questionnaire may be developed for ease of information collection. The BOP information will be organized in to three groups: air and fuel delivery components, thermal monitoring and control components, and fuel cell system controls.

Building on the information base from the fuel cell manufacturers, the OFCC will contact manufacturers and suppliers of potential BOP components. The OFCC will disseminate the fuel cell manufacturers' information, screen potential BOP suppliers, and initiate dialog and information exchanges between suppliers and fuel cell manufacturers.
The **Work Plan** for the activity and the use of the **Program Funds** will include:

1. Interviews and BOP data collection from fuel cell manufacturers.
2. Cataloging the fuel cell manufactures BOP data and identifying common BOP components from disparate fuel cell manufacturers.
3. Identifying Ohio based BOP suppliers that have or can develop BOP components for fuel cell manufacturers. Establishing a directory of the components available from these BOP component manufacturers.
4. Sharing and disseminating both databases in the technical exchange housed at Lorain County Community College through interviews and establishing direct contacts between fuel cell manufacturers and BOP component fabricators.
5. Establishing quarterly meetings and information exchanges between the BOP component fabricators and fuel cell manufacturers.
6. DJW Technology will work with NREL to establish the supplier network and identify common technical specifications from fuel cell manufacturers.

Maturity of the Technology/Market Acceptance:

The sales of fuel cells in the world have increased by 86% from 2011 to 2012 with a forecast of a 46% increase for 2013 and all signs are showing continued strong growth in the fuel cell industry in the future. Due to its diverse strengths in fuel cells, Ohio is positioned very well to be part of that growth. The OFCC, in conjunction with its 60 members and its collaborators, is well placed to widen the scope of its supply chain activities.

In the last two years the OFCC has held 4 supply chain exchange events. Fuel cell manufacturers from all over the world meet with Ohio suppliers, resulting in new connections and new sales for the participants. The OFCC, and its partner the Ohio MEP program, have laid the groundwork for an expansion of the Ohio Supply Chain Initiative.

The Ohio Technical Exchange Center will work with mature supply chain companies and manufacturers and allow them the benefit of a much more enhanced exchange system that will have a much higher rate of success. Because of the additional business created through the exchange supply chain companies will diversify their portfolio of customers and will allow for higher profitability.

Projected Impacts:

The primary projected impact will be to increase the number of manufacturing jobs in Ohio by increasing the participation of Ohio's supply chain component suppliers in the commercialization of fuel cells. Coupling the *technology exchange* database with the expertise of the Ohio supply chain will identify pathways for reducing the cost of fuel cell components. The State of Ohio's supply chain has been called the best in the world, both in quality and cost. The impact of the *technical exchange* could be considerable in expanding the existing job base and developing new, high technology jobs for Ohio The companies impacted would include our listed collaborators and the 60 plus members of the OFCC as well as many other supply chain companies.

Sustainability:

The services offered by the Ohio technical exchange center will help provide a lower cost alternative (Ohio suppliers) to fuel cell system manufacturers throughout the world and resulting in new customers for the OFCC supply chain members. The OFCC is funded through membership dues and the proposed project will increase the membership and the additional funds will be used sustain the technical exchange center.

AMP – 14 – 03 TechSolve

January 13, 2014

The Ohio Development Services Agency
Office of Technology Investments
77 South High Street, 28th Floor
Columbus, OH 43215

To whom it may concern:

Thank you for the opportunity to submit this "Letter of Intent" on behalf of TechSolve and its partners Jet Machine and Magna Machine for the project **"Small Manufacturer, Low Cost Equipment Performance Monitoring"**.

Lead Applicant:	TechSolve, Inc. 6705 Steger Drive, Cincinnati, OH Ron Pieper, Manager, Viz Products pieper@techsolve.org (513) 948-2113
Collaborator One:	Jet Machine 6899 Steger Drive, Cincinnati, OH High-end machining, welding, and assembly of metal components for the defense, oil/gas, and aerospace industries
Collaborator Two:	Magna Machine 11180 Southland Road, Cincinnati, OH Custom and large-component machining; 20% of business is in Wind Supplier-Clipper Turbine Works
Estimated State Funds to Be Requested:	$450,000
Intended Use of Grant Funds:	Develop, test, market, and sell a low-cost, easily implemented status monitoring and recording system for manufacturing equipment

We are eager for you to review our proposed project overview. Please don't hesitate to call or e-mail if you have any questions or need additional information.

Sincerely,

Gary Conley
President

6705 Steger Drive Cincinnati, OH 45237
(513) 948-2000 (800) 345-4482 fax (513) 948-2109 www.techsolve.org

Proposed Project Title: "Small Manufacturer, Low Cost Equipment Performance Monitoring"

Summary of Proposed Project

TechSolve's machine tool monitoring technology has enabled large companies to double their productivity and dramatically improve their profitability. This project will make it possible for Ohio small and mid-size manufacturers to access this technology at prices they can afford enabling them to dramatically increase their competitiveness and profitability. This will be accomplished by bringing to market MiniViz – a lightweight, low-cost counterpart of TechSolve's ShopViz® monitoring system.

MinViz will provide Ohio manufacturing plant managers an immediate visibility of each machine's status, utilization, productivity, and fault condition. The awareness provided by MiniViz will allow quick, remedial action of equipment malfunctions, stoppages, and slowdown; higher process consistency and production quantities; greater efficiency of existing equipment, and increased equipment reliability through awareness and remedy of recurrent machine faults.

By recording historical performance data, MiniViz allows performance comparisons from one machine to another as well as analysis of one machine's performance over several days, weeks, or months, allowing process improvement efforts to be validated.

With MiniViz, Ohio manufacturers can avoid unnecessary capital expenditures by ensuring that every manufacturing asset is performing to its capacity.

Problem Statement

There are 1,800 metalworking, machining, automated equipment, motor vehicle, and aerospace machined parts manufacturers struggling with operational inefficiencies that prevent their manufacturing assets from actively producing as efficiently as they could be. It is not unusual for an expensive, highly capable asset to be actually "in cycle" and producing parts less than 25% of its scheduled operating time.

While most modern machinery controllers are able to deliver status information, each provider has a proprietary communication interface. Manufacturers rarely have only one brand of machine, so gathering information from every machine is a technical challenge. Existing monitoring systems that can communicate with many brands and types of machines are complex and expensive. If the current monitoring systems store the data locally, manufacturers face expenses in server upgrades, additional IT expenses, licensed software, and different operating system requirements. If a cloud-based solution is employed, monthly fees for cloud services and maintenance apply and many plants, especially those doing work for the US Department of Defense with ITAR sensitive information, are deeply concerned about data security and disallow such systems.

Further, existing monitoring systems provide summary data aligning to what is viewable on a computer screen. Engaged manufacturers need a deeper set of data, often customized to the particular problem, to truly investigate root cause analysis.

A clear need exists for a simple and very low-cost monitoring system. This system should be locally deployed, user installable, and be based on a common operating system. Analysis of recorded data should be possible with familiar tools, and access to the stream of pertinent data items should be easily accessible.

MiniViz will enable manufacturers to double their productivity and dramatically increasing profitability.

Project Goals and Objectives

TechSolve proposes to prepare for market a system meeting the above requirements with the development of MiniViz. MiniViz will allow a broad range of manufacturers to connect their equipment to provide multi-machine monitoring and data collection at a low cost without the need of third-party assistance.

For ease of deployment on existing computer and network infrastructure, MiniViz will run on Microsoft Windows®, be light on resource requirements, and will need no supporting software modules other than those required for machine communication. Historical data generated by MiniViz will be in a common format (comma separated value, or csv) that is natively readable by Microsoft Excel® and Microsoft Access®, which are anticipated to be the most frequently used data analysis tools. The csv format is also readable by many other programs that may be employed to visualize and analyze the recorded data.

MiniViz will employ the MTConnect® standard for machine tool data communication. MTConnect, owned by the Association of Manufacturing Technology (AMT) has been proven to meet the needs of unifying various communication protocols into an industry accepted format. TechSolve's work with MTConnect has demonstrated that machines of many ages, capability, manufacturers, and types can have MTConnect-based data collection successfully applied. The adoption of MTConnect as a native status communication protocol is increasingly being adopted by machine tool builders and control system suppliers.

MiniViz will simultaneously display the current status and recent history of up to 16 machines, plus aggregate information for all connected machines. Users can choose the data items they wish to display. The dashboard will update automatically providing the user near-immediate awareness of downtime events on the manufacturing equipment. Dashboards can also be shown on a shop-mounted monitor for public display.

In addition to displaying current status information, MiniViz will allow the user to record selected data items to comma-separated value (.csv) files for later analysis with common tools such as Microsoft Excel. In this manner, users can choose to record the specific, pertinent data items on a troublesome machine to help diagnose a particular problem.

MiniViz can be connected to computer numerically controlled (CNC) mills, lathes, grinders and many other types of machines. MiniViz can connect to non-CNC equipment, assets (compressors, power, heating) and sensors (airflow, pressure, temperature) to provide a rich set of data to present, store, and analyze.

MiniViz and required MTConnect components will be completely user-installable, avoiding the need for expensive contracted technical experts.

MiniViz will be purchased and downloaded via an online shopping cart, and be priced on a per-user basis with site and multi-user pricing plans.

The importance of plant managers and supervisors having immediate and objective awareness of current manufacturing status cannot be understated. Many shops simply do not collect data and very few collect data automatically. The shops that collect data manually suffer from dedicating resources to the task of collecting data (a non-value added task); where an automated system frees these resources to focus on production or improving process performance (value-added activities).

Technical Approach and Work Plan

Currently, MiniViz exists in proof-of-concept form. The ability to gather data from computerized machine tools has been proven by currently available MTConnect-based solutions from TechSolve and others. MiniViz can present gathered data on-screen, but requires field trials to validate the initial assumptions on feature content and user interface as well as to guide future capability. MiniViz must also be made ready to accept and present MTConnect data from other related and essential sources, such as sensors and machine operators (for example, via barcode). This challenge requires software adaptation of successful past efforts

The barriers noted above will be overcome by a field implementation and test plan along with vigorous engagement with the project collaborators, both of whom are nearby Ohio companies engaged in for-profit manufacture of machined parts for a variety of industries. This critical feedback will result in the required computer software development to shape the product for ready market acceptance.

The collection and transmission of data from the machines has been largely proven, via a variety of means (Ethernet, cellular wireless, serial, direct connection, switch/sensor interfaces, and power monitoring). Proof of concept work has shown that a low-cost, lightweight, locally deployed solution is feasible and technically capable of creating the dashboard displays and recorded data files in a test environment. Next steps are to deploy MiniViz in an active manufacturing facility where the number of connections and the data volume will be potentially much larger, so the ability to handle higher amounts of data must be investigated and resolved. Further, great opportunity exists to author tools based on Microsoft Excel and Microsoft Access that provide foundational level analysis, with the ability for users to modify the provided tools to suit their specific needs.

TechSolve is a founding sponsor of the MTConnect Institute, maintains an active presence with the MTConnect Technical Advisory Group, and participates on various focused working groups. TechSolve has authored MTConnect Adapters (communication translators) for a wide range of production machines and devices (power monitors, barcode readers, temperature and flow sensors, etc.). TechSolve has produced and sold ShopViz (a cloud-based machine monitoring system) and JobViz (a cloud-based work order tracking system), both based on the MTConnect standard. TechSolve is also engaged with several major machinery and control manufacturers to provide MTConnect Adapters.

Ron Pieper will lead the effort and coordinate activities with the TechSolve team and collaborators. Mr. Pieper has been in charge of TechSolve's Viz suite of monitoring products since 2010.

Amit Deshpande will coordinate technical discussions with the collaborators, and maintain the roadmap, and work closely with TechSolve's marketing department to increase visibility and augment technology implementation.

Dave Wickelhaus is the chief architect and code writer for MiniViz.

Dr. Xiqun Wang has the responsibility to connect devices to MiniViz via the MTConnect Standard. Dr. Wang will develop software and hardware solutions as required when they do not exist.

Nirupama Zambre is responsible for software quality control and documentation.

TechSolve's marketing team will monitor the progress of the program and prepare pertinent material, announcements, case study reports, and web tools to demonstrate the program's success

and ensure that Ohio manufacturers are aware of MiniViz and can exploit its benefits to production awareness.

All work on MiniViz (software architecture, code development, testing, and deployment) will take place in Ohio.

Maturity of the Technology/Market Acceptance
We have fully developed and deployed this technology in large companies in the form of TechSolve's ShopViz and JobViz products. MiniViz represents a lightweight, low-cost adaptation of this technology at a cost small manufacturers can afford.

Projected Impacts
True measurement of machine utilization can provide justification to replace equipment, add equipment, or avoid an unnecessary capital equipment expense by improving current practices. Improvement efforts are able to be evaluated and assessed immediately and accurately. Productivity and profitability stand to improve significantly when a manufacturer makes best use of its equipment. Immediate situational awareness is key to that result.

Magna Machine and Jet Machine are the for-profit collaborators. Each is a highly capable machining facility with a variety of metal cutting equipment and production demands ranging from low-quantity to high production. Each has expressed interest in machine monitoring to track machine utilization and production efficiency, and has committed the necessary resources to apply MiniViz throughout the pertinent levels of the organization and onto as many manufacturing assets as possible. Each will provide periodic feedback on MiniViz performance and capability, and determine improvement metrics to develop solid case studies of the efficacy of MiniViz when enthusiastically employed.

Sustainability
With the help of the Ohio Edison AMP, MiniViz will mature into a viable, flexible, and affordable monitoring solution for manufacturers of a wide array of products. With the immediate visibility that MiniViz will enable Ohio manufacturers to double their productivity and dramatically increase their competitiveness and profitability.

MAGNET
Manufacturing Advocacy & Growth Network

LETTER OF INTENT
Edison Advanced Manufacturing Program (AMP)
2014 Request for Proposals

January 13, 2014

Lead Applicant
MAGNET (Manufacturing Advocacy & Growth Network)
1768 E. 25th St.
Cleveland, OH 44114
216-391-7002
Contact: Michael R. Morgenstern, Chief Development Officer/MAGNET
Mike.morgenstern@magnetwork.org

Project Title
Low-Cost Additive Machine Development for Adaptive Freeform Metal Parts Fabrication

Estimated State Funds to be Requested
$500,000

Collaborators

Lincoln Electric	Cleveland, OH
rp+m	Cleveland, OH
Case Western Reserve University	Cleveland, OH

Total Cash Costs
$500,000 State Funds + $350,000 cost share = $1,000,000 over 24 months

Intended Use of Grant Funds
The following details projected outcomes from the proposed project:

- Design and product development of low-cost additive manufacturing machine
- Develop control systems of low-cost additive manufacturing machine
- Refine commercialization and channel-to-market strategy

PROJECT SUMMARY
The following provides an overview based on elements described in section 3.3.6 of the RFP.

Problem Statement
Additive manufacturing (AM) has arrived as both an emergent and proven technology. It promises to alter the economics of manufacturing, enabling the creation of myriad new products, services, and business models and bringing competitive advantage to regions that effectively leverage its capabilities. Currently, it is most developed as a plastics & polymers-forming method, but metals are rapidly coming to the fore. This is demonstrated in the manufacture of metals-based products where performance, cost, and lead time requirements are high. There is significant work to be done for this promise to be realized, however, as the applications in which metals-based AM is used are limited. One of the primary reasons that it is limited is that the cost of AM equipment is prohibitively expensive in its current form, making it inaccessible for the large of majority of small and medium sized manufacturers.

In Northeast Ohio, three industrial sectors with the high location quotient for region are primary metals (highest in list), fabricated metals (2nd in list), and machinery (tied for fourth in list). AM of metals has a bearing on all three; for example, the production of consumables, metal parts, and machinery components. In addition, for small and medium-sized manufacturers (SMMs) in particular, access to robust affordable AM technology can impact cost of operations, as has been demonstrated with DoD at depots and in the sheet metal industry.

In this context, it is notable that America Makes (i.e., the National Additive Manufacturing Innovation Institute) has its physical facility in Youngstown OH and three of the first seven funded projects are led by Ohio institutions (two by a university and one led by a company). It also is notable that of these first 7, only 3 deals with metals and two of those three are the Ohio university led efforts.

Project Goals and Objectives
One key goal of this effort is to leverage this expertise to the benefit of Ohio's industrial base through the creation of a beta-machine that is designed with constraints of industry in mind. For example, capital cost, availability of consumables, and on-site training support and workshops.

Thus, the objective of the proposed project is the development and commercial launch of metals-based additive manufacturing equipment that will meet the needs of small and medium sized manufacturers (SMMs). The project will focus on the technical development of a machine that will utilize Wire and Arc Additive Layer Manufacturing as the core process technology, and on the commercial deployment of the capabilities afforded by this equipment to a variety of manufacturers in Ohio.

Key technical challenges include:

- Designing a product and manufacturing system that will enable a modular design capable of being adapted to different solutions and that is able to be offered at a cost of less than $10,000.

Key commercial challenges include:

- Development of distribution and marketing channels that will facilitate widespread usage in Ohio and beyond

Technical Approach and Work Plan
The project work will be focused in the following areas:

- Mechanical and electrical design for a low cost machine
- Establish usable suite of consumable materials
- Control system development
- Path optimization
- User interface and software development
- Development of market implementation plan applicable for small and medium sized manufacturers

MAGNET will provide overall leadership for the project. Lincoln Electric will lead the technical development, with rp+m, CWRU, and MAGNET providing significant support. MAGNET will lead the efforts to support market implementation at SMMs in the region and state via MEP partners.

Maturity of the Technology / Market Acceptance.
Some initial work done at The Lincoln Electric Cutting Solutions has shown the viability of Wire and Arc Additive Layer Manufacturing approach for additive near net shape fabrication. This system combined an advanced power source that was capable of intelligently controlling the metal transfer across the arc at relatively low heat inputs and a motion control system on an X-Y table. The ability to build layers using a traditional arc welding machine mounted on an X-Y table with wire that is readily available in the market demonstrates the ability to lower the costs to a point where we can expand the 'accessible' market for this technology from the laboratory to the garage.

Challenges lie in implementing this approach in an affordable piece of equipment with an appropriate control system.

Projected Impacts
Impact in Ohio will be significant, and include the following:

- Lincoln Electric will have a new product and would establish a presence in the market for additive manufacturing equipment, positioning it for growth in a new market and for significant export opportunities. Projected jobs and revenue growth, during the project term and beyond, will be included in the final proposal.
- rp+m will have a new tool for supporting design and manufacturing of metals based products for manufacturers of all sizes. SMMs in Ohio, especially those in fabricated metals, will have early access to this new product, giving them a head start on realizing the benefits to their business afforded by metals-bases additive manufacturing. And local institutes of higher education will have access to this leading edge equipment in educating their students, addressing talent challenges in the manufacturing community. Projected jobs and revenue growth, during the project term and beyond, will be included in the final proposal.

Sustainability

The collaborators on this team are well positioned to leverage the work of this project in realizing significant impact for the state. Lincoln Electric is committed to bringing the product to market. The addition of this tool to the capabilities at rp+m is complementary to its range of tools. MAGNET is well positioned as an MEP affiliate to support the design, development and long-term usage of this tool by a wide range of manufacturers in NEO and beyond.

MAGNET
Manufacturing Advocacy & Growth Network

LETTER OF INTENT
Edison Advanced Manufacturing Program (AMP)
2014 Request for Proposals

January 13, 2014

Lead Applicant
MAGNET (Manufacturing Advocacy & Growth Network)
1768 E. 25th St.
Cleveland, OH 44114
216-391-7002
Contact: Michael R. Morgenstern, Chief Development Officer/MAGNET
Mike.morgenstern@magnetwork.org

Project Title
Implementation of Positive Thermal Coefficient Ink in Advanced Manufacturing Products and Processes

Collaborators

Horizons Inc.	Warrensville Heights, OH
EGC	Chardon, OH
Therapy Innovations	Chardon, OH
DuPont Inc.	Circleville, OH

Estimated State Funds to be Requested
$500,000

Total Cash Costs, over 24 months
$500,000 Program funds and $500,000 cost share = $1,000,000 over 24 months

Intended Use of Grant Funds
The following details projected outcomes from the proposed project:

- The establishment of Positive Thermal Coefficient Ink (PTC Ink) process within an Ohio flex circuit factory to create next generation Printed Flexible Heaters
- Hospital grade heat pad will be launched as first application of Printed Flexible Heaters
- Car seat warmer market will be developed using Printed Flexible Heaters and PTC Ink
- Market expansion of Printed Flexible Heaters sector and dispersion of technology into new markets & manufacturing processes

PROJECT SUMMARY

Problem Statement and Overview

Current heating products use a graphite foil as the heating element. This graphite foil fails in applications of repeated flexing and can cause fires within a year, thus limiting its uses (restricting entry to certain markets) and presenting safety issues.

