



Advanced Functional Fabrics of America

Project Call 1.0

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1. AFFOA's Mission

AFFOA's mission is to enable a manufacturing-based revolution—the transformation of traditional fibers, yarns, and textiles into highly sophisticated integrated and networked devices and systems and facilitate the conversion of the textile industry into an Intellectual Property (IP)-differentiated, value-added, high-tech industry. At the heart of this revolution is a simple premise: highly functional textile-systems necessitate sophisticated fiber-device components. To pursue this mission, AFFOA is addressing the spectrum of challenges associated with volume manufacturing of revolutionary fibers and textiles from design to end product prototypes through project calls. The ultimate goal of these efforts is to facilitate the transition of revolutionary fibers and textiles from lab prototype demonstrations to pilot production (Manufacturing Readiness Level (MRL) of 4 to MRL 7), delivering the functionality of sophisticated fiber devices into systems at scale. The convergence of device technology into fiber and textile production, enabling wireless connectivity and big data tools, will lead to fabrics that provide valuable services: fabrics that see, hear, sense, communicate, store and convert energy, regulate temperature, monitor health, and change color while delivering the conventional qualities of textiles to benefit the commercial consumer and warfighter. AFFOA will support the productization of advanced fabrics across diverse applications and markets from materials to consumer electronics and from composites to apparel.

“Made in America” Strategy

A core element in AFFOA's approach is to facilitate a domestic “Made in America” manufacturing capability in advanced fabrics based on US innovation. To that end, AFFOA is aggregating existing US university IP in the field of revolutionary fibers and textiles (RFT) and directing the Institute's follow-on investment in IP that will be manufactured in the US. AFFOA's projects will address scaling challenges in order to make this IP more valuable and accessible to US manufacturers. Project teams that combine universities and manufacturing companies are encouraged.

AFFOA recognizes that companies protect IP through various mechanisms, including patents and trade secrets. Proposals are expected to address each participant's willingness to share



background and foreground IP and know-how. Protection of this information does not exclude an organization from participating in a project. For proposals of equal merit in all other evaluation criteria, awards will be made to teams most willing to collaborate to improve overall domestic manufacturing practices. Data reporting will be required as part of the reporting process.

AFFOA's Manufacturing Thrusts

Computer Aided Design of Integrated Textiles (CAD-IT) – This manufacturing thrust includes component and system computer design tools and/or computational modeling and simulation of properties and performance.

Fiber Yarn Devices (FYD) – FYD are fibers and yarns that have device attributes and enable fabric system level capabilities, addressing one of project topics described below. This manufacturing thrust encompasses all methods of monofilament and yarn device production. For Year 1 projects, fibers shall be currently available at scales that exceed 100m or as required for product prototype integration.

Textile System and Assemblies (TSA) – This thrust begins with producing textiles from FYD through woven, knitted and non-woven approaches. Fabrics are then assembled into finished product form using subsequent processing steps including dyeing, lamination, coating, printing, cut and sew and composite formation. For Year 1 Projects, TSA should be of scale expected in final product implementation and shall be of scale to enable System Integration and Testing.

System Integration and Testing (SI) – SI encompasses the integration of the fabric product into a working, validated system. This manufacturing thrust includes electrical interconnects, power integration, data storage, inference algorithms and fabric system testing. Product prototype testing protocol will depend on the specific use case. Durability, washability, shrinkage, stretch, temperature and mechanical properties.

2. Year One Roadmap Projects: Goals, Objectives and Attributes

The objective of Year 1 Roadmap projects is to construct an advanced fabric product prototype that demonstrates a revolutionary fabric capability well beyond current state of the art. These



prototypes are expected to help substantiate new business models for commercialization of fabric based products. Each project should incorporate all four manufacturing thrusts and deliver a working prototype to AFFOA by the end of Year 1. As the textile supply chain is diverse, it is envisioned that most projects will involve a team consisting of multiple organizations to fulfill project requirements. AFFOA will host a Members Day shortly after this project call release to facilitate team assembly for response to the project call. AFFOA will also launch its Members Portal with a Project Call 1.0 microsite where members interested in a particular topic can post their relevant capabilities and identify others in complementary positions within the supply chain for teaming. Members will be sent log in information upon launch.

The goal of the Year 1 Roadmap projects is to facilitate proprietary product development funded by industry in order to commercialize revolutionary fibers and textiles. AFFOA will seek to connect these projects with industry sponsors. Example markets AFFOA seeks to address include Aerospace, Apparel, Architectural/Interiors, Consumer Electronic, Consumer Product, Defense, Healthcare (devices & pharmaceuticals), Machinery, Materials, Media Communications & Cloud, Software & Database, Transportation. This list is representative, and proposers may submit project proposals that address other specified markets.