This project advances the development of a Printable Flexible Heater technology. It utilizes printable Positive Thermal Coefficient (PTC) Inks to create a flexible circuit 40x times more flexible than traditional foils. PTC Inks were developed by DuPont Chemical and are a known material. Adoption of PTC Inks has been slow due to the difficult process control (i.e. maintaining heater performance irrespective of ink variation). However, Flex electronics-related markets offer many more avenues for product expansion.

The project will be led by MAGNET (Manufacturing Advocacy & Growth Network), the Northeast Ohio Edison Technology Center and regional MEP provider for the State of Ohio MEP. MAGNET project lead activities include the following:

- Process Development and Engineering for material application
- Process monitoring & quality control inspection and feedback loops including the use of six sigma methodology
- Product development engineering from ideation through final drawings

The for-profit manufacturers involved are *Horizons, Therapy Innovations LLC* (TI) and *EGC.* Horizons will make the Printed Flexible Heaters for multiple markets. Therapy Innovations is focused on the thermal therapy pad market. EGC will provide the capital-intensive components for the Thermal Therapy Pad. All 3 companies involved have made heater circuits in the past, and all found the limitations of their existing technology, common to the industry, prevented deep market penetration. All 3 companies recognize that the recent advancements in printable heater materials will open doors to the $120,000,000 per year Therapy Pad market as well as the U.S. automotive seat warmer market, valued at approximately a $3,000,000,000 per year.

Specifically, Therapy Innovations LLC's target market includes rehabilitation facilities such as physical therapy at clinics, hospitals, schools and home health care. It also includes elderly care via home health care, nursing care and hospices.

The specific technical and operational challenges include the following:

A. Implementing the PTC Ink on the Horizon flex circuit production line
B. Advanced process controls to get precision thick films on the Printed Flexible Heaters
C. Applying known robust electrical connections to PTC Ink printed circuits
D. Encapsulating a high thermal density shell around the Printed Flexible Heater.

This project will improve the likelihood of launching successful products at competitive prices for the following three reasons:

1. Base technology PTC Inks stay flexible after 5-year life of product
2. PTC inks also allow a robust electrical connection needed for long life
3. PTC inks are inherently failure-resistant (electrically self-limits shorts or failures.)

Project Goals and Objectives

Goals are grouped around three (3) main objective sets:

1. Create a PTC Ink printing capability in Ohio capable of producing at least 100,000 sq. ft. per year of Printed Flexible Heater circuits for any application
2. Produce Printed Flexible Heaters for the Thermal Innovations Therapy Pad for under $5
3. Implement manufacturing line that can produce at least 100,000 sq. ft. of Thermal Therapy Pads per year (finished product)

Technical Approach and Work Plan

The team will leverage DuPont's expertise in the application of the PTC Ink, MAGNET's history of advanced process development and process control, and Horizons' decades of experience in development of printing flexible circuits. The critical-to-quality characteristics of thickness, resistivity per unit volume, and full circuit conductance will be baselined and optimized.

The Therapy Pad will be optimized for cost and performance using MAGNET engineering expertise and methods. TI and EGC experience and market expertise in this field will inform the process from ideation through final release. The Printed Flexible Heaters produced with the PTC Ink will require a robust and flexible electrical connection.

MAGNET is one of the State of Ohio's Edison Technology Centers, and is the Northeast Ohio provider for the Ohio Manufacturing Extension Partnership (MEP) program. MAGNET will contribute leadership and innovation-focused engineering at each step of the way. MAGNET product development tasks include leading ideation sessions for the Therapy Pad, designing prototypes and design validation plans, aiding in product testing and final drawings. MAGNET's other innovation strengths to accelerate commercialization include market research and talent planning for business growth.

Therapy Innovations LLC's mission is to design, develop and market new technologies for the medical and allied health fields. By designing and testing with professionals in the field, Therapy Innovations is committed to practical and efficient devices enhancing patient care and safety.

Horizons Inc. is a 60-year-old company with 140 employees, privately owned and located in Cleveland, Ohio. Their specialty is in the area of flexible printed electronic interface devices, and in label, data plate and instrument panel manufacturing.

EGC is a 30-year-old company in Chardon, Ohio, which produces graphite products of all shapes, sizes and scales. EGC's Q-foil graphite heaters are used in industrial and hospital markets today, and it was used to prove the market acceptability of the Thermal Therapy Pad.

Management Structure

MAGNET will be the Lead Organization and Roger Buelow will be the principal investigator and project manager. Each company involved will be a subcontractor for the ID'd project activities directly to MAGNET. MAGNET Innovation Advisor (Robert Schmidt) will guide and administer MAGNET project work.

Maturity of the Technology/Market Acceptance

The material technology (PTC Ink) critical to achieving a Printed Flexible Heater technology was developed over 10 years ago by DuPont. PTC Ink has shown its maturity as it has progressed

through the PPAP process used by the automotive industry in some car seat warmers. The application of PTC requires *advanced process control* compared to other printed circuits, as well as advanced design and engineering functions with feedback between the process, the material and the application. The market knowledge was gathered during the successful launch of a graphite-foil-based heater, which informs all the specifications for the Thermal Therapy Pad.

Projected Impacts

Importance and relevancy of the project

The Thermal Therapy Pad is immediately applicable for use at sports therapy, occupational therapy, hospitals and home use today. The advanced process controls which enable the Printable Flexible Heater technology will also open the door for rapid design and engineering functions for other products, putting Ohio in a leadership position for this technology.

Other flex circuit companies in the Nortech FlexMatters cluster that can benefit from this include Cleveland Medical Devices, Valtronic, and Hallsten. NorTech Flexmatters has a "Prototyping Network" which will accelerate use of Printed Flexible Heater technology to the 100+ member companies. The Printed Flexible Heater can be put to use by BioEnterprise startups including Cardio Insight, Therapy Partners, and Thermedx. As mentioned above, the automotive market will be early adopters of this technology, including Ford, Chrysler and GM.

In the near term (including during the term of this project), Thermal Therapy Pads will be launched into the sports therapy, and hospital markets. Within 2 years of launch, sales of Therapy Pads in excess of $30M/year are expected, with job creation of 100 jobs. Organic growth and new medical device markets will double this by year 4.

In the long term, the OEM automotive car seat warmer industry could be a $300M/year industry for Ohio with 500 jobs. Aftermarket seat warmers further increase this number. The low cost and high durability of PTC based Printed Flexible Heaters will open up additional new markets including busses, trains, and even outdoor stadium seating and integration within clothing and apparel design. This is directly in line with goals laid out by ARPA-E in their Personal Thermal Management Systems program.

Success Metrics will include total companies engaged, contracts and revenue from post-project sales, partner org. jobs/FTEs dedicated to the AMP project as well as jobs/FTEs projected from post-AMP project deployment. The largest long-term success metric would be a strategic build-out of "heater/flex" cluster in the State of Ohio.

Sustainability

The team is dedicated to the successful implementation of this technology post-project term. This will be shown in plans to acquire both capital equipment and invest in additional application development. Company commitment is evident in the current investment to ensure a successful implementation. A partial list of company commitment to the larger AMP project includes:

- Waterjet investment of over $125,000 budgeted by EGC in 2014
- Quad IV and Pick and Place investment of over $120,000 budgeted by Horizons in 2014
- Ongoing engineering at 3-6 FTE per year, moving the design forward.

AMP – 14 – 06

OH!Polymer
PolymerOhio, Inc.

January 13, 2014

Edison Advanced Manufacturing Program
Ohio Development Services Agency
AMP@development.ohio.gov

Subject: Edison Advanced Manufacturing Program LOI

Dear Sir:

Attached is PolymerOhio's Letter of Intent to submit a proposal to the Edison Advanced Manufacturing Program. Our proposal is titled, **Simulation Software for Ohio Manufacturers.** The State's support of projects and services to small and mid-sized manufacturers is important to the growth of Ohio companies and the creation of jobs. Many of these projects could not be completed without support from the State.

We are pleased to participate in this important program.

Please contact me if there are any questions about the proposal.

Sincerely,

R L. Markham

Richard Markham
VP Productivity Initiatives

Edison Advanced Manufacturing Program

Letter of Intent

Lead Applicant: PolymerOhio, Inc.
155 Commerce Park Drive
Westerville, OH 43082
614-776-5720

Contact: Richard Markham
rmarkham@polymerohio.org

Project Title: Simulation Tools for Ohio Manufacturers

Estimated Funds Requested: $375,000 (estimated)

Collaborators:

Applied Sciences, Inc.	Avery Dennison Corporation	Biobent Polymers
Dimco Gray Corporation	GrafTech International Holdings, Inc.	Moore Industries
Macromeric, Division of Saco	NFM Welding Engineers, Inc.	Rowmark, LLC
Uni-Facs Steelworks, LLC	Worthington Industries	Avery Dennison

Intended Use of State Funds:

The funds will be used to refine the Manufacturing Portal's access functions and mechanisms to provide a robust and user-friendly environment for customers and to fund projects with the Collaborating companies through which they will experience the value and ease of use of simulation-software accessed through the Portal. Success Stories will be developed based on their projects.

In addition, funds will be used to inform small and mid-sized manufacturers (SMMs) of the value of simulation and other digital tools in increasing productivity, growing their businesses and creating jobs. A survey will be carried out among Ohio manufacturers to learn about company attitudes about simulation and needs within their companies for other simulation tools. Two simulation tools will be selected based on the survey and added to the Portal.

Some funds will support the Portal Team in conducting outreach and informational events as well as in managing the collaborators' projects, providing technical support for all users as requested, maintaining the Portal and adding to the Portal website.

Cost share will be provided by the Collaborators, software providers and PolymerOhio staff time

Summary of the Proposed Program: See attached

Summary of Proposed Program

PolymerOhio's proposed program, Simulation Tools for Ohio Manufacturers, will provide easy and affordable access to advanced manufacturing technology, namely simulation software, that is available but infrequently used by small and mid-sized manufacturers (SMMs). Licenses for many different types of simulation software can be purchased but prices of the more beneficial software may cost $50,000 or more. This program will expand the use and value of PolymerOhio's Manufacturing and Polymer Portal to SMMs throughout Ohio leading to increased productivity, company growth and job creation.

Problem Statement

For decades large companies have realized the tremendous power of digital tools. By evaluating "virtual" prototypes rather than building and testing physical prototypes, these large companies can reduce their development costs by as much as 50% and reduce the time to market by weeks and sometimes months. Unfortunately, SMMs rarely take advantage of these productivity–enhancing tools because of the cost of:

- simulation software
- hardware
- trained engineers to use the tools
- IT support
- implementation.

This leaves SMMs at a disadvantage in competing for business with the larger companies and with foreign companies that are applying simulation tools to increase their productivity.

SMMs comprise about 85% of the manufacturing companies in Ohio. It is important that an approach be found through which SMMs can affordably access tools to enhance productivity and growth.

Project Goals and Objectives

The goal of this program is to help Ohio SMMs increase profitability and create jobs by:

- increasing productivity
- speeding new product development
- facilitating process and material optimization.

The objectives of this program include:

- Assisting Ohio manufacturers in learning about simulation software, selecting appropriate tools and affordably and easily applying the tools through the Manufacturing Portal.
- Upgrading the Manufacturing Portal for improved reliability and expandability to properly service the growing clientele using this unique resource.
- Based on information from Ohio SMMs, selecting and implementing additional software that will further enhance the productivity of Ohio manufacturers.

Technical Approach and Work Plan

The Portal's target market includes manufacturers in any specialty with particular emphasis on polymer-related manufacturers. Although companies of any size can benefit from the tools available through the Portal, target companies include those with employees in the range of 20 to 250.

Within these companies, the Portal Team's contacts will focus on:

- The Decision Makers – Executives at Ohio companies that can benefit from digital tools.
- The Doers – Engineers and scientists at Ohio companies that can benefit from digital tools..

Each will be approached differently but concurrently.

Two major barriers stand in the way of successful implementation of the Portal as a well-recognized, frequently used and sustainable resource for Ohio SMMs: 1) reticence of SMMs leaders to investigate and try out simulation software through the Portal and 2) lack of a user-friendly, reliable and expandable Portal customer interface. To overcome these barriers, four tasks will be completed:

Task 1. Inform Ohio SMMs of the value of M&S. The Portal Team learned that the most effective avenue to make contacts is through events such as lunch-and-learn workshops, seminars, training classes and webinars followed by one-on-one visits covering details for that specific company.

Task 2. Carry out projects with SMMs to evaluate and use each of the software offered on the Manufacturing Portal. The program will fund projects at up to two companies for each of the seven simulation tools offered through the Portal. The objective is to help engineers and managers at the collaborating companies experience the use and benefits of simulation tools. Under the project, the Portal Team will work with company representatives to assure that the software is appropriate for that company, train the company's engineers in using the software and pay the access fees for at least three simulation projects selected by the company. Each company will provide labor as cost share to match the project funds. At least one publishable Success Story will be required from each funded company.

Task 3. Upgrade the web server and website-software interfaces. The present Portal mechanisms and interfaces are basically prototypes, i.e., capable of providing access and functions without reliability or robustness. No more than three concurrent users can access a given simulation tool. Significant down time is encountered each month. An IT firm skilled in developing interfaces and access points between virtual machines and cloud providers will be selected to carry out the refinement and expansion of the Portal to a "production level" site.

Task 4. Expand the library of simulation software. The Portal Team will survey Ohio manufacturers to learn about their knowledge and interest in simulation software, identify software that will be most useful in up to three selected manufacturing specialties, and negotiate business agreements with at least two providers and implement the selected software on the Portal.

The Portal Team, led by Richard Markham, Vice President for Productive Initiatives, will comprise six Polymer Ohio staff members. All have significant experience and technical skills relevant to manufacturing coupled with experience in project management. Four are working on the Portal Team. Mr. Markham has led the development of the Portal concept since its inception. The organization selected to upgrade the Portal interfaces will be selected based on experience and relevant knowledge about the tasks to be completed.

Maturity of Technology/Market Acceptance

The "Maturity of the Technology" applies to two different types of technology. One is the technology of the delivery mechanism and the other is the technology of the software tools that are offered through the Portal. The several technologies involved in the delivery mechanism are not newly developed. The difficulty is in fine tuning the combination to be reliable and to interact as needed. This combination must be upgraded to provide the robustness and user-friendliness required to assure repeat customers by improving the interfaces, expanding the capacity for access by additional concurrent users and providing safety checks and backups to assure reliable user-friendly service. The issues will be remedied under Task 3.

The second technology underlying the Portal is the technology of simulation software. These types of tools have been available for decades. They became significantly more efficient and user-friendly. There are many available and many others are in development. This type of technology presently has a mature, although niche, market. More and better software will continue to be introduced to the market and simulation will eventually become a "best practice" among advanced manufacturers.

Projected Impacts

The ability to access and use affordable simulation software is important to Ohio SMMs because it will lower over all manufacturing costs helping them compete in global and domestic markets. By taking the lead in offering affordable access to these tools, the Portal will be an important resource in assuring continuing growth of Ohio SMMs and consequently in creating new manufacturing jobs.

Users of the Portal have gained significant savings in costs and time through the Portal. For example, an injection molding company saved $8000 in its first use after an investment of less than $1500. An extrusion company developing a new product by reactive extrusion was able to decrease the amount of the expensive reactive component by 12%, increase output by 8% and reduce scrap by 5%.

Introducing Ohio companies to simulation tools will make a significant impact on the state's manufacturing community leading to more jobs and higher revenues. Collaborating companies on the projects to be established under Task 2 are listed on the cover page.

Benefits to the collaborating manufacturers from applying simulation software include:

- improved productivity
- increased profitability
- reduced time to market

- new and innovative products
- more competitive position in the global market.

Metrics for the proposed program will include:

- Number of informational events - workshops, webinars, classes
- Number of company's visited
- Increase in Ohio users of the Portal for each software
- Company estimates of savings and increases in revenues
- Company statements of jobs retained and added due to the use of the Portal
- Success stories from Portal users.

Sustainability

Long-term plans for the Portal have always included sustainability, i.e. grant independence. Market research and experience have shown that not only is the market adequate to sustain the Portal but the interest in using simulation software and other digital tools is growing nationwide in all manufacturing specialties. Although the Ohio market is expected to sustain the Portal, internet marketing was started less than six months ago as an inexpensive way to leverage the Ohio marketing efforts and gain additional users outside the state. This much larger market will provide revenues to sustain the Portal. Also, each software provider is required to contribute $5000 per year to assist with the marketing activities and the maintenance of their software on the cloud provider and the marketing content on the website.

An important factor in sustainability is that companies are not usually one-time users. Companies will likely use the software at least five to seven times a year and will continue over several years with very low cost of sales in the later years. .

Estimated Cost of this Proposed Program

The estimated cost for this program over a two-year period of performance is in the range of $375,000. Matching funds are estimated to be near $400,000.

AMP – 14 – 07

OH!Polymer
PolymerOhio, Inc.

January 13, 2014

Edison Advanced Manufacturing Program
Ohio Development Services Agency
AMP@development.ohio.gov

Subject: Edison Advanced Manufacturing Program LOI

Dear Sir,

Attached please find our Letter of Intent to submit a proposal to the Edison Advanced Manufacturing Program Request for Proposals. The title of our proposal is **Material Processing for Advanced Plastics Recycling**. We appreciate the State's support of small and medium-sized manufacturers in their desire to offer new and innovative products and services to their customers. These offerings often entail substantial risk in the development and adoption of new technology. We welcome the opportunity to compete for financial assistance in these endeavors.

Please contact me if you have any questions about our proposal.

Sincerely,

Gary A. Walzer
VP Manufacturing Services

155 Commerce Park Drive, Suite 8
Westerville, Ohio 43082
614-776-5720
www.polymerohio.org

OH!Polymer
PolymerOhio, Inc.

Edison Advanced Manufacturing Program

Letter of Intent

Lead Applicant	PolymerOhio Inc 155 Commerce Park Drive Westerville, OH 43082 614-776-5720
Lead Applicant Contact	Gary Walzer VP Manufacturing Services gwalzer@polymerohio.org
Project Title	Material Processing for Advanced Plastics Recycling
Estimated State funds requested	$250,000
Collaborators	Geo-Tech Polymers; Westerville, OH Doug Gels, General Manager Landmark Plastics; Akron, OH Tony Ferrara, Operations Manager

Intended use of Grant funds – Funds will be used to research, test, purchase and install equipment and develop the process that will demonstrate an economical method for recycling and reusing plastic material from a controlled feedstock stream.

Narrative

Problem Statement

Plastic recycling programs are often hampered by the diversity of polymer materials, inability to control collection sources, and the ability to develop cost-effective means to handle the potential wide variation in feedstock (sizes, shapes, and materials). Plastic molders would like to offer their customers alternatives to disposal, to reduce total costs, and provide a hedge against rising neat resin prices associated with increasing petroleum costs. Plastic molders are beginning to offer "buyback" programs where molded parts are returned to the molder after serving a useful life at the customer facility. To properly re-use this material, a recycling process requiring size reduction, separation, washing and repelletizing must be developed. This process must often be customized to accommodate the unique materials and product size/shape mix involved.

Geo-Tech Polymers (GTP) has been working with Landmark Plastics to maximize the recycling potential of plastic products used in the horticulture market. Landmark manufactures plastic pots and trays for nurseries and growers. Once the plastic pots and trays reach the end of their useful life, Landmark is implementing a buyback program with nurseries to recycle the plastic back into new plastic pots and trays. GTP has been working with Landmark to develop an economical recycling program to reclaim the plastic. GTP has very effective processes with regard to the

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washing and re-pelletizing requirements, but is currently hand sorting the material which is not cost effective. An automated density separation system is required to economically complete the recycling process.

Project Goals and Objectives

The project team will identify, evaluate, and select appropriate sorting/separation technology resulting in a recycling process that is cost justified. GTP will then procure and install all the requisite equipment to become the toll processor for Landmark's buyback program in the horticultural industry.

Technical Approach and Work Plan

GTP has very effective processes for washing and re-pelletizing requirements. To use external service providers for the other necessary operations (size reduction and sorting/separation) is not economical when the needs of the multiple profit centers and transportation costs are factored in. The project team, led by PolymerOhio, will identify suppliers of technology and equipment for both the size reduction and sorting/separation processes. Trials will be conducted using actual and simulated feedstock to represent the Landmark products. Necessary equipment modifications will be identified and implemented. After successful demonstrations of each unit operation, GTP will procure and install all the equipment for a complete plastic recycling operation (size reduction, sort/separate, wash re-pelletize).

Maturity of the Technology/Market Acceptance

There are several types of size reduction and density separation technology available in the industry. However, effective use of this equipment requires extensive research and testing, both at the unit operation and complete system level, to ensure proper processing on the materials in question. Once developed, these recycling operations have proven to be effective means of recycling plastic parts and polymeric material. Product buyback programs are growing in popularity in the automotive industry for everything from batteries to brake pads. A complicating factor for many recycling programs is the inclusion of paints and coatings on the incoming raw material. GTP has proprietary methods for removing these materials so they don't contaminate the finished product.

Projected Impacts

Successful development of the separation stage of the recycling process and installation of a toll processing line will result in an immediate business expansion opportunity for GTP. Landmark has identified an immediate need of 2-3 million pounds per year of recyclable horticulture materials. This will expand greatly once Landmark can aggressively market the program based on development of a proven while and effective recycling system. It is believed that once the recycling program is marketed, 3-4 times that amount will be available. Successful project completion will result in increased sales of $2 million and creation of 10 jobs at GTP. Landmark will be able to offer a new service to their clients, and benefit from the use of lower cost raw materials.

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Sustainability

Beyond the immediate new business with Landmark, GTP would be in position provide similar toll processing for other plastic molders. This is not limited to horticultural product manufacturers. An immediate target would be automobile bumpers. Efforts have already been made to strip bumpers from vehicles at junk yards, but the program requires the same sorting technology to effectively recycle the material. Working with just one automotive scrap yard in the Cincinnati area generated 40-50K pounds per month of material for recycling.

Geo-Tech Polymers is the most effective provider of recovered plastics technology for recycling and reusing materials in high-end applications. Their proprietary, exacting and environmentally friendly approach enables removal of paints and other coatings from plastics, recovering valuable plastic substrate materials without the use of solvents and chemicals that diminish base polymer properties or degrade the surface appearance of parts manufactured from the reclaimed materials. Geo-Tech's "closed loop," financially and eco-friendly supply cycle is moving America toward a sustainable manufacturing and consumption model while providing a cost advantage to their customers. Geo-Tech has sufficient financial and technical resources to fully implement the results of this project to produce measurable impact to Ohio.

Landmark Plastic Corporation's focus is on providing an extensive variety of injection molded and thermoformed plant packaging and growing systems. They accomplish this with an experienced production, tool engineering and logistics team backed by a 200,000 square feet, state-of-the-art manufacturing facility. Landmark's range of products includes bedding packs and trays, market packs and landscape trays, transport and nursery trays and tray systems, pots of all shapes and sizes, and decorative pots and accessories. They offer more than 500 base SKUs and more than 2,500 versions when labeling, printing, color and secondary process are accounted for. They serve all of North America from their base in Akron.

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AMP – 14 – 08

OH!Polymer
PolymerOhio, Inc.

January 13, 2014

Edison Advanced Manufacturing Program
Ohio Development Services Agency
AMP@development.ohio.gov

Subject: Edison Advanced Manufacturing Program LOI

Dear Sir,

Attached please find our Letter of Intent to submit a proposal to the Edison Advanced Manufacturing Program Request for Proposals. The title of our proposal is **Development and Implementation of Co-injection Molding for High Performance Parts**. We appreciate the State's support of small and medium-sized manufacturers in their desire to offer new and innovative products and services to their customers. These offerings often entail substantial risk in the development and adoption of new technology. We welcome the opportunity to compete for financial assistance in these endeavors.

Please contact me if you have any questions about our proposal.

Sincerely,

Gary A. Walzer
VP Manufacturing Services

155 Commerce Park Drive, Suite 8
Westerville, Ohio 43082
614-776-5720
www.polymerohio.org

OH!Polymer
PolymerOhio, Inc.

Edison Advanced Manufacturing Program

Letter of Intent

Lead Applicant	PolymerOhio Inc. 155 Commerce Park Drive Westerville, OH 43082 614-776-5720
Lead Applicant Contact	Wayne Earley Sr. Consultant Wayne.a.earley@polymerohio.org
Project Title	Development and Implementation of Co-injection Molding for High Performance Parts
Estimated State funds requested	$350,000
Collaborators	Venture Plastics; Newton Falls, OH Steve Trapp, President MVP Plastics Inc, Middlefield, OH Darrell McNair, President UDRI; Kettering, OH Kevin Cunningham, Associate Engineer

Intended use of Grant funds – State funds will be used for professional technical labor to assist in designing, developing, testing and prototyping new products made via the co-injection plastic molding process. Funds will also be used to lease machine time on an existing co-injection molding press, and procure tooling as needed for development and testing purposes.

Narrative

Problem Statement

Plastic molders must often conduct product design, process development and produce prototype parts on a speculative basis in to win new orders. Historically, co-injection plastic molding has been unutilized by small and medium-sized plastic molders due to the high capital costs of both the equipment and tooling required. Applications of the technology were limited to those products with significantly high volumes to amortize fixed costs of equipment and extensive development costs for both the product and process. The start-up costs for co-injection molding are out of reach for many Ohio molders. Several have been forced to turn away business, and at times loose customers, due to their inability to offer co-injection molding. Now with the development of new resins, hot runners, controls technology and unique regional assets, small and medium-sized plastic molders in Ohio are poised to move this process from niche to mainstream applications. Adoption of the co-injection molding process will allow Ohio plastic molders to capture market share from other processes and materials and grow their business.

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Project Goals and Objectives

The goal and objectives of this project will be to develop, coordinate and deliver the resources and services needed to aid select Ohio plastic molders in testing and implementing co-injection molding technology. This will include:

- Conducting numerical simulation analysis services for several products, processes and tooling design. Use of numerical simulation will greatly reduce the time and cost associated with development of new parts and molding processes. PolymerOhio will leverage the resources available through the Manufacturing and Polymer Portal.
- Coordinate the design and development of new resins for use in co-injection machines as necessary.
- Procure prototype tooling for development purposes, possibly through the use of additive manufacturing processes.
- Conduct testing, development and pre-manufacturing trials for Ohio plastic molders using co-injection molding equipment obtained previously with Ohio Third Frontier funding.
- For-profit collaborator partners will procure the necessary equipment and tooling to begin producing and delivering co-injection molded parts to their customers.

Technical Approach and Work Plan

In addition to PolymerOhio in the lead role, the project team includes Venture Plastics (Venture) and MVP Plastics (MVP), both established molders in Ohio, and the National Composites Center , which houses the co-injection molding machine. As project lead, PolymerOhio will initiate and execute all the tasks necessary to achieve the stated project goals. Those tasks include:

1. Liaise with Venture and MVP to understand their needs for information and data necessary to make an investment decision to adopt co-injection molding. This will include the identification of specific parts and associated performance requirements.
2. Working with Venture and MVP, PolymerOhio will conduct numerical simulation analysis to study the co-injection molding process, identify material flow and cooling patterns, and assess resultant part performance. As necessary, PolymerOhio will work with resin suppliers to formulate modified resins to produce the desired technical performance requirements of the final product. The numerical simulation will be used to evaluate various part designs and material flow properties that will produce the required part performance. Moldex3D simulation software is available on the Manufacturing and Polymer Portal, operated by PolymerOhio, on a pay-per-use basis, which is a cost effective method of obtaining these services for the project.
3. Tooling will be procured and test samples will be produced using the co-injection molding machine available at the National Composites Center.
4. Upon analysis of test samples, prototype tooling will be procured for the complete part and molding will be conducted at NCC.

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5. Steps 2-5 will be repeated as necessary to develop sufficient information for the for-profit partner to make the investment decision to obtain co-injection molding equipment and begin producing parts.
6. Venture and MVP will prepare and submit sample parts to prospective clients using the co-injection process for approval.
7. Venture and MVP will invest in new co-injection capital equipment to full fill new product orders.

Maturity of the Technology/Market Acceptance

Co-injection molding is the process of injecting two resins simultaneously through a single gate to form a multi-layer structure. This advanced molding technique has been used with some success in specialized applications like ketchup containers, stadium beer bottles and medical vials. However, recently there has been a re-emergence of interest in co-injection technology spurred on by the development of new resins, barrier systems, controls and hardware technologies.

There are a number of target markets that would benefit from the advancement of co-injection technology. In general, there is a high demand for products with advanced barrier properties that produce shelf-stable products for packaging products such as sports drinks, carbonated beverages, condiments, chemicals, medical, fruits, coffee, pudding cups, spreads, tea, beer, wine, dairy, soups, baby food and pet food. These markets have traditionally been served by glass, can and multi-layer thermoforming products, but the market is hungry for the advantages that an injection molded part could give. The great benefit of injection molding is the production of a net part in a single operation, eliminating secondary operations, handling, assembly, scrap or other costs. Injection molded parts for the packaging marketplace could cut the costs of a barrier packaging by 30 to 50 percent. The cost of a barrier closure could be reduced by more than 50 percent, compared to the traditional three-piece system with liner and foil.

Co-injection molding requires extensive additional equipment compared to conventional injection molding. Many small and medium-sized Ohio plastic molders have been unable justify investment in this new equipment to capture new business.

Projected Impacts

Both Venture Plastics and MVP Plastics have a strong desire to develop a new manufacturing capability that can be marketed to existing and potential customers. They conservatively estimate that within two years, they could achieve new sales volume in excess of $2 million. Project success will be measured by the introduction of new products introduced by Venture and MVP using the co-injection molding process. In addition, Polymer Ohio will work with other Ohio molders to utilize the same assets (simulation software and process development equipment) to investigate and justify similar investment in co-injection molding technology.

Sustainability

Venture Plastics is a very successful industry leading Ohio based injection-molding company. They are a "Best in Class" supplier providing a range of services including custom molding,

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engineering, part design, and part consolidation for cost reduction. They serve the industrial/consumer, appliance, truck, automotive, and communications markets.

MVP Plastics specializes in providing custom molding, decorating and assembly operations for clients in the automotive, appliance, telecommunications, and healthcare industries. They are a leading supplier of automotive interior products with a specialty in louvers and outlets for the climate control systems.

Both Venture and MVP have sufficient capital to invest in equipment and tooling to grow their business through the use of co-injection molding once the business case has been justified. One of the goals of this project will be to produce the requisite justification to support investment in new co-injection molding equipment and its implementation to capture new business. Upon project completion, PolymerOhio will be in a position to offer similar development services for other Ohio plastic molders wishing to implement co-injection molding.

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Edison Advanced Manufacturing Program

Letter of Intent

Lead Applicant:	PolymerOhio, Inc. 155 Commerce Park Drive, Suite 8 Westerville, Ohio 43082 Main office phone: (614) 776-5720
Lead Applicant Contact:	Ken Vaughan Email: kvaughan@polymerohio.org Contact phone: (440) 248-9814
Proposed Project Title:	Tailoring Physical Properties Through Innovative Surface Texture Application
Funding:	Total estimated project cost: $500,000 Project duration: 2 years Estimated state funds to be requested: $250,000 over two year period
Collaborators:	1. Schneller LLC 6019 Powdermill Road Kent, Ohio 44240 2. Johnsonite 16910 Munn Road Chagrin Falls, Ohio 44023 3. OMNOVA Solutions Inc. 175 Ghent Rd. Fairlawn, Ohio 44333 4. University of Akron 302 E Buchtel Ave. Akron, Ohio 44325

Intended use of funds: The goal of the project is to develop a deep understanding of how surface textures affect physical properties of surfaces and the subsequent impact on performance attributes. The end result of this research will be a significantly-enhanced ability to develop textures that meet both the performance and design expectations of customers. This will be achieved by developing correlations between texture structure and physical performance that will be built into a predictive model that can be used in the engineering process. Grant funds will be used for professional technical labor and laboratory costs associated with measuring and analyzing engineering properties (or surface texture) and performance attributes of a variety of textured samples, resulting in the development of an engineering or scientific model that drives new texture design.

Summary of project:

Background

PolymerOhio has organized a working group of Ohio manufacturers for whom textures are a critically important part of meeting customer needs. The group, working together since 2012, is composed of non-competing companies and the discussions within the group are covered by a Non-Disclosure Agreement. The purpose of the group is to share best practices regarding design and production of textured products and to jointly pursue improvements in technology that will provide each of the members with competitive advantage in their respective markets. The members of this "Texture Working Group" are the manufacturing collaborators for this project.

Surface textures are used extensively throughout industry. They are important for both aesthetic and functional purposes. In many products or applications textures provide performance-critical functionality to the product, for example, a better grip, tightly controlled levels of light reflectivity, or low-slip surface. Surface textures are also known to have significant effects on critical properties such as angle-dependent color, resistance to staining and water, or even ice repellency. In certain applications the ability to meet customers' stringent requirements for a combination of functional performance properties is a key factor in determining competitive advantage. As markets are increasingly faced with strong global competition, the ability to quickly design and produce textures that meet customer performance requirements often determine which supplier receives the order.

Recently, advanced analytical tools for measurement and manufacturing methods for prototyping of surface texture have been developed. These new tools have the high levels of resolution required for scientific studies that can lead to meaningful new know-how in this field. These advanced tools have not yet been fully applied to the understanding of textures and their physical performance.

Problem Statement

The problem faced by suppliers in these performance-critical applications is that designing textures is often a trial and error process. As an example, understanding why two samples of the same composition and with similar textures have vastly different cleanability is not always clear. Manufacturers desire a more scientific approach to developing textures that deliver novel or improved aesthetic and physical performance.

Project Goals and Objectives

The goal of this project is to help our for-profit manufacturing partners gain competitive advantage through innovative design and manufacturing processes in the field of advanced surface textures. To accomplish this goal we will develop a deep understanding of how surface textures affect physical properties of surfaces and the subsequent impact on performance attributes. More specifically, this project will identify correlations between engineering properties of various textures with the resultant physical performance attributes and will result in the development of predictive models that translate performance requirements into texture design. This improved understanding of the correlation between engineering properties and performance attributes will improve the ability of the

manufacturers to meet customer requirements without the trial and error process. It will provide a competitive advantage for the manufacturing companies both in speed of product development and performance of the product, resulting in increased customer satisfaction, growth in market share, sales volume, and employment to support the production resulting from this growth.

This project is one step in a roadmap of continuous improvement and growth in texture technology that the members of the Texture Working Group are pursuing. The various elements of the roadmap each stand alone and each independently benefit the manufacturing partners and their growth in technical ability. Besides this predictive model to translate performance attributes into engineering design, the elements of this roadmap include such things as the ability to electronically catalog and reproduce textures, the ability to generate textures through additive manufacturing, the ability to generate sample tooling through advanced prototyping techniques, and a process for continually refining the predictive model. Facilitated by PolymerOhio and working collaboratively, the manufacturing partners expect to accomplish together this aggressive vision by sharing costs and technology.

Technical Approach and Work Plan

The manufacturing collaborators on this project include three Ohio companies with long histories in producing textured surfaces. They all operate in markets where the performance attributes of the textured product is critically important and where their customers have high expectations of specifically and consistently meeting these performance specifications. Schneller LLC (a subsidiary of Cleveland-based TransDigm), with headquarters and manufacturing in Kent, Ohio, is a designer and producer of interior components for mass transit, largely aircraft interiors. Johnsonite, headquartered in Chagrin Falls, Ohio with additional manufacturing in Middlefield, Ohio, designs and produces flooring and associated products for commercial markets. OMNOVA Solutions, headquartered in Fairlawn, Ohio, designs and produces textured sheet products as a supplier to both Schneller and Johnsonite, as well as to many other customers and markets.

To achieve this goal, we will partner with the University of Akron, an academic institution with a strong, existing interest and capability in design and analysis of textures in polymeric products, to study and identify correlations between engineering properties and performance attributes. The collaborators will first identify the most relevant engineering properties to be measured and identify the high priority performance attributes to be studied. The manufacturing companies will produce a variety of sample textured surfaces. The various laboratory facilities at either the manufacturing companies or the academic partner will measure a range of physical properties of the textured surfaces over a range of scale from nano to micro to macro. The various labs will then conduct tests to measure the performance attributes of the various samples. This process will likely be repeated several times in an iterative process in which controlled textures will be developed (this could be existing textures or new innovative texture approaches, e.g., micro-, bio based, or nano textures or production via additive or subtractive manufacturing) in various materials to identify and prove the various correlations.

As project lead, PolymerOhio will coordinate and manage the following tasks necessary to achieve the project goals:

1. Identify and obtain representative sample textures.
2. Identify relevant engineering measurements and conduct measurements on samples.
3. Identify and prioritize performance attributes and conduct tests on samples.
4. Repeat steps 1-3 as necessary to identify and prove correlations between surface textures and performance attributes.
5. Develop predictive model that predicts performance based on texture surface properties.
6. Integrate the predictive model into each of the for-profit collaborators' design and engineering process.
7. Develop and introduce new products to utilize and prove the model.

Maturity of the Technology/Market Acceptance

For the markets of greatest relevance to our for-profit partners, e.g., commercial flooring, high-performance coated fabrics, and automotive and aircraft interiors, all of their products require performance-critical textures. Our manufacturing partners are strong competitors in these markets and are generally able to provide competitive texture designs, albeit often by a trial and error process. As markets move to more rapid change and evolution, the ability to more quickly develop and supply product is an expectation of our for-profit partners' customers. The global markets served by our manufacturing partners are large (measured in billions of US$), continue to grow, and continue to expect higher levels of product performance.

Projected Impacts

Texture affects every product manufactured by our three for-profit collaborators. This project and the resulting predictive model will impact the business of the manufacturing partners in many dimensions, including both new product development and improvements in existing products. Hence the impact will show up in many ways. For example, between the three manufacturing partners 20-30 new product development projects are conducted in a typical year, each requiring the development of multiple alternative designs over a one year period. This predictive model will enable designs projects to be conducted more quickly (reducing time required by 25%) and with fewer alternatives (resulting in lower development costs). The predictive model will enable the manufacturing partners to develop products with better performance so, for example, developing products with a more cleanable surface is likely to add at least $2 million in revenue among the three companies and developing flooring with better slip resistance should add at least $1 million in annual sales. This predictive model will also impact existing performance of the manufacturing partners by identifying solutions to product performance issues. For example, this technology is expected to offer solutions to interlayer adhesion problems in certain applications, where this benefit alone could provide $5 million in annual savings. All of these benefits and more can be achieved within two years of the successful completion of this project and will have an ongoing impact.

Sustainability

The three manufacturing partners combined profitably produce $750 million of textured products each year, of which 100% would be considered to have performance-critical textures. Each of these three companies would be considered to be a strong global competitor in their respective markets.

The manufacturing partners conduct ongoing efforts to improve their understanding of textures, to improve their abilities to design and produce textures that meet their customers' needs, and to develop technologies related to textures. This project will be a major step forward in the ability to quickly engineer textures that meet given performance criteria and will be synergistic with other efforts in both design and production of textures by these manufacturing companies.

In addition to the major benefit to the manufacturing companies, the involvement of an Ohio academic partner will provide a growing body of knowledge in the design and performance of surface textures in polymeric products that can translate to other industries. Specifically, the University of Akron has a history of research in the area of designing and producing textures to meet various applications. The UA component of research work will be performed at the Akron Functional Materials Center (AFMC).

The Texture Working Group represents a new business model for PolymerOhio in which PolymerOhio organizes and facilitates an effort to be substantially involved in specific business segments and, jointly with the members, make major improvements in their business. As PolymerOhio demonstrates its success with helping the manufacturing partners involved in this project, we expect to roll out this same business model to additional target groups. The specific technology developed in this project will be available to additional non-competing Ohio manufacturers who join the Texture Working Group.

Letter of Intent for Additive Manufacturing of Intelligent Mouth Guards

Project Title

Additive Manufacturing of Intelligent Mouth Guards

Lead Applicant

NorTech
737 Bolivar Rd. Suite 1000
Cleveland, Ohio 44406
Phone: (330) 363-6883

Contact Person and PI

Tim Fahey, Director of Cluster Acceleration - NorTech
Phone: (330) 363-6886
e-mail: tfahey@nortech.org

Estimate of State Funds to Be Requested

The total project cost is estimated to be $460,000.00 of which the team will be requesting **$230,000.00** from Ohio's Edison Advance Manufacturing Program

Collaborators and Use of Funds

- NorTech – (Program management)
- SportSafe/Safeguard (Face to Customer manufacturing process and fabrication)
- Cleveland Clinic Foundation (Product validation)
- RP&M (3D manufacturing and process development)
- Lubrizol (3D material development for FDM process)
- AVID (3D additive flexible electronics design)
- Valtronic (3D additive flexible electronics fabrication)
- Linear Dimensions (supply/integration of special electronics)

Proposal Narrative

Problem Statement

This project intends to apply additive manufacturing and other complementary technologies to the commercial production of instrumented "intelligent" mouth guards (IMG) used for detection of traumatic brain injuries in athletes and the warfighter. Prototypes of these advanced mouth guards have been developed at the Cleveland Clinic along with Sportsguard, a company that currently supplies mouth guards to most of the professional NFL teams and major colleges, and now a commercially viable version is to be introduced to the market.

The for-profit team members of this project from Ohio include **Sportsguard** (original prototype development and final production) and a spin out known as **SafeGuard** (IMG supplier to the markets and face to the customer), **RP+M** (fused deposition modeling (FDM) process development and parts manufacturer), **Lubrizol** (additive manufacturing compatible materials development), **Valtronic** (additive flexible circuit fabrication), **AVID Technologies** (additive flexible electronics circuit design), and **Linear Dimensions** (supplier of special electronic components for additive flexible electronics). In addition to the for-profit businesses, the project team also includes two non-profit constituents, **NorTech** (program manager for the project) and **Cleveland Clinic Foundation** (product validation and market requirements).

Technical Challenge: Current un-instrumented mouth guards for high performance athletes and research purposes are custom designed to match the bite patterns of individual users, an application ideally suited for digital fabrication. Users provide a bite pattern in a formable template, from which a custom mold is built and then used to produce the mouth guard using an FDA-approved elastomer in a thermoforming process. Secondary operations are often needed to then tailor the product to the user's gum line. Further, for the IMG, direct incorporation of the electronic instrumentation (needed for blunt force detection) into this production process is challenging, expensive and unlikely to meet the tight design specifications required. The sensitive flex circuit will be subjected to potentially destructive forces, high temperatures and orientation effects during the fabrication process. Mitigation of circuit damage during fabrication and use necessitates the need for precise fabrication of a multi-material unit, reinforcing the circuit insert with more rigid material, while placing a softer material against the user's teeth and gums for comfort and safety. Precision design features are further required to secure the insert against movement. This is not feasible in the current process and would require conversion to mass production via injection molding, necessitating expensive tooling and prohibiting user customization.

Additive manufacturing is ideally suited to overcome these issues and revolutionize the manufacture of custom mouth guards with multiple points of value.

Understanding the Business Opportunity: Almost daily, headlines emerge regarding concussion in football players, deteriorating mental capacity in boxers, Traumatic Brain Injury (TBI) in soldiers returning from Iraq and Afghanistan and the long-term risk of head impact in the form of Chronic Traumatic Encephalopathy (CTE), dementia, Alzheimer's and Parkinson's diseases. More than 2 million individuals sustain TBI each year, including nearly 200,000 concussed children visiting emergency rooms yearly, totaling $60 billion in costs. The well-known risks associated with concussion have resulted in highly publicized legal action and legislation. The National Football League is currently a defendant in more than 140 lawsuits filed by more than 2,100 former players alleging negligence and failure to inform players of the link between repeated traumatic head impacts and long-term brain injuries. And since 2009, 43 states have passed concussion legislation. While severe TBI are readily diagnosed and treated,

concussions, especially for children, are clinically ill defined. This proposed IMG will fundamentally improve the detection and management of concussion. The products to be commercialized address key gaps in concussion understanding and care by introducing products that establish a new paradigm for clinical assessment, management, and protection.

Project Goals and Objective

Goals: The goals of the project that will lead the team to improve their processes (having broad applicability to a vast customer base), include the following:

- Current manual bite mold methods of customer engagement can be replaced by dental scanning, improving product precision and enhancing patient experience, building off the market success of Invisalign with this approach.
- Manual molds for thermoforming can be eliminated, reducing labor & cost
- Secondary operations can be eliminated and replaced by digital design
- Design features can be incorporated to secure and protect flex circuit instrumentation inserts
- Multiple materials can be employed to optimize a balance of user comfort and circuit protection

Objectives: The team will focus on the following objectives:

- New design rules for electronic circuit design that support FDM fabrication processes;
- New set of FDM printable elastomer materials, spanning a range of hardness, available for similar biomedical and commercial applications;
- New AM fabrication and design guidelines for the secondary operations associated with integrating embedded components;
- Improved software for translating scanned images of biological features into machine tool paths and adaptable secondary operations;
- New structural design rules for integrating flexible electronic circuits into flexible additive manufactured devices
- Expands use of FDM to novel dental application and enables leverage into high value military use.

Improvements In Manufacturing: Upon successful conclusion of this project, the market participants (Sportsguard/SportSafe) will have all the requirements to proceed to scale up and commercialization of custom, instrumented mouth guards for FDM production by RP+M, using flexible circuit inserts fabricated by Valtronic. Also, the rest of the team members will make up a supply chain with new advance capabilities that can be applied to the existing market opportunity in athletics and leveraged to other segments including warfighter protection and clinical support for sufferers of head trauma associated with dementia, Parkinsons disease and other neurological disorders.

Technical Approach

Tasks: Following are the specific steps the team will take to meet the goals and objectives.

1. Develop design parameters and process conditions for incorporation of flexible circuits into FDM-produced parts;
2. Develop FDM design parameters to improve impact resistance of current mouth guards through 3D additive design optimization;
3. Develop a set of medical-grade thermoplastic polyurethane polymers suitable for use in the FDM process; prepare spools of representative grades for use in FDM trials;
4. Develop design rules for 3D scanning of bite patterns to enable direct digital design input to FDM;

5. Optimize the design of current prototype circuits by employing miniaturized components reducing parts count, lowering power consumption and employing additive 3D printed electronics concepts all to make the IMG suitable for incorporation in FDM process;
6. Manufacture pre-production intelligent mouth guards via FDM for use in validation and market suitability testing;
7. Compile all information into a report suitable to support commercialization decisions for intelligent mouth guards and to serve as a design guide for leverage into military, consumer, and industrial markets related applications involving highly functional "smart" components and structures.

Overcoming technical and operational barriers: This project will advance the technology of additive manufacturing through the implementation of secondary processes for circuit incorporation and through the development of a new materials set for the FDM process. The project advances the manufacturing of custom mouth guards, replacing low technology mouth molds, tooling and thermoforming processes with digital imaging and additive manufacturing.

Roles of the Team: The team members have the following roles in the project;

- NorTech – (Program management)
- SportSafe/Safeguard (PI, Face to Customer, manufacturing process and fabrication)
- Cleveland Clinic Foundation (Product validation)
- RP&M (3D manufacturing and process development)
- Lubrizol (3D material development for FDM process)
- AVID (3D additive flexible electronics design)
- Valtronic (3D additive flexible electronics fabrication)
- Linear Dimensions (supply/integration of special electronics)

Experience of the Team: All team members are recognized as innovation leaders in this region with a long history of business success and a majority of the participants have extensive advanced manufacturing experience that includes additive manufacturing.

Management Structure: NorTech will administer the project through its Program Mangers role and SportSafe will provide PI and Project Management services. An advisory committee composed of members of America Makes and 3D additive manufacturing users will be created and integrated into the regular project activities.

Maturity of the Technology/Market Acceptance

This proposal builds on experience from past awards: *"The NAMII-FDM Team will establish a set of business relationships, protocols, and analytical models which will enable efficient development and transition of future multi-functional feedstock materials which hold great promise for a broad suite of applications."*- Proposal No. WRO 374. The present proposal will extend the design rules from this prior proposal to a broadened materials set for FDM, while extending this foundation for FDM to fully functional "smart" subsystems and components.

In general, the technologies that will be incorporated into this project are relatively mature and reside in the TRL 4 to 6 range.

Since this combination of integrated 3D additive manufacturing capabilities represents the next generation of fabrication for future "smart" devices and controls, (supporting concepts like the "internet of things" for example) the long term outlook for the team member business growth is excellent.

Potential estimates of growth in terms of revenue and jobs vary from 20% to 50% over the next 5 years depending on team member opinions.

Projected Impact

Upon successful conclusion of this project, the market participants (Sportsguard/SportSafe) will have all the requirements to proceed to scale up and commercialization of custom, instrumented mouth guards for FDM production by RP+M, using circuit inserts made by Valtronic. This technology can deliver tremendous benefits to young children as well as premier athletes or frontline soldiers, providing direct diagnostic data in real time that can identify when trauma to the brain has taken place or to track the accumulative effects of blows to the head. This provides an excellent example of the use of 3D additive manufacturing to enable commercial realization of embedded electronics in a high value medical device application. The leverage of this advancement into the defense sector is significant as it establishes ground work for realization of wearable embedded sensors that can be digitally fabricated in-field to match the specific needs of the individual warfighter.

This proposal also has a profound impact on federal and commercial supply chains, as it establishes a team of stake holders capable of providing embed electronics into AM generated structures. This capability will open up a broad array of applications within the military and aerospace sectors. Direct leverage to warfighter usage is apparent, for on-person sensing of blast impact on head trauma. The use of AM processes enables singulation and in-field fabrication, both of value in the military arena.

NorTech uses Ohio's Commercialization Framework to manage its projects and, as such, will be establishing and managing the A,B, and C metrics for the project. Beyond the immediate commercial viability, this project positions Ohio manufacturers at the forefront of the use of embedded electronics in additive manufacturing, an advanced capability with profound long-term leverage well beyond the market for intelligent mouth guards. The industrial and consumer implications of embedded "smart surfaces" in customized 3D designs are substantial.

Sustainability

All for profit team members will achieve market readiness by the end of this project with SportSafe have developed the basis for a new business altogether. And because a new supply chain of advanced manufacturing capabilities with broad applicability will be created, any business in the region interested in highly functional integrated systems and devices will be able to leverage these new competitive advantages into their products. As with all of NorTech projects, we will perform a detailed study of the impact on Ohio business that this additive fabrication with embedded 3D electronics will have on the State as a normal course of business. We share the study with the region and use it to monitor progress.

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1/9/2014

Ohio Development Services Agency
Edison Advanced Manufacturing Program LOI
AMP@development.ohio.gov

To Whom It May Concern:

The University of Akron Research Foundation is pleased to provide this Letter of Intent and project overview to submit a proposal related to the Edison Advanced Manufacturing Program 2014.

Respectfully,

Vice President
Akron Research Foundation

Cc:file

- Lead Applicant: University of Akron Research Foundation
- Address: 411 Wolf Ledges Parkway, Akron, Ohio 44311
- Telephone: 330-972-7840
- Contact: Thom Olmstead
- Contact e-mail: tolmstead@uakron.edu
- Proposed project Title: Surface Treatment Platforms
- Estimated Total Cash Cost (12 months): $375,000
- Intended Use of Funds: Production, Research and Development and Sales/Marketing
- Collaborators:

  The University of Akron Research Foundation

  The Timken Company

  The University of Akron

  ECG Enterprises

Problem Statement.

The annual loss to U.S. industries due to friction and wear has been estimated by various sources to be between 2 and 6% of the GDP. With a 2010 GDP of $14.526 trillion, friction and wear losses in the USA range from $291 to $872 billion. Over 70% of these losses arise from mechanical systems using components made from steel alloys. To cite a few examples, the total cost of wear for a single U.S. naval aircraft is estimated to be $243 per flight hour. In normal driving, frictional losses can account for between 10% and 40% of the fuel consumption of a medium-sized vehicle with a two-liter gasoline engine. In the case of engines with optimized combustion processes, the relative friction loss is even higher, which makes it an especially attractive proposition to minimize the friction loss in diesel engines featuring modern combustion processes. In 2014, the global market for automotive coatings related to corrosion and wear is expected to be in excess of $750 million and the global market for energy/oil and gas coatings is expected to be in excess of $900 million. Significant growth is anticipated in the aerospace market as well to accommodate new airlines/airplanes in Asia. Additionally, increased demand for agricultural equipment, medical devices, military corrosion costs, and increased urbanization in Asia (specifically China) as well as growing countries across the globe will contribute to coating demand. There are numerous companies in the State of Ohio that manufacture components and finished goods for the industries and applications noted above. Additionally, there are literally thousands more companies in and outside of Ohio that require solutions related to friction, wear and corrosion.

Project Goals and Objectives.

Akron Surface Technologies (ASTI) is a spin out from the University of Akron Research Foundation and is starting to generate revenues via technology licensed from the Timken Company. The University of Akron's TESL laboratories has created a new coating technology that is in the early stages of testing and modification. That technology is being licensed from the University of Akron to Akron Surface Technologies. This new coating technology has shown great promise to date and the objective is to be positioned to further develop and test that technology and enter the market by the end of Q3, 2014.
Objectives: Generate revenues over the next twelve months via the following:

- Utilize existing technologies and leverage the relationship with Timken
- Secure contracts from companies already targeted and engaged
- Complete Phase 1 of our sales model
- Complete the development of our newest coating technology and go to market with that technology by the end of Q3 of 2014

Schedule:

ACTIVITY	PLAN START	ACTUAL START	EXPECTED COMPLETION
Revenue generation utilizing existing technologies	Oct-13	Oct-13	Ongoing
Sci-containing Diamondlike Carbon Coating			
In-Lab Development	Aug-13	Aug-13	Feb-14

In-Lab Testing	Oct-13	Nov-13	Feb-14
Initial Field Testing - Independent Party	Nov-13	Nov-13	Jan-14
In-Lab Formula Modifications	Feb-14		Apr-14
Phase 2 Field Testing - Independent Party	May-14		Jul-14
Formula Design Freeze	Aug-14		Aug-14
Limited Market Launch	Sep-14		Sep-14
Full Market launch	Dec-14		Dec-14

Proposed Use of Funds:

	Project Funds
R&D	$125,000
Supplies	$50,000
Equipment	$200,000
TOTAL	$375,000

It is expected that lab, internal testing and material expenses will require approximately 46% of the requested funding. Purchased Services in the form of third party independent testing approximate 35% of the requested funding. Approximately 54% of the requested funding will be allocated to machine equipment, fixtures and maintenance.

Technical Approach and Work Plan

ASTI has access to the University of Akron's TESL Laboratory for research & development as well as product testing and modification. The TESL Lab has short run production capabilities that ASTI can utilize. ASTI has a production facility for coating medical devices in Stow, Ohio. The building where the facility is housed is owned and provided by the National Machine Company. ASTI has access to a wide range of resources at the University of Akron and UARF. These include but are not limited to: legal and patenting services, grant writing services, contract support, operational support and human resources.

Management Team

Thom Olmstead is the President and CEO of ASTI. He gained his executive leadership expertise in the biomedical space, including roles with Mill-Rose Laboratories where he served as General Manager/President and was responsible for the sale of Mill Rose to C.R. BARD, where he served as Director of Marketing. At BARD he was responsible for the integration of the Mill Rose portfolio of technologies into the US and foreign markets. Following Mill Rose, he served as Vice President of US and international sales and marketing at Vision-Sciences headquartered in Boston MA. Subsequently Mr. Olmstead joined Cleveland Clinic Innovations as Senior Business Development Manager and was the co-founder of Navis Medical Corporation in that role. Most recently he served as Director of Business Development and Technology Assessment at the Austen BioInnovation Institute in Akron. He has distinguished himself in executive management and has extensive experience in sales, marketing,

operations, manufacturing, business development, technology development and commercialization in both domestic and global markets.

Dr. Gary Doll is ASTI's Chief Technical Officer and the Timken Professor of Surface Engineering and Director of the Center for Surface Engineering and Lubrication Research at the University of Akron. He received his Ph.D. in Condensed Matter Physics from the University of Kentucky and was a postdoctoral fellow in Physics at the Massachusetts Institute of Technology. After MIT, he joined the General Motors Research Laboratories where he began his research in thin film coatings, surface engineering, and tribology. Later, he became the Chief Technologist of Tribology at the Timken Company where he was responsible for global research and development activities in bearing tribology, lubrication, surface engineering, and non-ferrous materials. Over his career, Dr. Doll has published over 150 articles and book chapters, edited four proceedings, and received more than 25 US Patents.

Dr. Ajay Mahajan is the Associate Dean for Research in the College of Engineering at the University of Akron and was just recently named as the Vice president of Innovation at the University. Dr. Mahajan received his Ph.D. and M.S. both in mechanical engineering from Tulane University in New Orleans and serves on the ASTI Board of Directors.

Thomas Stimson was most recently Vice-President of the Technology Advancement & Operations-Bearing and Power Transmission (BPT) business group at The Timken Company. His responsibilities included coordinating Technology for Strategy and Planning across the Timken Engineering Stream. Mr. Stimson is a member of the ASTI Board of Directors.

Wayne Watkins serves as Associate Vice President for Research at UA, Adjunct Professor and Intellectual Property Fellow at the UA School of Law, and Vice President of UARF. Mr. Watkins directs UARF programs in intellectual property management, emerging enterprise creation and support, technology-based economic development, and university/industry collaborations. He currently serves on several boards of directors and is a member of the ASTIs Board of Directors.

Kenneth Preston serves as Associate Vice President for Research and Director of Technology Transfer for UA, as well as the Vice President & Executive Director of UARF. Prior to his roles in university research, Mr. Preston served as Vice President, Senior Counsel and Chief Patent Counsel for TRW, Inc., a Cleveland and Los Angeles-based, worldwide manufacturer and marketer of defense, aerospace, electronics, information and automotive products and services. Mr. Preston is a member of the ASTI Board of Directors.

Maturity of the Technology/Market Acceptance

Akron Surface Technologies Inc. (ASTI) is a start-up Company born out of the collaboration between the University of Akron Research Foundation (UARF) and the Timken Company. Incorporated in the State of Ohio and located in Northeast Ohio, ASTI was initially created to commercialize vetted and superior engineered surface technologies and expertise from the Timken Company to markets and market applications outside of Timken's core competencies and target markets. ASTI has licensed from the Timken Company, valuable, well proven, yet underutilized surface engineering technologies that are generally acknowledged as superior to other surface engineering solutions and unmatched in the marketplace. There is significant demand across numerous industries and applications for our coatings

ASTI will focus on producing and selling these solutions directly to Timken, Timken's customers, and others. Because of Timken's focus on its core technologies of bearings and gears, its recently announced split into two separate companies and changes in executive management, Timken has elected to utilize ASTI to meet some of its coating needs with the expectation that over time ASTI will grow into a primary supplier of coatings for Timken. In fact ASTI is already generating revenues from Timken for coatings related to research and prototyping. In addition to its licensed technology, ASTI's entry into existing and new markets will be enhanced through the creation and licensing of new intellectual property from the University of Akron's TESL Labs. This includes the development and recent provisional patent filing of the Labs' first new coating technology. Leveraging its strategic relationships with both the University of Akron and Timken, ASTI is poised to accelerate the commercialization of its existing and new coating technologies.

Projected Impacts.

Our current technologies and those in our development pipeline provide significant reductions in wear and corrosion of metal and other surfaces beyond what exists on the market today. Applications include equipment and materials used in the manufacturing/production process as well as finished goods. In addition to a reduction in maintenance/replacement costs, reductions in wear and corrosion, provide an opportunity for manufacturers to use less expensive materials in their processes and finished products. Our current technologies have applications across numerous markets and companies that have a presence in Ohio, including but not limited to: mining, aerospace, agriculture, transportation, wind energy, medical imaging, food processing, aggregates and oil and gas.

Sustainability.

In summary, we have started to generate revenues via our licensed Timken technology. Additionally, we expect our newest technology to be launched by the end of Q3, 2104. In addition to current revenues to support the Company, we are aggressively pursuing non-dilutive and dilutive capital from a variety of sources, including UARF, the State of Ohio, the City of Akron, SBIR and private equity.

College of Polymer Science and Polymer Engineering
Goodyear Polymer Center
Akron, OH 44325-3909
(330) 972-8594 Office
(330) 972-5290 Fax

AMP – 14 – 12

Ohio Department of Development
Technology and Innovation Division
77 South High Street
25th Floor Columbus, OH 43215

Subject: Edison Advanced Manufacturing Program LOI

Dear Sir or Madam:

Please accept this Letter of Intent from The University of Akron and The Austen Bioinnovation Institute in Akron for our Edison Advanced Manufacturing Program proposal. The relevant information about our proposal is as follows:

Lead Applicant Name:	The University of Akron 102 Buchtel Avenue Akron, OH 44325
Contact Person:	Matthew L. Becker, Ph.D. The University of Akron College of Polymer Science and Polymer Engineering Akron, OH 44325 (330) 972-2834 becker@uakron.edu Austen Bioinnovation Institute in Akron Center for Biomaterials in Medicine
Proposed Project Title:	Advanced Roll to Roll Manufacturing of Functional Nanofibers and dECM Hybrids
State Funds Requested:	$500,000
Collaborators:	SNS Nanofiber Technologies, Hudson, OH Viscus Biologics, Dayton, OH
Intended use of funds:	Support manufacturing innovation and advanced roll to roll manufacturing methods transfer to industrial partners

Sincerely,

Matthew L Becker, Ph.D.

Advanced Roll to Roll Manufacturing of Functional Nanofibers and dECM Hybrids

PROBLEM STATEMENT

This proposal will focus on overcoming product enhancement and manufacturing barriers through partnerships with Viscus Biologics, SNS Nano Fiber Technology and The University of Akron.

Advancing medical grade polymer nanofiber-based substrates to clinical trials and products has traditionally required that the bioactive peptide, protein or drug species be incorporated into the polymer prior to the fabrication process. This requirement has several disadvantages with regard to cost, versatility and sterilization. In addition, the changes imposed to the polymer solution characteristics by the bioactive component requires repetitive formulation and optimization with each new bioactive group, fiber diameter and product application. Each of these is a significant barrier to overcoming regulatory hurdles and commercialization.

The University of Akron has developed novel chemistries for the synthesis of end-functionalized, degradable polymers, novel roll to roll processing and electrospinning techniques that enables the spatially-resolved variable formulation of fiber diameter, fiber density and surface concentration methods within a single substrate and allows the production of complex xenograft polymer composites. When coupled with the end-functionalized biodegradable polymers that enables incorporation of peptides, proteins and other useful elements, our research team possesses a suite of materials and technologies that overcome these technical barriers. These technologies have been disclosed and protected by provisional patent applications. The proposal will focus on the optimization of the electrospinning process into a roll to roll manufacturing process that will suit the needs of Viscus Biologics LLC and SNS Nanofiber Technology. This innovative strategy minimizes the changes necessary to the manufacturing process while enabling facile diverse functionalization strategies that provides differentiation and competitive advantages with respect to competitors.

PROJECT GOALS AND OBJECTIVES

This proposal will focus on overcoming product enhancement and manufacturing barriers with our industrial partners partnerships. Using the post electrospinning functionalization with the roll to roll deposition and continuous manufacturing approach, the resulting medical grade materials can be produced in a reliable, cost effective manner.

For SNS, the post-electrospinning functionalization overcomes the changes imposed to the polymer solution characteristics by the bioactive component requires repetitive formulation and optimization with each new bioactive group, fiber diameter and product application. Each of these is a significant barrier to overcoming regulatory hurdles and commercialization.

For Viscus Biologics, the fiber deposition methodologies will mechanically reinforce the materials as well as facilitate the attachment of proteins or peptides to decellularized xenograft tissue using roll to roll methods. These methods offer solutions to the problems of rapid degradation and limited mechanical properties. The development of families of functionalized xenografts with well-defined properties and attachment sites using robust chemistries would allow the rapid development of new functional xenograft products. These technologies will greatly increase the clinical utility and versatility of xenograft tissues.

We project that successes associated with this proposal will generate >15-25 jobs in Ohio and >$20M in annual sales at the end of the 3-year project period.

TECHNICAL APPROACH AND WORK PLAN

The University of Akron team will utilize novel chemistries that facilitate the attachment of proteins or peptides to nanofiber mats and meshes currently being produced and sold by SNS NanoFiber Technology. The chemistries will interface with current materials, processes and sterilization technologies. These traits will lead to rapid production of new, highly functional materials that can be sold with pre-attached peptides or proteins or drugs or "as is" to be further functionalized by end-users customers or clinicians. The development of families of nanofibers that can be functionalized on site, where needed would allow the rapid development of many new nanofiber-based products.

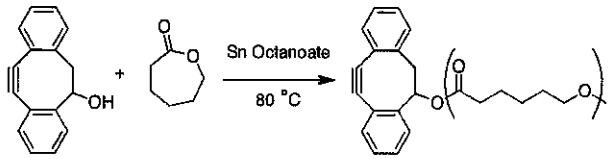

Figure 1. A 4-dibenzocyclooctynol is able to initiate the polymerization of lactic acid, glycolic acid and (e-caprolactone) shown above. Following an electrospinning process, the fiber mats can be functionalized with peptide or proteins using conditions that are atom neutral and require no external catalyst. Below we show the derivatization of PCL nanofibers with azide-functionalized gold nanoparticles as a visual demonstration.

Recently, researchers at The University of Akron have developed a polymerization method utilizing 4-dibenzocyclooctynol (DIBO) as an initiator for the ring-opening polymerization of ε-caprolactone, benzyl protected L-glutamic acid and lactic acid which yields end-functionalized polymers (**Figure 1**). The DIBO group survives the relatively mild polymerization conditions and offers efficient, orthogonal and biocompatible functionalization opportunities with azide bearing molecules. The incorporation of DIBO at the polymer chain end enables large-scale production of new types of easily functionalizable nanofiber-based scaffold with versatile regenerative medicine applications. This will enable attacheing any number of bioactive species to the nanofiber mat without altering the manufacturing process in any way. This is a stunning new approach to creating functional nanofiber based products that will enable accelerated development and significant reduce the development costs and infrastructure required to generate different products.

Additionally, there is broad usage in the biomaterials world of bioresorbable polymers and important commercial applications continue to emerge. An increasingly relevant problem is that these materials do not accurately recapitulate the properties of native tissue. Combinations of resorbable polymers with xenografts have been contemplated for some time but the disparity of the technologies needed to manufacture such combinations in one organization has limited their development.

The assembled team has all the expertise needed to significantly impact this market now through innovative products that address unmet needs in health care. The University of Akron (UA) has an established, internationally-recognized expertise in polymers, biomaterials, and engineering. UA will lead the development of the advanced roll to roll functionalization, characterization and manufacturing efforts. The combination (chemical or physical) of polymeric materials with xenograft tissue will lead the partners (especially Viscus and SNS Nano, supported by U Akron) to develop suites of new materials with broad commercial application.

MATURITY OF THE TECHNOLOGY/MARKET ACCEPTANCE

The market for Tissue Engineering and Regenerative Medicine is a highly competitive, but rapidly changing space, with over 50 manufacturers selling over a 100 different products. Our analysis of this space offers numerous opportunities for entrepreneurial companies to offer innovative products, since growth in this space largely occurs from mergers and acquisitions. Major manufacturers include Medtronic, Cook Medical, Lifecell, W.L. Gore and Integra and the size of the potential market for these products has been estimated to be worth over $20 Billion Dollars for wound care alone.

Viscus Biologics business model is predicated upon inventing, developing and manufacturing allografts and xenograft materials. We do not sell to the marketplace directly, but rather through relationships with large multinationals who have the marketing size and scope to effectively market their products. They are in late stage discussions with several of these partners and expect to close deals in Q1 2014, prior to filing the first 510(k) s of our initial surgical products. We expect these partners to be equally interested in second generation products utilizing combinations of xenografts and polymers.

The current capabilities of SNS Nano focus mostly on the design & development of products and the manufacturing of medical device components. In the near future (2nd quarter 2013), SNS will have fully implemented the requirements for QSR and be able to also manufacture the final products for use in the medical field. At this point, the plan is to have distributors or partners handle the marketing and selling of our medical products.

PROJECTED IMPACTS

The envisioned products include medical and antimicrobial materials for wound healing, advanced hemostats and nanofiber-based products for bandages, dressings and hernia repair.

Viscus Biologics anticipates growing its work force in Ohio over the next three years. We have recently (Jan 2013) relocated our headquarters from Cleveland to Dayton to be close to our processing center. We lease this space from Community Tissue Services, together with technical support including personnel. We anticipate Viscus hiring needs over the next three years to be in the range of 5-10 people, all based within the Dayton facility. Additionally, we expect that the hiring needed by CTS to support our processing needs will require further hiring in the range of 5-10 people. The hiring by Viscus will be at the college or graduate level (engineers, scientists and regulatory processionals) while the majority of the hiring at CTS on our account will be at the technician level. We believe that participation in the program could lead Viscus to an additional $5-10M in incremental revenue growth over the course of the grant period.

SNS envisions adding 2-6 employees over the next 3 years to assist in the R&D efforts related to the project, all based at their facility in Hudson, Ohio. Additionally, if the products are successful, another 8-12 production jobs would be added as well. Depending on the type of market entry, 3-5 sales positions could be needed. SNS would anticipate an additional $5-10M in new revenues.

Viscus Biologics projects the sales of xenograft-based decellularized tissue products will combine the advantageous properties of decellularized tissue and polymer nanofibers to impact 3 distinct markets: Military, Civilian and Pediatric

SNS will produce nanofiber products from a variety of DIBO functionalized polymers. Degradable polymer nanofibers will be developed for use as peptide functionalized degradable burn dressings, hernia meshes, and wound dressings. In addition a "Universal NanoMat" for on demand functionalization will be developed. These products will impact the military and civilian (adult and pediatric) markets.

SUSTAINABILITY

Viscus Biologics LC is a joint venture established in 2012 between Proxy Biomedical Ltd (Galway, Ireland and Cleveland Ohio) and a confidential large player in the food market. Proxy has revenues in the range of $5-$10M while the other owner has revenues in the $500M-$1B range. Viscus Biologics anticipates a small operating loss of ~$1M in 2013, becoming profitable thereafter. They project revenues in the $12-15M within three years.

SNS Nanofiber Technology has a reliable source of private funding. The parent company, Schill & Seilacher has been in business since 1877. They also have a sister company, Struktol Company of America located in Stow, Ohio. Struktol expects that SNS Nano will need substantial funding for growth over the next several years, and they are more than adequately prepared to fund such growth. SNS Nano has no liabilities other than inter-company debt.

Significant intellectual property (IP) exists at The University of Akron covering the functional polymers to be utilized in the envision products and advanced Roll to Roll processing and manufacturing. The IP developed on the project will be managed by The University of Akron Research Foundation. IP will be shared as appropriate, protected, licensed and leveraged to achieve maximum commercial value. Despite their age and relative size, SNS Nano Fiber Technology and Viscus Biologics have each independently demonstrated strong and reliable development and manufacturing capabilities, commitment to Ohio and the ability to market and distribute products nationally and globally.

AMP – 14 – 13

BioOhio

January 13, 2014

Office of Technology Investments
Ohio Development Services Agency
77 South High Street, 28th Floor
Columbus, Ohio 43215
614.466.3887

Re: Edison Advanced Manufacturing Program Submission (AMP) FY 2014 Letter of Interest:

Dear DSA:

This letter is intended to serve as our Letter of Interest to submit a proposal for the FY 2014 Edison Advanced Manufacturing Program (AMP).

We are seeking funding to build a technology infrastructure for a system designed to help manufacturing firms in the state quickly and effectively select and identify candidates for entry-level roles in manufacturing areas such as production, packaging, and warehouse/distribution. This intellectual property based cluster set and tool will be accessible by Ohio manufacturers and will accelerate the filling of appropriate skilled people for the companies open manufacturing jobs, increasing manufacturing output and efficiencies and increase the retention of productive employees.

Lead Applicant and Collaborators
BioOhio is the lead applicant. John F. Lewis Jr., BioOhio President & CEO will serve as the project lead. 1275 Kinnear Rd., Columbus, OH 43212. 614-675-3686. jlewis@bioohio.com.

BioOhio, for 26 year has been an Ohio Thomas Edison Center and from 2010-2012 a designated National Institute of Standards and Technology, Manufacturing Extension Partnership (Ohio NIST MEP Center), has the mandate to catalyze and support the development of a world class bioscience industry in the state of Ohio. BioOhio through its 430 members, extensive contacts within the state of Ohio and globally and its other services will help accelerate the commercialization and market entry for this new product.

For this program, we will be collaborating with Taylor Strategy Partners (TSP), a talent acquisition and management consulting firm based in Columbus. For more than 40 years TSP has provided a unique combination of business consulting and talent acquisition management, enabling clients in the life science industry to identify and retain the best human capital. Key TSP personnel in the development of this program include Mickey Shimp (President); K.C. McAllister, (EVP, Business Operations); and Chad Thompson, Ph.D. (Managing Director, Consulting & Assessment Practice), an Industrial/Organizational Psychologist with expertise in testing and selection who will serve as the main technical expert.

We plan on testing at least 1,000 current Ohio employees to form the core data set for analysis. Our collaborators for this have not been finalized but those that have expressed initial interest include, Midmark, NAMSA, Aptalis, Meridian Biosciences, Neoprobe, Cardinal Heath, Astro Manufacturing, Sparton Medical, Johnson & Johnson (Ethicon Endo Surgery), STERIS, Boehringer Ingelheim (Roxane Labs) and more. This is a statewide effort.

Total Cash Costs
To fund this project, we are seeking an investment of $275,000 over 18 months.

3.3.6 Proposal Narrative

Problem Statement. Our efforts will be focused on the development of an assessment system designed to measure the critical knowledge, skills, abilities, and personal characteristics (KSAPCs) required for success in entry-level manufacturing roles (e.g., production, packaging, warehouse/distribution) within bioscience manufacturing in Ohio. BioOhio and TSP have a significant, in-depth understanding of customer needs in this area. BioOhio has conducted extensive market research, including a statewide workforce and training needs survey in 2011-2013 along with 58 in-person interviews in 2013 with members where manufacturing talent issues were specifically explored. Finding the right skilled talent for these companies various manufacturing positions was their #1 barrier to growth.

Project Goals and Objectives. Creation of an entry level manufacturing data set, allowing companies access to this data set, thus allowing Ohio companies a competitive advantage to better select candidates who have the knowledge, skills, abilities, and personal characteristics required to effectively fill open positions.

The companies interviewed (some will be our collaborators on this project) nearly all were excited when BioOhio described an Ohio bioscience manufacturing based cluster set, accessible for a fee, which would show the profile of a "high performing employee" versus a "lower preforming employee" from a behavioral and statistical perspective. Each company explained this would achieve greater manufacturing efficiencies, greater manufacturing productivity and achieve greater retention of their employees.

Technical Approach and Work Plan. Discuss the overall activities that are proposed in order to meet the project's goals and objectives. Specify in detail how and by what methodologies the technical or operational barriers will be overcome. Discuss the composition and specific relevant experience of the team that has been organized, the roles of team members and the management structure that will be used to conduct the project.

Participant Identification. Developing an assessment specific to the requirements for entry-level manufacturing and distribution positions within the biopharmaceutical industry requires primary research. The first step in building this custom assessment is to identify individuals

and companies who will volunteer to allow us to collect data about their incumbents and managers.

Draft Item Development. Since this assessment is being custom-developed from scratch, writing test items to measure the key competencies will be necessary. This initial list of items will include situational judgment, biodata, and more to provide the broadest possible set of measurable items. This list will become the "validation version" of the assessment. Additionally, performance rating items (to be completed by managers) will also be created.

Data Collection. Three distinct groups of data need to be collected from people who participate in the development of the assessment. For incumbents, ratings will be collected regarding a) the importance of various competencies in their jobs and b) their answers to the questions on the validation version of the assessment. Their managers will also provide c) performance ratings. We will use TSP's Talent Assessment and Reporting Platform to collect all of these data online.

Data Analysis. The goal of the data analysis will be to construct an assessment that maximizes the prediction of performance in the role. A number of different statistical techniques will be employed to construct the assessment, with special emphasis paid to test fairness and utility.

Programming Final Tool and Reporting. In this phase, the final version of the assessment and associated reporting will be programmed onto the BioOhio/TSP Talent Assessment and Reporting Platform.

Dr. Thompson will lead the technical work described above. Dr. Thompson has ten years of experience developing testing solutions across a wide variety of roles and industries. Prior to his work at TSP, Dr. Thompson led a similar test development effort spanning multiple companies while employed at a leading international human resources consulting firm.

Maturity of the Technology/Market Acceptance.

As part of an overall evaluation of how BioOhio can best serve its membership, BioOhio executives conducted interviews with dozens of members. The need to identify talent was among the top areas of concern uncovered during these sessions. These companies were even more interested when presented with the concept of an entry-level assessment focused measuring key competencies required for success in bioscience manufacturing. As a result, we believe the market is clamoring for such solution because company after company were asking for it. Thus we know market acceptance will be strong.

By some estimates, personality testing is a $500 million dollar market. There are a wide variety of broad, "generic" tests available for purchase. In the last 15 years, the overwhelming trend has been for administration to be done over the internet. As a result, the technology required to support test administration is well-known and understood. Our solution is unique when compared to the existing market in two key respects. First, our assessment will be created specifically to predict success in bioscience manufacturing jobs. Secondly, by collecting data first on BioOhio members, we will be able to tell companies how a candidate stacks up to a relevant labor market (e.g., bioscience manufacturing candidates in Ohio).

Projected Impacts.

This project is important because it will help companies meet one of their most pressing challenges – identifying and retaining key talent. We will work with 5-10 collaborating companies from the likes of these BioOhio member companies below. In year two, other companies among the more than 1,000 bioscience companies in Ohio will have access to this tool.

Companies who utilize our assessment solution will benefit from increased efficiency in their pre-hire process and hire employees who are more productive, turnover less often and work more safely.

The success of this project can be judged through several different metrics. First, follow-up studies with users can demonstrate a return on investment based on reduced turnover and accidents and increased production efficiency. Additionally, the number of companies using the assessment tool, the total number of candidates assessed, and the total number of jobs filled using the tool are also objective metrics. We project more than 275 jobs being filled during year two, after the Programing and Final Tool is complete.

- Abbott Nutrition
- Affymetrix
- Alkermes
- American Medical
- AMRESCO
- Amylin (BMS/AZ)
- Aptalis Pharma
- AssureRx Health
- Astro Manufacturing
- Athersys, Inc.
- AtriCure
- Battelle
- Bionix
- Cardinal Health
- ChanTest
- Charles River
- CAS
- Cleveland HeartLab
- Cleve Med Devices
- ClinicalRM
- CTI Clinical
- DG Medical
- Quidel
- E-BEAM Services
- Ethicon Endo-Surgery
- Frantz Medical Group
- Gebauer Company
- GFS Chemicals
- IMDS
- Interplex Medical
- Kuss Filtration
- Medpace, Inc.
- Meridian Bioscience
- Midmark Corporation
- Morris Technologies
- Mound Laser
- NAMSA
- Navidea
- NITTO DENKO
- Novella Clinical
- Oakwood Labs
- Omnitek
- OrthoHelix Designs
- Otsuka
- PharmaForce
- QED
- Ricerca Biosciences
- Roxane Laboratories
- Smithers Rapra
- Sparton Medical
- STERIS
- Stress Engineering
- Teva
- Valtronic
- WILResearch

Sustainability. Companies throughout Ohio will continue to hire talent in manufacturing and distribution, both to backfill employees who turnover and expand their operations. At the end of the work described in this letter, an assessment will be available online and be ready to be deployed. Initial users will include our development partners and the technology platform is quickly scalable to accommodate an unlimited number of users.

Within two years of project completion, we anticipate having at least twenty companies actively using the assessment, driving at least $250,000 per year in revenue.

AMP – 14 – 14

Edison Advanced Manufacturing Program 2014

Letter of Intent (LOI)

Lead Applicant:

- Name: EWI
- Address: 1250 Arthur E. Adams Dr, Columbus, OH 43221
- Contact Person: Chris Conrardy, VP and CTO
- Contact Person Phone: 614.688.5191
- Contact Person Email: cconrardy@ewi.org

Project Title: Structural Connection Performance Simulation and Testing

Estimated State Funds to be Requested:

- State Funding: $500,000
- Industry Cost Share: $500,000

Intended Use of Grant Funds:

- Labor: $40k
- Equipment / Materials: $230k
- Subcontracts: $230k (Ohio Supercomputer Center)

Collaborators:

- The Ohio Supercomputer Center (OSC)
- Honda R&D Americas
- Select Arc, Inc.

Period of Performance:

- May 1, 2014 – April 30, 2016

Program Summary:

The project consists of developing an integrated platform for evaluating the performance of candidate welded automotive components and other structural connections. The work takes advantage of the complementary, market tested, capabilities provided by EWI and OSC. EWI will acquire additional material testing capabilities to augment existing capabilities. This equipment will be used to characterize the properties (e.g. strength, fatigue, impact, etc.) of both individual welds (with the aim of defining stack-up/process failure criteria) as well as full component subassemblies. EWI's expanded testing capability will be made available to industry on a fee-per-use basis and for proprietary client-funded projects in line with EWI's existing business model. Select Arc, an Ohio manufacturer of arc welding consumables, will utilize these expanded testing capabilities.

EWI will also apply its expertise in prediction of welded automotive assembly performance as a baseline for defining the framework for the evaluation protocols to be implemented as part of this program.

OSC will supply its considerable experience in high-performance computing application implementation to develop specific component platforms. Utilizing the domain expertise at EWI and the capabilities of OSC's AweSim program, modeling and simulation (M&S) workflows related to weld testing will be converted into web-based 'apps' that are able to directly utilize data generated by the testing equipment to virtually test variations structural connections. These platforms will be accessible by individual component designers, and (along with the testing available at EWI) facilitate "virtual" product performance evaluations, reducing design times and costs. Honda will partner with both EWI and OSC to define candidate applications for evaluation (from their supply base), as well assure that the approaches taken are consistent with Honda's internally developed approaches.

Problem Statement:

Structural connections are designed to meet performance requirements for specific applications (e.g., load, impact, collision, fatigue). Implementing new connection designs, materials, and manufacturing methods often requires very expensive and time consuming prototyping and testing. This has become a serious problem as companies drive to reduce product development timelines and costs.

A number of prominent studies indicate that modeling and simulation (M&S) is critical to the competiveness of U.S. industry. Benefits include reduced product development time, creation of higher quality products and faster time to market. Effective M&S still relies on some physical testing to provide empirical data necessary for refining the simulations and to validating the results. Large companies use M&S not only for solving very large and complex problems more quickly, but also for devising new approaches to previously unsolvable problems. Yet, the ability to access M&S is still outside the reach of many small and medium sized manufacturers (SMMs). The benefits remain unattainable for these companies due to high equipment and software costs and limited staff skills.

For example, over the last few years the automotive industry has been developing enhanced methods of predicting crash worthiness of structural components. A key aspect of these approaches has been the ability to integrate weld failures in full vehicle crash models during impact/quasi static loading. Such failure models take advantage of the combination of loads predicted in simulations using commercial software (such as LS-DYNA), and estimate combinations of these loads, which result in component failure. These failure criteria are an empirical construct, and must be independently developed for each stack-up and weld size in the vehicle. State of the art for this technology is practiced by a number of very large automotive manufacturers. That state of the art includes data-basing failure criteria for specific metal stack-ups and joining processes, providing intermediate scale validations of these failure criteria, and use of numerical simulation software (such as LS-DYNA) for prediction of large components and assemblies. Such activities require intensive and specialized mechanical testing, as well as a large-scale computational capability.

Extension of these approaches to SMMs provides similar opportunities for product optimization and testing cost reduction as seen at the OEM's. These companies often lack the equipment, staff skills, software, and computational capability to take advantages of these approaches. SMMs are often caught between demands of their customers for better component performance data, and a lack of capital to invest in the advanced technology necessary to compete.

Project Goals and Objectives:

This project will implement a service offering for evaluating the performance of welded structural sub-assemblies paralleling the empirical weld failure criteria/ LS-DYNA methods state of the art at the major automotive OEM's. This will be done through; (1) providing a testing capability proficient of providing performance data on necessary welded connections; (2) creating a series of numerical analysis platforms both for defining performance of individual selected welds, as well as individual components of interest, and; (3) providing testing capability in both static and dynamic modes for verifying predicted performance at both the subassembly level.

This will result in a full service capability allowing analysis of candidate component designs over a short time period with a minimum of investment. The effectiveness of the approach will be demonstrated to attract the clients necessary for a self-sustaining service offering.

Technical Approach and Work Plan:

Work in this program will focus on the implementation of Ohio SMM accessible testing capabilities and predictive software simulation tools for evaluating the performance (both static and dynamic) of candidate component designs. EWI will work with Select Arc and Honda of America to identify additional mechanical testing and materials characterization capabilities for implementation.

EWI and OSC will also work with Honda of Americas to identify up to six future components at Ohio based SMM's. These components should be a representative sample of the range of assembly size, materials, material thicknesses, and joining processes of interest for a roughly 5-year timeframe. The candidate components will then be used as the basis to assess stack-ups and joining technologies (e.g., gas metal arc welding, laser hybrid welding) of interest. Based on this preliminary analysis, necessary individual joint testing capabilities will first be acquired and made available. In addition, mechanical deformation modeling platforms will be prepared to allow generation of comparative data matching the testing approaches for the individual welds. The combination of these approaches will act as a methodology for prediction of weld failure criteria over the range of applications of interest.

The approach will also include development of capabilities for intermediate and full-scale design evaluations. This will include welding and mechanical testing capabilities suitable to address the range of applications of interest. Testing must cover appropriate loading modes and deformation rates as required by the component intent. Also, LS-DYNA platforms appropriate for the scale of the defined components will also be prepared. Initially, the outputs from the full simulations will be compared to mechanical properties data for validation. Successful demonstration of these platforms will then be used as the basis for developing component adaptable interfaces allowing easy access and application to new generations of components from SMM's.

The work will also include both outreach and technology transfer activities for the implemented methodologies, to make Ohio industry aware of the new capabilities available to them. Availability of a supportable methodology, as well as continued outreach to the manufacturing community will serve as the basis for developing sustainable support for the capabilities assembled in this program.

Maturity of the Technology / Market Acceptance:

EWI has a highly competitive, ISO certified mechanical testing service, performing thousands of tests for clients annually. EWI is also experienced in developing both test data and tools for crash modeling for automotive manufacturers. The tools described for implementation as part of this program are state of the art at many large manufacturers. EWI and OSC have a unique capability to bring these solutions to the entire supply chain. The proposed project will build upon this market tested service to create new capabilities for testing structural connections in conjunction with OSC's AweSim M&S capabilities.

OSC brings unique high-performance computation and interfacing capabilities to make the developed methods accessible for candidate designed components. For example, in 2007 EWI and OSC launched an online weld simulation tool that offers improved productivity and profitability to EWI's thousands of member companies. Tested by over 500 engineers worldwide, there are currently more than 1,160 users. The award-winning and patented EWI Weld Predictor app incorporates the specifications required for a detailed simulation of a gas-metal arc weld including the geometry, material properties and welding procedure.

Projected Impacts:

The National Center for Manufacturing Science (NCMS) reports that access to effective predictive simulation technologies can reduce product design cycles by as much as 66%. They report that although 75% of small manufacturers saw advantages of such simulation tools, the cost of implementing these software tools and attracting the right caliber of employee to operate and validate them is prohibitive. The combination of these requirements can often push the cost of entry to these high-end tools outside the budget of SMMs and engineering firms as the annual investment required can run into hundreds of thousands of dollars. The proposed project will create a service offering to allow Ohio companies of all sizes to access high-impact component modeling, testing, and validation capability.

Sustainability:

Numerous program income sources will ensure sustainability. EWI is sustainable based on fees for testing and proprietary projects. EWI will charge industrial clients for the subject matter expertise and testing required to successfully take advantage of component modeling tools. The expanded testing capabilities will also be useful for a wide range of industrial applications beyond automotive component evaluations, such as testing of welding consumables for Ohio manufacturers.

Additionally, EWI and OSC will charge fees for national use of the M&S capabilities after completion of this project. OSC ensures sustainability through a number of complementary programs, including its state-funded AweSim project. As previously mentioned, an existing prototype app, the EWI Weld Predictor, has produced approximately 1,500 app runs over the past two years. This type of usage could create an ongoing revenue stream to maintain and expand the M&S toolkit.

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EWI
We Manufacture Innovation

1250 Arthur E. Adams Drive, Columbus, Ohio 43221
614-688-5000 • ewi.org

Edison Advanced Manufacturing Program
Letter of Intent (LOI)

Lead Applicant:

- Name: EWI
- Address: 1250 Arthur E. Adams Drive, Columbus, Ohio 43221
- Phone: 614-688-5000
- Contact Person: Chris Conrardy, VP and CTO
- Contact Person Email: cconrardy@ewi.org

Proposed Project Title: Implementation of Advanced Formability Services for Lightweight Vehicle Structures

Estimated State Funds To Be Requested: $400,000

Collaborators:

- Honda R&D
- KTH Parts
- Shiloh Industries
- Ohio State University

Intended Use of Grant Funds:

- Labor: $170,000
- Purchase of equipment and materials: $180,000
- Subcontracts: $50,000 (Machine shops and Ohio State University)

Summary of the Proposed Project

Problem Statement:

Today, the automotive industry is challenged to produce vehicles with high-customer appeal, improved crash performance, reduced fuel consumption and reduced carbon dioxide (CO_2) emissions to meet the market demands and increasingly stringent government regulations. One of the few enabling technologies to help automotive industry meet these multiple challenges is *lightweighting auto body structures*. The automotive industry is increasingly adopting lighter and stronger sheet materials such as ultra-high strength steels and aluminum alloys to achieve these goals.

The increasing use of these materials presents significant technical and financial challenges for Ohio stamping companies, since new metal-forming technologies are often required. Materials formability test standards are also inadequate for these less-familiar materials. This lack of formability data has significant business impacts: increasing scrap, production downtime, and production engineering costs to adjust production processes to the incoming materials.

Ohio is currently the top automotive supplier in the U.S. and holds 19.5% of the automotive stamping market, valued at $4.3B. Ohio suppliers will keep or increase market share if they gain practical knowledge of how to use these lightweighting materials effectively in their product designs.

To successfully form lightweight vehicle structures, the industry is seeking practical knowledge of forming processes and tooling designs for these new emerging materials, including:

- Practical testing methods to evaluate formability
- More accurate prediction capabilities with reliable failure criteria based on the formability test data

To respond to these urgent needs, with the collaboration of the Ohio State University (OSU), and three Ohio based automotive industry partners, EWI proposes to develop a unique formability testing capability in order to provide testing services to Oho industry.

Project Goals and Objectives:

The objective of this project is to implement a formability evaluation methodology for lightweight sheet metals, enabling us to assess material formability for practical industrial applications. Upon completion of this project, the formability evaluation methodology will be immediately available to the industry as a self-sustaining service.

Technical Approach and Work Plan:

The technical approach to achieve this objective includes the following tasks: (1) procure equipment, tooling, and materials, (2) evaluate formability testing methodology, (3) demonstrate with industry example parts, (4) launch formability testing service.

Maturity of the Technology/Market Acceptance:

The program outlined in this proposal will apply known principles to implement practical formability evaluation methods that are relevant to industry applications. They are expected to become rapidly mature enough to generate near-term service income in conducting formability tests for industry. This need for the service was confirmed at the industry group discussions of the EWI Forming Center (EWI-FC) workshop with about 80 industry attendees on March 21-22, 2013, *"standard formability tests are not sufficient to provide the industry-needed formability data and the material data for predicting the local failures frequently experienced with these materials"*.

Projected Impacts:

According to the Center for Automotive Research[1], automotive companies have identified the application of lightweight metals as a strategic imperative to meeting fuel economy targets and remaining competitive. For example, the percentage of ultra-high strength steels used in vehicles are projected to grow from typically less than 10%[2] to as much as 50%[3] over the next 5 years. Improved formability data are expected to have immediate impacts for industry clients adopting these new lightweight materials, by reducing scrap and production downtime.

The three participating for-profit companies (Honda R&D Americas, Shiloh and KTH) will benefit from the application of the proven formability assessment methodology on their selected parts. This is expected to allow them to extend the applications of lightweight materials to other structural components that offer potentially increased market share.

Edison Welding Institute will expand its technical capabilities and establish a new and unique formability testing service.

The Ohio State University's Center for Precision Forming (OSU-CPF) will have access to the capability for student education.

Sustainability:

EWI has a proven track record in delivering manufacturing technology innovation services to industry. The proposed program will yield a range of commercially available formability testing and process simulation services at EWI to support the domestic metal forming industry. At least 30 current member companies of EWI-Forming Center can be potential users of these services. There are many more companies throughout Ohio that are potential clients. The annual revenue with these services is projected to increase in the years to come with expanded service activities of formability testing and simulations.

[1] Coalition for Automotive lightweighting Materials (CALM).

[2] Steel Market Development Institute, www.autosteel.org

[3] FutureSteelVehicle – Today, Tomorrow & Beyond, Ceesten Broek, WorldAutoSteel, Great Designs in Steel 2013

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YOUNGSTOWN BUSINESS INCUBATOR

January 10, 2014

Office of Technology Development
Ohio Department of Development
77 South High Street
Columbus, Ohio 43266

Dear Sir or Madam:

Please accept this Letter of Intent on behalf of the Youngstown Edison Incubator (dba Youngstown Business Incubator or YBI) and the project partners for the Advanced Manufacturing (AM) Program for Metallic Components. The goal of this proposal is the accelerated adoption of precision AM metallic parts by Ohio businesses, thereby growing Ohio's advanced manufacturing capabilities, improving the efficiency and reliability of the AM process, creating jobs, and strengthening the state's economy.

Problem Statement: Additively manufactured metallic components offers a path to shorter lead times, affordable low volume production, and complex or customized products. However, surface finish and tolerances are not always sufficient for use within assemblies. Post-processing (i.e. secondary operation after printing) such as machining, grinding, micro-finishing and heat treatment can address these needs, thereby integrating the advantages of additive and conventional manufacturing capabilities. The advanced manufacturing community in Ohio will greatly benefit from improved processing capabilities that produce complex 'functional' parts through this hybrid approach. The proposed program will develop a ready-to-implement post-processing system designed for finish machining of metallic AM parts, without significant modifications to existing machine set-up, providing a viable low-cost path to entry for small and medium sized manufacturers.

Project Team: YBI is a 501C3 organization whose mission is to facilitate the creation of high value businesses through collaborative partnerships that promote innovative technologies. It has been a member of the Edison Incubator program and the Jumpstart Entrepreneurial Network since 2001 and 2008 respectively. As the project lead, YBI has assembled a team of collaborators from diverse and talented organizations to develop an effective technology-acceleration-and-adoption model. The point person is Barbara Ewing, COO, YBI, 241 W. Federal Street, Youngstown, OH 44503. She can be reached at 330-259-7644 (office), 330-717-2269 (cell) or bewing@ybi.org.

Youngstown State University (YSU) is a strategic partner to YBI on numerous initiatives and is in the process of formalizing that relationship. YSU has a historical strength in materials and manufacturing, offering degrees ranging from an AAS in Mechanical Engineering Technology to a PhD in Materials Science and Engineering, and multiple appropriate offerings at levels therein. Both organizations are founding members of the National Additive Manufacturing Innovation Institute (aka "America Makes"). The partnership is currently anticipating a successful award from America Makes on a program entitled Accelerated Adoption of Additive Manufacturing Technology in the American Foundry Industry. The partnership between YSU and YBI has successfully translated technologies and supported development opportunities for the region's Small and Medium Enterprises (SMEs) through multiple collaborative projects.

Industrial collaborators include:

- M-7 Technologies developed a commercially available non-contact metrology scanner in collaboration with YSU through funding from the State of Ohio through a Wright Center for Sensor Systems Engineering award. Capable of installation in machining centers, their technology enables rapid data acquisition of geometric dimensions and tolerances of AM parts prior to machining, during machining operations, and upon completion (commitment confirmed).

- Butech Bliss manufactures low-volume assemblies for rolling mills, coil processing equipment, extrusion/forging machinery and custom applications. Butech desires to lower cost and reduce lead-time in the fabrication of various components in their assemblies (commitment confirmed).

- rp+m, an Ohio-based additive manufacturing company which has acquired a Direct Metal Laser Sintering (DMLS) technology to print metallic parts. They desire to increase their customer base and capabilities through precision AM-made parts (commitment pending).

Butech Bliss serves as an example of an SME throughout Ohio that would greatly benefit from AM-based processing, but are faced with the challenges of achieving the desired precision and surface finish similar to conventional manufacturing. Many small manufacturers are successful by focusing on one or two niche markets and applications. While they may be able to in principle purchase or access metal AM capabilities, the overall process of making functional commercial parts includes the complex finishing operations which are their core competency. This is a potential area of high growth for regional businesses: post processing finishing and metrology which often represent 50% of the overall value of an industrial part. The area of metrology and precision manufacturing is the next stage of additive manufacturing's evolution, with global manufacturers (GE Aviation) and NIST investing heavily in metrology based finishing. Organizations that develop this capability will be well positioned to capture this growth market.

Project Goals/Objectives: The proposed project aims to bring additive manufacturing of metal parts to Ohio SMEs by overcoming critical barriers-to-entry for these organizations. Specifically, we will make AM equipment available to companies that would not have the resources or business justification to purchase their own equipment. Secondly, we will develop a modular post-processing manufacturing system to finish-machine metallic AM parts, by capturing information on part feature locations after locating the part in post-processing setup to provide a more efficient way of accurately producing the final part, thereby eliminating the challenges associated with post-processing. Finally, we will provide a technically trained workforce that will pursue outreach among Ohio manufacturers to demonstrate ways to utilize AM in their products and simultaneously provide the engineering expertise for the design and manufacture of AM-prepared metal parts.

Technical Approach and Solutions: A critical barrier to entry for manufacturers who wish to employ additive manufacturing is that AM metal parts require post-processing for the removal of supports after printing, in order to achieve the required surface finish and precision tolerances. Current post-processing of AM parts involves significant set-up time and manual integration of the tool to the fixtured AM part. This is due to the errors

associated with work-holding a part with form inaccuracies (due to non-uniform shrinkage characteristics) and 'as-cast' like surface texture (AM processing characteristics). Our solution is to develop a modular post-processing manufacturing system that takes advantage of non-contact metrology to identify part feature locations after placing the part in the post-processing setup. The two unique attributes are to develop fixturing aspects for post-processing and to utilize non-contact metrology techniques to accurately develop finish-machining toolpaths and parameters.

Our system will integrate 'fixturing' features such as cylindrical support(s) into the part design prior-to AM processing. When held between a rotating indexer (4th axis in a machining center), the supports will present the part to the cutting tool. The major advantages to this approach are (1) Re- configurability: Fixturing cylinders can be added to any part design thereby eliminating custom fixturing based on each individual part design and (2) Re-orientation: Rotating the part about the machine axis, which eliminates manual re-orientation of the part and facilitates machining of all the surfaces in a single set-up. Secondly, we will use M-7's scanner system to collect point-cloud data after fixturing the AM-part (using in-built supports). Using CAD-CAM tools (e.g. Siemens NX), actual part location and geometry will be used to identify the 'rest-machining' volume in the AM part. A corresponding toolpath will be generated for multiple orientations (about the 4th axis).

In year 1, the development of fixture-design and metrology-based toolpath generation will be conducted by YSU along with M-7 scanner system. Butech Bliss will identify target precision components for printing and post-processing with the intent of adopting the technology for production afterwards. In year-2, validation and part qualification of mechanical/aerospace parts with engineering specifications will be pursued by rp+m and Butech Bliss, demonstrating the feasibility of this approach for SME manufacturing businesses.

Throughout this program, YSU will produce a trained cadre of engineers, technologists and production staff, with their integration into the design and manufacturing process. Curricular components for engineering and technology students, workforce training, and student internships will be developed to fully engage students and practitioners, as appropriate.

YBI will identify additional candidate manufacturing companies in Ohio that could utilize precision printed parts and build the infrastructure required for efficient implementation of the AM and post-processing network. After successful demonstration of the precision post-processing in year-1, YBI will conduct workshops to introduce the companies to post-processing of printed parts within specifications. These workshops will educate companies on the value of precision parts, how their engineering teams can take advantage of design freedom offered by AM, and how to develop specifications for precision printed parts.

Maturity of Technology/Market Acceptance: The technologies being considered in the proposal are in the market place. Laser sintering systems and other AM methods are commercially available, as is M-7's non-contact metrology system. Machining centers are widely present in most manufacturers and indexers are commercially available. The challenge is the integration of the technologies, data management, and establishing process flow from part design to AM fabrication and finally post processing in a machining center.

Request: The project team is requesting $500,000 from the State of Ohio and is committing $500,000 in cash and in kind contributions. Funding will be used for the activities of the proposal as outlined below:

Personnel: Staff is needed to develop materials and provide technical expertise on fixture designs, materials characteristics and post processing capabilities.

Outreach/Marketing: Key to this initiative is an outreach mechanism to introduce AM to the traditional manufacturing community, explain its application, host events, develop materials, etc. Outreach activities will include participation conferences and workshops, traditional media messaging, the use of social media, in particular LinkedIn user groups, and personal meetings.

Equipment: Equipment for both AM production (powder, laser-processing) and post production efforts (machining center, 4 axis, jaw chucks, cutting tools, tool holders, etc.) are needed. Our intention is to secure capabilities for post-processing of AM and not to acquire AM equipment.

Material: The price of materials for AM processes remains a primary driver of overall cost of production. Purchase of materials in bulk for partners will make the process more cost effective.

Production: Manufacturers need to print and "finish" parts and test them to validate strength, precision, and other materials characteristics.

Education/Workforce training: Curricular integration is required for both experienced and student engineers. Funding will also be set aside to offset the cost of student -interns to work with companies directly on integration of the technology into their operations.

Budget (Two Years)	
Personnel	$125,000
Outreach and Marketing	$75,000
Equipment	$250,000
Materials	$150,000
Production	$200,000
Education/Workforce Training (internships)	$125,000
Travel	$25,000
Overhead/Miscellaneous	$50,000
Total Cost	$1,000,000

Outcomes: Project goals include:

- Implementation of in-situ metrology of additive parts during post-processing. Implementation will include shop-floor level human-machine interface
- Printing and doing post production of 30 AM parts
- Precision parts meet specifications and are implemented into production, for a minimum of 5 different parts.
- Adding 15 Ohio SMEs to the partner team, Outreach and marketing to 100 Ohio firms, Hosting 10 workshops/seminars and participating in 4 statewide conferences
- Training and placing 15 interns in Ohio SMEs
- Providing education/development to 30 of engineers/engineering students

YBI and the project team thank you in advance for your consideration of this request. If you need additional information, please contact me at 330-717-2269 or bewing@ybi.org.

Barb Ewing
Youngstown Business Incubator

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Office of Technology Investments
Ohio Development Services Agency
77 South High Street, 28th Floor
Columbus, Ohio 43215-6108
(614) 466-3887 or (800) 848-1300

Email: AMP@development.ohio.gov

Subject: Edison Advanced Manufacturing Program LOI

January 13, 2014

Dear Sir or Madam:

This is a Letter of Intent to submit a proposal in response to the 2014 RFP from the Ohio Third Frontier, Advanced Manufacturing Program.

Lead Applicant: Cleveland State University
2121 Euclid Avenue
Cleveland, OH 44115-2214

Contact Person: Dr. Zhiqiang Gao, Director
Center for Advanced Control Technologies
Washkewicz College of Engineering
Cleveland State University
Phone: (216) 687-3528
Email: z.gao@csuohio.edu

Project Title: Active Disturbance Rejection Based Product Control for Polymer Industry

Estimated State Funds: $500,000

Collaborators:

1) PolyOne Corporation
33587 Walker Road, Avon Lake, Ohio USA 44012

2) Manufacturing Advocacy & Growth Network – MAGNET
1768 East 25th Street, Cleveland, Ohio 44114-4420

Other collaborators: to be determined.

Regards,

Zhiqiang Gao

Attachment: Summary of Proposed Project

Ohio Third Frontier
Advanced Manufacturing Program
Request for Proposal; Fiscal Year 2014
Letter of Intent from Lead Applicant: Cleveland State University

Title: Active Disturbance Rejection Based Product Control for Polymer Industry

SUMMARY

The Center for Advanced Control Technologies (CACT) at Cleveland State University hereby submits this Letter of Intent for a proposal in response to the Ohio Third Frontier Advanced Manufacturing Program (AMP). The thrust of this proposed project is to deploy the ADRC (active disturbance rejection control) based product control technology for the purpose of helping Ohio Polymer industry to gain a competitive edge in manufacturing technologies. The initial deployment, as reported by polymerohio.org, has resulted in over 50% energy savings and significant quality improvements across ten production lines at an Ohio extrusion facility. The requested funding will enable industry-wide deployment of this exciting technology across polymer industries in Ohio, resulting in improved productivities, energy savings, new jobs and potential new startup companies.

Ohio Polymer Manufacturers: the Critical Needs for *Product Control*

Extrusion based polymer processes have application in polymer finishing, melt compounding, polymer chemical modification, polymerization, and production of final product formats (sheet, profiles, tubes, etc.). In virtually all cases the management of product quality as well as the control of these processes, whether simple or complex, has not changed significantly in more than 100 years of operation. Surprisingly, with all the relatively recent advances in online process monitoring (viscometry, color, near IR spectroscopy, for example) and advanced control paradigms (ADRC for example) the industry has failed to significantly implement these technologies and enjoy the competitive advantages to be accrued from real time control of product quality. This situation will likely persist until commercially viable systems linking all the necessary online product monitoring and advanced control systems, i.e. product control, are demonstrated and made available.

While there has not been a widespread implementation of a true product control paradigm, there are at least a few examples of product control: (1) Perhaps the most widely used example is that of using a melt gear pump between the extruder discharge and the die used for sheet, film, or profile production. Such a system closes the control loop between a melt pressure measurement, melt pump, and extruder screw speed to maintain a uniform polymer discharge and production of a high quality product. (2) An economically attractive route to multiple viscosity grades of a given resin is by melt blending a low and a high viscosity grade to any intermediate viscosity. This is most effectively accomplished by measuring product melt viscosity in real time using an online viscometer and closing the control loop with the feeders dosing the low and high viscosity starting resins. (3) The online, real time measurement and closed loop control of the extrusion based coloring of plastics is gaining momentum in the industry. Color can be measured in real time using an online UV/VIS spectrometer and closing the control loop with the feeders dosing the color additives. In this way color is continuously controlled within very tight limits. These examples demonstrate the proposed technology is beyond pre-competitive and the project is

"sound, relevant and mature enough to generate near-term product manufacturing or improved manufacturing operations".

Active Disturbance Rejection Control: the Enabling Technology

ADRC is an enabling industrial control technology that came out of CACT at CSU, the lead applicant, after nearly two decades of incubation. It differs from other advanced control technologies appeared on the scene in the past decades in that 1) it is a powerful solution for the real threats in industrial processes: disturbances, disruptions and other uncertainties; 2) it is easily implementable in current industrial platforms; 3) it is easily operable by personnel with varying technical abilities; and 4) it saves energy and improves product quality. In short, ADRC is the critical piece that makes the product control described above possible.

ADRC has recently been recognized by both academia and industry as a seismic change in control engineering. ADRC workshops have been held at the most visible venues of professional gatherings such as the American Control Conference (June 2013) and the Chinese Control Conference (July 2011 and July 2013); ISA Transactions and Journal of Control Theory and Applications are printing special issues on ADRC and related topics; plenary talks are given at 2012 Latin-American Control Conference and the 2014 Chinese Conference. Moreover, for the first time in history, ADRC threatens the dominance of the existing industry workhorse, the PID (proportional-integral-derivative) control, as evident in the massive rollout of by Texas Instrument (TI) of motion control chips where ADRC replaces PID wholesale. In addition to TI, ADRC has been field tested by major multinational, Fortune 500, companies for the manufacturing industry, an example of which is the field test of ADRC at the Parker Ravenna Ohio facility mentioned above.

What will be accomplished with the program fund:

The OTF AMP funding requested will enable the deployment of the ADRC based product control across the polymer industry in Ohio and beyond, giving Ohio polymer companies a crucial technical advantage in global competition and generating new jobs here in Ohio.

Problem Statement

Process control in polymers industry is antiquated. Advanced process control provides opportunity for cost savings, better products, and energy savings. If deployed statewide in the polymers processing industry, this would strengthen Ohio's leading position in polymer processing.

In particular, the proposed project will systematically add active disturbance rejection capability to all major control loops in manufacturing processes in polymer industry to enable product control for melt compounding, reactive extrusion, and sheet and profile extrusion. Product quality is most often based on sample collection and off-line analysis. This is often a time and waste material intensive operation. Process control in polymer industry has been exclusively based on a PID paradigm and has focused on the closed loop control of the major process operational parameters, set temperature profile, screw speed, and throughput rate. However, the foundation of this control paradigm is over 100 years old. In our current (and most certainly future) world of global competition a more effective paradigm, i.e. product control based on ADRC, will provide for a commanding competitive advantage.

Project Goals and Objectives

On the technical side, fundamentally improve material handling and control in the manufacturing process; replace the archaic PID based control strategy with that of ADRC for drastically increased efficiency, significant improvement on product quality, and marked drop in energy consumption.

Provide a product control system that "surrounds" the extrusion process closing the control loop between continuous online measurement of critical product attributes (via online viscometry and/or spectrometry, for example) and the most relevant operating parameters (e.g. throughput rate, relative raw material dosing rates, and/or screw speed). The control system as supplied would include a "control parameters template" into which the customer/processor would input the necessary correlations between product quality attributes and formulation and processing parameters that they developed for the particular process/product of concern.

The new product control technology will be optimized and demonstrated on sophisticated, state of the art reactive extrusion operations.

On the commercial side, channel to market will be developed; new applications will be identified; business model will be established to support industry wide implementation.

Technical Approach and Work Plan

Productize ADRC based product control technology on all industrial control platforms:

- Control algorithm redevelopment for thousands of existing controllers in the form of programmable logic controllers (PLCs), Distributed Control Systems (DCS), and dedicated machine control systems.
- Implementation of various transmitters for monitoring process variables including pressures, temperatures, levels, flows, and the aforementioned product attributes.
- Hardware and software redesign and optimization
- Operator interface for factory personnel
- Supervisory control and data acquisition interface for process monitoring
- System integration

Implement commercial strategy by:

1. Outreaching to other applicable manufacturers in Ohio
2. Developing business model to support implementation

Maturity of the Technology/Market Acceptance

The novelty and effectiveness of the ADRC based technology are on clear display at the Parker Parflex extrusion facility in Ravenna, Ohio, as mentioned earlier, resulting in over 50% reduction in energy consumption and 4X improvement in CPI. Its versatility is further proven in the new line of industrial control chips released by Texas Instrument in April 2013. The proposed project will focus on advanced product control in reactive extrusion operations, as demanded by market forces.

Projected Impacts

Ohio polymer companies such as PolyOne will obtain new manufacturing capabilities, enhancing its competitiveness. Once evaluated and implemented, the new technology standard will lead to improved productivity of existing processes; new process control products made possible by the adopting the ADRC based product control package; new jobs associated with the new ventures and the increased tax revenue for the state; and, finally, the constant royalty income stream for CSU. The proposed project will also likely result in follow-on investment from extrusion equipment manufacturers and the development of new products that will result in new jobs.

Sustainability

Deploying the ADRC technology and the associated product control package, as the result of this project, is deemed critical by Ohio polymer companies such as PolyOne Corporation. CSU, meanwhile, is committed to support the licensing of existing technology and the development of new ones. MAGNET has highlighted engagement of small and medium manufacturers in the polymers processing industry as a key part of its economic impact strategy.

Funding Requested: $500K

Collaborators: PolyOne Corporation, Manufacturing Advocacy & Growth Network (MAGNET); other collaborators: to be determined.

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National Composites Center
2000 Composite Drive
Kettering, Ohio, USA
45420

13 January 2014

Via email to: AMP@development.ohio.gov

Letter of Intent

Edison Advanced Manufacturing Program

Lead Applicant:	National Composites Center
Address:	2000 Composite Drive Kettering, OH 45420
Phone Number:	937-297-9450
Contact Person:	Lisa Novelli
Email Address:	Lnovelli@compositecenter.org
Collaborators:	Airbus S.A.S Adisco, Inc. Gosiger, Inc. Lord Corporation Noble Tool Corp. TechSolve
Project Title:	Materials Manufacturing Technology Hub
Requested Funds:	$500,000
Use of Grant Funds:	The grant funds will be used for operating costs to support staffing of technical personnel to lead engineering technology efforts. Cost share contributions may consist of a combination of capital, cash, or in-kind.

PROJECT SUMMARY

INTRODUCTION

With aerospace manufacturing procurements expected to double within the next ten years, considerable strain will be placed upon suppliers to meet growing global demand. Having a significant stake in the aerospace industry, Ohio must leverage its strong manufacturing legacy to increase the competitiveness of its supply chain.

The National Composites Center (NCC), in collaboration with Airbus S.A.S. (Airbus), has devised a program to enhance Ohio and U.S.-based aerospace manufacturing through an unconventional approach to supply chain and workforce development. The Materials Manufacturing Technology Hub (MMaTH) stimulates economic growth by empowering business diversification and vertical progression within the aerospace manufacturing supply chain.

MMaTH exceeds current initiatives to help improve the overall state of American manufacturing in materials CNC machining. By addressing weaknesses that hinder workforce development and supplier certification and by creating a unique collaborative effort between academia and diverse industry interests, MMaTH provides a breakthrough opportunity to galvanize manufacturing within Ohio and the United States.

PROBLEM STATEMENT

The need for MMaTH is perpetuated by a supply chain at risk of being unable to support the present and future needs for advanced CNC machining. The number of qualified aerospace manufacturers has dwindled significantly over the years. Manufacturers previously engaged in aerospace and defense work have shifted their focus to other areas, such as the growing medical device industry, or went out of business due to the downturn. Many suppliers are hesitant to invest more in aerospace machining due to a perceived history related to cyclical industry downturns and decreasing labor force. Economic conditions and skill-set deficiencies have precluded significant investments within the past several years in capital, personnel, and quality certification. The lack of an experienced workforce, inability to grow, and antiquated technology will force less financially stable companies to exit the industry. These small businesses are often considered the backbone of regional manufacturing. Their loss would considerably impact the state's ability to compete.

The future success and growth of aerospace manufacturing will be dependent upon those companies that can respond quickly to demand (speed to market) and market changes, utilize technology for improved productivity, and demonstrate unmatched flexibility (competitiveness). In today's environment, primes are looking to the supply base for up to 80% of the required

process and product innovation. This requires increased knowledge and capabilities on behalf of the suppliers, as well as better collaboration, interdisciplinary integration, and communication throughout the entire supply base. Suppliers to aircraft original equipment manufacturers (OEM) are likely to be challenged to keep pace with production requirements and are expected to invest in skills development, equipment, tooling, and manufacturing capacity.

The necessity of comprehensive supply chain development led to a partnership between Airbus and the National Composites Center via a Memorandum of Understanding signed on October 24, 2012. The MMaTH concept arose from an investigation of the Ohio and U.S. materials processing supply chain to support Airbus procurement needs. It was determined that Ohio suppliers could become more competitive if they had vital resources made available to them in the areas of technology, workforce development, and industry knowledge.

PROJECT GOALS AND OBJECTIVES

The goal of the MMaTH program is to provide economic development opportunities within the American manufacturing industry and specifically Ohio. It seeks to create and retain jobs, improve competitive readiness of small to medium sized companies, augment workforce development efforts, and allow competitive opportunities for supply chain entry or advancement, and enable overall aerospace industry growth.

Focused on CNC machining of aerospace components, MMaTH will offer resources for suppliers in strategic areas such as Engineering Technology, Training (Workforce Development), Business Analytics, and Supply Chain Development. These tactical sections address issues that have been widely identified as barriers currently facing the industry.

Specific objectives for Phase I of the MMaTH program include the following:

- Develop solutions for Airbus and Tier 1 suppliers in commercial aerospace part issues, i.e. cost reductions, new production methodologies, improved quality, efficient machining, manufacturing repeatability
- Help suppliers advance or gain entry into the aerospace market through certification and networking
- Create new and enhance existing manufacturing jobs through apprenticeship training

Achieving these objectives will provide a path for expansion of the program as well as improve the competitiveness of Ohio companies to attain economic growth.

TECHNICAL APPROACH AND WORK PLAN

The MMaTH program (Hub) is a project administered by NCC to expand and strengthen Ohio's supply chain in CNC machining. The predominant focus of the center is the development of a CNC machining/forming supply chain to support current needs as well as the aerospace market surge.

As a concentrated center of excellence dedicated to materials manufacturing, MMaTH builds upon a strong Ohio manufacturing legacy, enhancing the existing supply chain and increasing business attraction. The Hub will be administered by the National Composites Center (NCC), a 503(c)3 not-for-profit applied research and development organization. Founded in 1996 as one of the first centers of its kind in the United States, NCC offers a rich history of expertise and achievements in advanced materials processing and manufacturing development. As a result of its work with private industry as well as university collaboration, NCC has proven to be a valuable asset for economic development in Ohio through company attraction, job creation, and business attraction and incubation.

NCC will serve as the Program Manager, leading a centralized structure to manage strategic activities as well as coordinate efforts from Hub participants. With regional support offered by Montgomery County and the City of Kettering, the Hub will be located within the Kettering Business Park which offers ample space for offices and manufacturing. The offices will house business operations such as accounting, human resources, engineering, production planning, and program management. The manufacturing area includes adequate plant space for equipment, tooling, inspection, and production work areas. The Kettering Business Park is an ideal setting that can accommodate business attraction related to the MMaTH program.

MATURITY OF THE TECHNOLOGY/MARKET ACCEPTANCE

MMaTH ("Hub") provides a definitive environment for an improved learning experience that meets the needs of industry. This program will be the first to gather expertise from a unique group of resources spanning vital facets of manufacturing and machining. Representatives from machine builders, tooling designers, CNC programming, aerospace procurement, quality compliance, and information technology will unite to solve parts problems for Airbus and Tier 1 suppliers, perform as trainers, and serve as business consultants. No other center in the country delivers this type of synergistic methodology. The Hub is designed by industry, for industry, to bolster manufacturing efforts in Ohio and the U.S.

PROJECTED IMPACTS

Knowledge integration is a key component for creating advancements in aerospace engineering technology. The unification of a cohesive group of subject matter experts

representative of the CNC parts manufacturing community to work collaboratively within the Hub is a key strategy for ensuring project success. The ability to improve and advance aerospace engineering technology would yield the following MMaTH program benefits to Airbus and other participants:

- Cost reduction and increased throughput due to more efficient machining, reducing cycle time
- Cost reduction attained by the ability to machine materials or parts features that were not previously possible
- New production methods and materials due to improved machining processes
- Weight reduction enabled by new materials and machining processes
- Resolution of quality issues through new machining methods
- Improved product performance resulting from improved machining capabilities
- Testing of new design concepts
- Technology intellectual property (IP) in innovative processes (trade secret or patentable)

SUSTAINABILITY

The flexibility offered by the MMaTH program allows for incremental growth and investment for sustainability. Scalability allows for careful analysis of capital and operating requirements and return on investment (ROI).

The program model is scalable and progresses through various phases. Phase I establishes a foundation for anticipated growth and sustainability and sets the stage to develop expansion objectives. The ROI can be derived based on the success of Phase I to achieve optimal levels of scale-up during subsequent phases.

The ultimate goal would be to have MMaTH recognized as a world class center and vital resource for aerospace supply chain development. Economic growth in Ohio will be realized through the creation of jobs for trained workers, company expansions to meet market demand, increased revenues for suppliers, and business attraction.

AMP – 14 – 19

January 10, 2014

Letter of Intent

Submitted to Ohio Development Services Agency

Edison Advanced Manufacturing Program

Lead Applicant: CIFT
5555 Airport Highway
Suite 100
Toledo, Ohio 43615

Contact Person: David Beck, CEO
dbeck@ciftinnovation.org
419-535-6000, ext.106

Project Title: Ohio Advanced Food Processing and Packaging Technology Consortium

Estimated Funding: $500,000

Collaborators: Avure Technologies, Inc., Middletown, Ohio
Con Agra Foods, Archbold, Ohio
Cooper Foods, Oakwood, Ohio
Hirzel Canning Co., Toledo, Ohio
Sandridge Foods, Medina, Ohio
The Ohio State University, Department of Food Science and Technology
Wornick Foods, Cincinnati, Ohio

Intended Use Of Funds: The funds to be sought by CIFT for this program will be used to support the expanded use of advanced food processing technologies and techniques that are currently used by Ohio food processing companies. The consortium will identify opportunities for Ohio companies to expand their levels of production by reformulating existing products to utilize new technologies in their facilities. It will provide for other Ohio manufacturers to utilize these technologies on a limited basis prior to making large commitments, thereby establishing markets for their products. It will develop protocols and processing parameters for companies to more easily adapt their products to new processing and packaging technology, and it will create supply chain relationships among Ohio companies involved in food processing, thereby establishing Ohio as a "center of excellence" in the food processing industry.

Ohio Advanced Food Processing and Packaging Technology Consortium
Project Summary

Problem Statement: The food processing industry is rapidly changing. Consumers are increasingly demanding that their products be "fresh", that they be "natural", and that they be packaged in "environmentally friendly" materials. These trends have led to the adaption of several processing techniques in the industry that produce premium products that satisfy these demands. Processing techniques such as High Pressure Processing, which can kill pathogenic bacteria, denature spoilage agents, and enhance flavors without additives, are rapidly growing in the industry. Microwave assisted packaging can likewise enhance product safety and quality, as can aseptic packaging. Flexible, reclosable packaging that can be processed in retort cookers is rapidly growing in popularity due to its ease of handling and storage. A number of Ohio companies are leaders in the use of these technologies, and have an opportunity to expand their leadership. Sandridge Foods and Cooper Foods are Ohio companies that lead the industry in the use of HPP. Wornick Foods is a leader in the use of both flexible packaging and microwave, and Hirzel Canning is a leader in aseptic processing of vegetable juices and sauces. Avure Technologies is one of only two producers of HPP equipment, and has recently established their food R and D Center in Middletown, Ohio. In addition to expanded sales of their own products, there is also an opportunity for them to expand their contract manufacturing businesses. International companies such as Nestle, Campbell's Soup Co., J.M.Smucker, Con-Agra Foods PepsiCo, and others are current and potential users of these technologies on a contract basis.

Project Goals and Objectives: The objectives of this project are to help Ohio food processing companies maintain and grow their competitive advantages through the expanded use of advanced processing technologies. These include High Pressure Processing (HPP) currently used by Sandridge Foods and Cooper Foods, a Microwave Assisted Thermal Processing System (MATS), operated by Wornick Foods, as well as a flexible packaging system for shelf stable products located both at Wornick and the Con Agra Foods facility in Archbold, and an advanced aseptic system currently operated by Hirzel Canning Company. This will be accomplished in two ways; first, the project will provide resources to these companies to enable them to provide contract manufacturing services to others, and secondly, it will provide support for other Ohio manufacturers to begin to utilize these technologies prior to making large capital investments in equipment. The net effect of these combined will be to establish Ohio as a "center of

excellence" in advanced and emerging food processing technology. This will further enhance the reputation of the Department of Food Science and Technology at The Ohio State University as a national leader in new, emerging, non-thermal processing techniques.

Technical Approach and Work Plan:

Several tasks will be included in the project. First, CIFT will identify and qualify candidates for using the production facilities of consortium members. It will promote the opportunity for product reformulation through industry events and through direct communication with the industry. Joint promotional events will be held in conjunction with Ohio State. Then, products can be developed by the tech centers at Wornick in Cincinnati, at Avure in Middletown, or at Ohio State that are amenable to HPP, MATS, flexible retort packaging, or aseptic packaging. Test batches can be produced, processing parameters established, product testing completed, and sensory evaluations performed to ensure consumer acceptance and acceptability. Through its resource network of staff and affiliates, CIFT and the other partners will complete shelf life and microbiological challenge studies for all products. Arrangements will then be made among the partners and other Ohio companies seeking to expand into the technology, or between the partners and companies seeking contract manufacturers for larger business arrangements. The net effect of these efforts will be an increase in business for the initial project participants, and a general expansion in the use of the technologies. As these activities are proceeding, they will be documented in "checklist" form, so that future product development opportunities can draw on initial project experiences and be facilitated. The consortium educational partner, Ohio State University, will develop and offer short courses and seminars that will increase the knowledge base among Ohio companies.

Maturity of the Technology/Market Acceptance:

The technologies addressed by the product, are new in the market, but are increasingly demanded by consumers. HPP is one of the most rapidly expanding processing techniques in the industry, because it enhances flavor naturally, and allows for minimal use of enhancers and preservatives. It can extend shelf life for products, which can expand the markets in which Ohio products can be marketed. Because of its flavor enhancing capability, it creates a "premium" perception around its products. Flexible packaging allows for enhanced ease of use by consumers, and is being increasingly used by large manufacturers because of this consumer appeal. It represents an opportunity for ease of storage and reusability, both much desired traits by consumers. Likewise, aseptic packaging allows for extended shelf life and room temperature storage, each very appealing to retailers and consumers. Many companies that have traditionally packaged in metal cans are expanding into these lighter, easier to use, and environmentally friendly containers for their products.

Projected Impacts:
As the full proposal will demonstrate and explain, this project will provide immediate business benefits to the industry participants, by expanding sales of their own products, as well as expanding their contract manufacturing business with other companies. Each of the participating companies is either actively soliciting this type of business, or is being approached by others seeking to utilize some of the new techniques. In addition, Ohio is home to about 1,100 food processing establishments, who employ nearly 70,000. A large number of these produce items that are potential candidates for HPP, for MATS, for aseptic processing, or for flexible retortable pouches. This project will enable any of them to enter these markets without the large initial investment that might otherwise delay their entry, thereby enabling them to keep abreast with the competition. Finally, the creation of the infrastructure made possible with this project will further establish Ohio as the "go to" location for advanced food processing operations, further enhancing its desirability as a location for food processing companies.

Sustainability:
An important deliverable from the project will be documentation of processing parameters for food products of various types. This data will facilitate business development for the participating partners. As methods for processing soups, stews, or entrees are developed for example, they can to some extent be used to facilitate process development of similar products. This knowledge base will be very important to the sustainability of the program. Strengthening the knowledge base of the infrastructure created by the project will also be an important asset for sustaining and expanding the activities for Ohio's industry. The complete proposal will set performance metrics which will estimate both the increases in sales revenues that are realized by the initial project participants, as well as the number of new users of the technologies on a contract basis. It is expected that the support that is to be provided by this project will produce business expansions for the partners in a relatively short period.

AMP – 14 – 20

OHIO ENERGY & ADVANCED
MANUFACTURING CENTER

Letter of Intent to Submit a Proposal for the Edison Advanced Manufacturing Program (AMP)

Lead Applicant: Ohio Energy and Advanced Manufacturing Center, Inc.

Anticipated Initial Collaborators:

1. ADMA Products, Inc. (ADMA)
2. American Trim LLC (AmTrim)
3. DJW Technology LLC (DJW)
4. National Renewable Energy Lab (NREL)
5. Oak Ridge National Laboratory (ORNL)
6. Ohio Energy & Advanced Manufacturing Center (OEAMC)
7. Ohio Fuel Cell Coalition (OFCC)
8. Triumph Thermal Systems Inc. (TTS)

Point of Contact:

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Proposed Project Title: Development of a Consortium to Study and Advance the Commercialization of High Strain Rate Forming Technologies

Anticipated Funding Request: $310,000

Anticipated Total Cash Costs: $620,000

Problem Statement: The United States metal forming industry has lost its dominate position in the global economy. Our current system is based on the massive infrastructure that has been built for mass production. This served our country well throughout the late 19th and into the first half of the 20th century; but we have slowly lost our competitive advantage as mass production work, which requires a large labor force and is extremely cost sensitive, has been moved off shore to low-wage environments. If America is to regain market dominance in manufacturing, specifically metal forming, we must break free of the mass production paradigm and create a new paradigm that is geared toward mass customization.

Project Goals and Objectives (& Use of Funds) - The AMP funds will be used to create a High Strain Rate Forming Consortium that will eventually include all Ohio-based, metal forming, for-profit companies, that will benefit from the commercialization of this technology. The consortium will be a public-private, government-industry-academic partnership created to Study and Advance the Commercialization of High Strain Rate Forming Technologies. The primary objective of the consortium will be to stimulate investment and promote opportunities to produce commercial products using this emerging advanced manufacturing technology, especially by small-to-medium sized manufacturing enterprises (SME's).

Technical Approach and Work Plan – The metal forming current model requires heavy and intricate upper and lower forming die sets that must be matched precisely. High Strain Rate Forming, on the other hand, requires only one half of the forming tool, eliminating the cost involved in matching the upper and lower halves. High Strain Rate Forming is much less expensive as an initial investment. High Strain Rate Forming typically requires only 10% of the cost of conventional die sets. High Strain Rate Forming presses are more agile than traditional approaches and can be reconfigured quickly and easily because they are lightweight and relatively small.

Maturity of the Technology/Market Acceptance - High Strain Rate Forming technologies do exist. However the technology has been limited to niche markets and laboratories due to high cost and a lack of exposure in high volume applications. High Strain Rate Forming offers a low entry cost-and-deliver method that drastically reduces the capitalization impediments small innovative companies face when attempting to introduce a new product or process to the commercial market.

Projected Impacts - High Strain Rate Forming has the potential to revolutionize the metal forming industry through drastic reductions in the costs for energy, equipment and tooling. High Strain Rate Forming is a relatively new concept in manufacturing which needs to be perfected, embraced and further commercialized by the manufacturers of the United States. Commercialization of this emerging technology has the ability to make Ohio the center for High Strain Rate Forming Technologies in the United States.

Sustainability - A High Strain Rate Forming installation does not require the large and immobile infrastructure of a 1,000 ton press and the overhead that is associated with the press. A 1,000 ton High Strain Rate Forming installation is roughly the size of a typical industrial work bench and uses less than 1% of the energy consumed by a typical 1,000 ton hydraulic press while consuming less than 10% of the floor space.

Lead Applicant - The Ohio Energy and Advanced Manufacturing Center, Inc. (OEAMC) will lead and manage the High Strain Rate Forming Consortium activities. The OEAMC is an existing regional government-industry-academic partnership that is committed to assisting in the deployment of advanced manufacturing technologies. The OEAMC has extensive experience in managing federal and state grants.

Collaborators will initially include the following entities *(listed alphabetically):*

1. ***ADMA Products Group*** (ADMA) is a manufacturer of powder metallurgy products from titanium, zirconium, niobium and other advanced materials and alloys. They specialize in the manufacture of metal hydride powders, porous and near full density powder metallurgy parts and have extensive expertise in tailoring properties of material to fit the requirements of their customers. AMDA holds several patents in the field of metallurgy and metal forming and joining. www.admaproducts.com

2. ***American Trim*** (AmTrim) designs, develops and forms innovative and high quality components and provides innovative solutions to improve the forming, finishing and coating for metal and composite substrates. AmTrim has developed a process to apply electromagnetic forming to manufacture bi-polar fuel cell plate by means of re-useable driver plates to reduce cost and improve efficiency; applied Ls-dyna to simulate electromagnetic forming process to verify velocity of driver plate; applied laser profilometer to measure profile of fuel cell plate to verify deformation; and researched on the feasibility of springback correction by electromagnetic forming for Al alloys and high strength steel (HSS). www.amtrim.com

3. ***DJW Technology*** is a fuel cell and hydrogen technology company whose mission is to resolve client's energy issues. The company provides analysis and evaluation of fuel cell technology to the National Renewable Energy Laboratory (NREL), The U. S. Department of Energy (DOE), the U. S. Navy and to private industry. www.djwtechnology.com

4. ***National Renewable Energy Laboratory*** (NREL) is an expert in clean energy resources, technologies and systems. NREL has a rich history of scientific innovation and partnering with research and development to bring new products to the marketplace. www.nrel.gov

5. ***Oak Ridge National Laboratory*** (ORNL) is a multiprogram science and technology laboratory managed for the U.S Department of Energy by UT-Battelle, LLC. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security. www.ornl.gov

6. ***Ohio Fuel Cell Coalition*** (OFCC) was established to ensure Ohio's presence both regionally and nationally in current fuel cell discussions. The Coalition works to build upon existing industry and academic strengths and services to advance the integration of a coordinated, robust fuel cell infrastructure and supply chain and promote public awareness about the positive role fuel cell technology can play as an efficient, reliable and environmentally responsible source of energy in a wide variety of applications. www.fuelcellcorridor.com/

7. ***Triumph Thermal Systems*** (TTS) is a leading global manufacturer & supplier of heat exchange and transfer systems and components for temperature control in fuel, lubrication, hydraulic, environmental, and related systems. They are the aerospace industry's provider of choice for high-quality thermal management technologies worldwide as a result of our premier service and support of aerospace, military and other commercial customers since 1929. www.triumphgroup.com

Summary

It is the goal of the initial collaborators to form an intimate group of metal forming companies and universities who will work together to bring widespread use of High Strain Rate Forming to manufacturers in Ohio and the United States.

The initial collaborators will also cast a wide net for additional consortium members from the metal forming, for-profit community and Ohio universities whose capabilities compliment the proposed advanced metal forming technology.

By the time the consortium is fully formed it should consist of all Ohio-based, for-profit, metal forming manufacturing companies both large and small, manufacturing consortiums, public and private universities and two national laboratories who will work together to commercialize High Strain Rate Forming technologies in a way that will benefit each participating company and the United States metal forming industry as a whole.

AMP – 14 – 21

Edison Advanced Manufacturing Program

A collaborative effort to advance U.S. Manufacturing technologies

PRESENTED TO

The Ohio Development Services Agency
Office of Technology Investments
77 South High Street, 28th Floor
Columbus, OH 43215

13 January 2014

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Letter of Intent

Dear Ohio Development Services Agency;

The Ohio Aerospace Institute (OAI) is poised to the lead charge of industry, academia and federal laboratories focused on making substantial and measureable progress to strengthen advanced manufacturing in the United States. As a non-profit research institute, the mission of the Ohio Aerospace Institute (OAI) *is to enhance our partners' aerospace competitiveness through research and technology development, workforce preparedness, and engagement with global networks for innovation and advocacy.* OAI is ideally suited to combine the world-class strategic partners, many of whom are Key Opinion Leaders (KOL) in advanced manufacturing to identify and deliver the next generational and transformational innovations in and around manufacturing. For this application OAI will leverage key manufacturing partners across the manufacturing value chain, such as Rockwell Automation, Parker Hannifin, Pratt & Whitney, UTC Aerospace Systems, Valtronic, PCC Airfoils, Crane Aerospace, Kent State University and Lorain County Community College. These partnerships are in addition to the long standing alliance with the NASA Glenn Research Center and Air Force Research Laboratory. These partners speak, in part, the voice of the aerospace manufacturing community. The aerospace manufacturing sector remains an icon for advanced manufacturing in the US.

> *"In 2011, the U.S. aerospace industry contributed $86 billion in export sales to the US economy. The industry's positive trade balance of $47.1 billion is the largest trade surplus of any manufacturing industry and came from exporting 49 percent of all aerospace production."* [4]

The highest levels of the United States (US) government administration have placed top priority on reinvigorating and transforming the domestic manufacturing sector. This priority opens the door for scientific innovation which will lead to a sustainable model of economic growth and job creation [1]. The needs for advances in manufacturing are closely aligned with similar federal initiatives like *Strategy for American Innovation* [2] and the *National Strategic Plan for Advanced Manufacturing* [3]. Advanced manufacturing is a matter of fundamental importance to the economic strength and national security of the United States [3].

Despite manufacturing being the backbone of the US economy, recent changes and setbacks to the industry have left the US racing to retain a foot hold as global leader in manufacturing and manufacturing innovation. Downturn of the US automotive industry, an aging workforce of skilled labor, notable talent drain to other industries such as health care, and information

technology (IT) and proliferation of viable off-shore manufacturing options are specific points that have impeded innovation around advanced manufacturing.

Several pillars of focus are at the heart of the health and performance of the manufacturing sector. Presently, there is a separation between industrial research and development (R&D) activities and the uptake technological innovations into the domestic supply chain [3]. The workforce knowledge/skills and production capacity need to align with customer needs. This separation is supported by lack of sustainable partnerships involving government entities, industry, and universities?. Recent analysis and recommendations [5] identify three target areas in public/private partnerships: **innovation, talent availability and business climate** for national manufacturing strategy to ensure domestic manufacturing remains competitive.

OAI seeks to close technology gaps and broaden advanced manufacturing opportunities. OAI was formed nearly 25 years ago, as a neutral and trusted agent to foster innovation partnerships among the ***government, industry and universities.*** In this role, OAI has successfully led programs where the aerospace industry is aligned through an OAI initiative to tackle critical manufacturing and technology needs.

As a collaborative initiative, this Edison Advanced Manufacturing Program will focus effort on developing a technology roadmap and priority matrix focused on long term industrial research needs in and around advanced manufacturing. During the program, emphasis will be placed on addressing the major technological barriers which inhibit the global competitiveness of US companies. It is expected this work will lead to technological innovation which strengthen the manufacturing infrastructure.

Figure 1- Logos of OAI's active memberships (Partial List)

OAI will partner with a diverse team which includes broad participation from advanced manufacturing companies of all sizes, universities and government agencies to serve as stakeholders on this collaborative project. This participation will be largely drawn from the OAI Industry and University membership program(s).

Program Overview

This proposed program will leverage follow Open Innovation/ Pre-competitive collaboration models OAI has used successfully previously. As illustrated in **Figure 2** OAI, in the role of Program Manager will serve as the capture point for the voice of the manufacturing community. The target areas will be supported sub-committees of public/private collaborations. OAI and the Sub-Committees then steer the "Advanced Manufacturing Team" through a strategic roadmap which leads to manufacturing advantages (**Figure 3**).

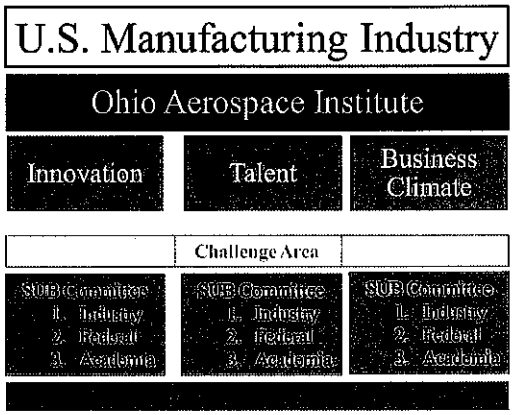

Figure 2

Program Objectives

OAI has created with this program with the intent on strengthening advanced technologies and solutions as they apply to manufacturing. This program is aligned with OAI's corporate strategic roadmap and mission. The key objectives for this program's success as are as follows:

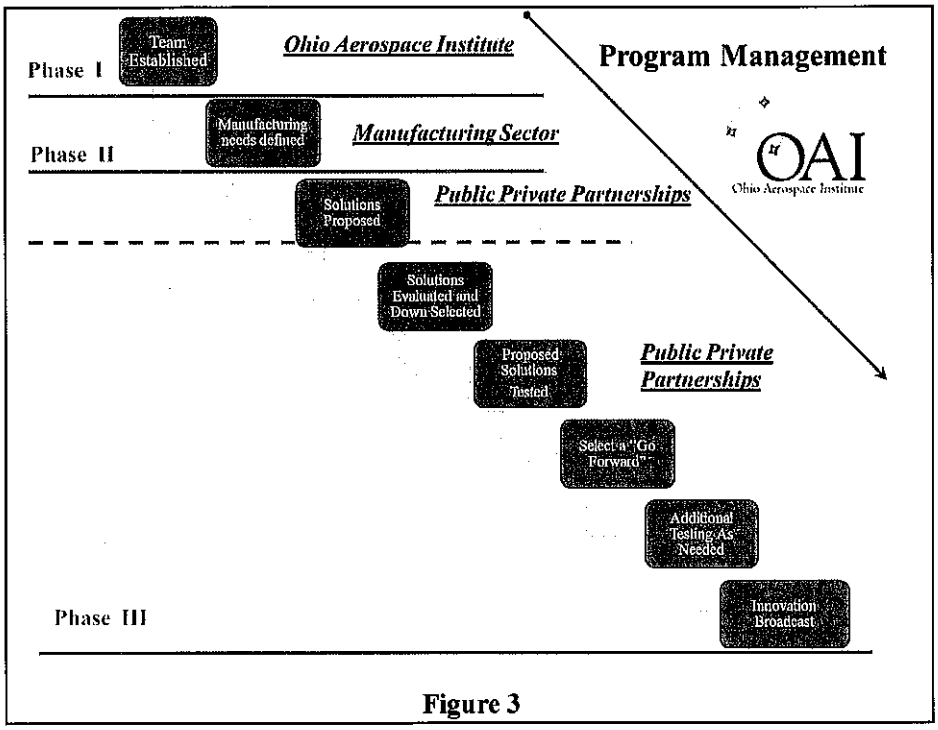

Figure 3

Objective 1: Form a collaborative advanced manufacturing team, with an appropriate leadership team of Subject Matter Experts (SME) and Key Opinion Leaders (KOL) from government; industry and universities.

Objective 2: Identify major technological and related barriers that inhibit the growth of advanced manufacturing in the in Ohio and domestically U.S.; as they relate to *Innovation, Talent Availability and Business Climate*

Objective 3: Create an intake mechanism, where technical manufacturing challenges *can be defined and solutions offered*

Objective 4: Generate a priority matrix and strategic roadmap around research projects supporting short and *long-term industrial research needs,*

Objective 5: Create a plan which allows these collaborations to convert to a *sustainable, long term, technology development mechanism*

The industry led partnership will work with a broad range of firms involved across stages of the value chain to and create pathways to translate these technology advancements into commercial reality for U.S. manufacturers [6]. **OAI sees this works as a means to spur wide reaching manufacturing partnerships and catalyze technology infrastructure and American excellence in advanced manufacturing in Ohio**

Cost and Scope the Program

This program is expected to last the full 24 months. The anticipated costs (including the indirect) to reach the proposed objectives and follow the process describe in **Figure 3** is $400,000. A 1:1 cost share is expected.

4.) Bibliography

1] E. O. o. t. President, *A National Strategic Plan for Advanced Manufacturing,* Washington; D.C, 2012.

2] S. M. Burwell and J. P. Holdren, *Memorandum for the heads of Executive Departments and Agencies,* M-13-16, 2013.

3] *A Strategy for American Innovation: Securing Our Economic Growth and Prosperity,* Washington, D.C.: whitehouse.gov, 2009.

4] "www.selectusa.commerce.gov," [Online]. Available: http://selectusa.commerce.gov/print/industry-snapshots/aerospace-industry-united-states. [Accessed 1 October 2013].

5] P. C. o. A. o. S. a. Technology, "Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing," 2012.

6] *Advanced Manufacturing Technology Consortia (AMTech) Program,* 2013-NIST-AMTECH-01, July 31, 2013.

7] "https://americamakes.us/," [Online]. [Accessed 16 October 2013].