[Core Competency Analysis and Learning Content](#)

The manufacturing of sophisticated, functional, integrated and connected fabrics requires knowledge and skills that encompass a diverse set of core competencies. AFFOA aims to identify, aggregate and make accessible the knowledge and skills required for the manufacturing of revolutionary fibers and textiles. To evaluate a projects impact on this learning process, each proposal team will submit a self-assessment of which core competencies are required to carry out the proposed work. At a minimum, relevant publications, patents, online modules and other technical documentation shall be identified or provided with explicit connection to the core competency. Description of original content (such as a tutorial video) or commitment to creating such content is highly encouraged.



Year 1 Project Attributes

Given AFFOA's mission and goals, a successful proposal should encompass the following attributes.

- Each project incorporates elements of all four manufacturing thrusts from CAD-IT, FYD, TSA, SI
- Relies on MRL 4 technology or higher (starting point of hundreds of meters, hundreds of gram level for fiber technology)
- Working product prototype offers new and revolutionary capabilities, i.e. a value-added service not currently available or expected from fabrics
- Working prototype implements technology not supported already through existing business models (e.g. corporate R&D)
- Enabling technology used is IP protected through issued patents and/or trade secrets and will be subject to "Made in US" commitment
- Compelling market specific application use case and commercial value assessment
- Manufacturing scaling executed in partnership with a manufacturer in Year 1
- Project includes a performance specifications roadmap and manufacturing scale roadmap to span the next five years and demonstrates a platform for additional capabilities in outlying years with specific identification of manufacturing and technology gaps
- Project-relevant core competencies utilized and proposed learning content
- Working prototype delivered to AFFOA for Institute use
- Dual Use for commercial and military markets
- Field programmability
- Connection to the digital world
- Working product-prototype that demonstrates a value-added service that can form the basis for a business model



3. Proposal Topics

Prototype systems proposed can be composed of wovens, non-wovens, knitted, and fabric-based composite structures.

Climate control

The objective of this topic is to produce a fabric system capable of providing local climate control that is significantly advanced over current state of the art. Fabric systems that passively or actively heat and/or cool, both measure and respond to temperature or influence humidity, evaporation rates and other metrics of comfort are considered appropriate for this topic area. Systems with responsive and/or adaptive climate control are of particular interest. Final system metrics identified in project call responses should include the system's size and weight burden, power requirements (if any), expected operating temperature ranges, temperature change rates and expected spatial profile of effects.

Construction Fabrics and Composites

The objective of this topic is to produce a fabric system capable of providing a new service in construction material or interior design and includes fabric-based composites. Fabric systems or fabric-based composites that can emit light, predict and/or report failure, measure curing rates or self-repair are considered appropriate for this topic area. Responses covering monitoring applications should include relevant metrics including power requirements and calibration protocols and demonstrate achievement of industry specific metrics by end of Year 1.

Color and Appearance

The objective of this topic is to produce a fabric system with designed color profiles to create new fabric capabilities. Fabric systems that can change color on demand, have engineered spectral reflectance or have designed directional reflectance in specific wavelength bands are considered appropriate for this topic area. Metrics for each proposed prototype will vary but should represent significant change over state of the art in desired properties in terms of durability, regeneration, cycle time, spectral selection, output or other. Both passive and active fabric systems are of interest. Proposals should address power requirements for active systems.



Monitoring and Acting

The objective of this topic is to produce a fabric system that can both sense and respond to external stimuli. Fabrics that provide large area fault detection, detect hazards (such as radiation, TICs, TIMs, pollution, pathogens, etc.), measure stress or strain, temperature, light or detect falls, are considered appropriate for this topic area. Metrics for each proposed prototype will vary but should include selectivity required for reliable operation (e.g. probability of detection vs. probability of false alarm), system-level power requirements, potential interferences, description of algorithms required to interpret response and plans to test in relevant operational environment.

Physiological and Performance Monitoring

The objective of this topic is to produce a fabric system that can monitor and report physiological and performance status. Measurements of interest include hydration level, blood oxygenation, energy expenditure, hypothermia or shock measurements in fabric systems or other as defined. Metrics for each proposed prototype will vary but should include signal to noise ratio required for reliable operation, system-level power requirements, description of algorithms required to interpret response and plans to test in relevant operational environment

On Demand Chemical Release

Fabric systems capable of releasing chemicals on demand for wound treatment, hemostasis, vector protection, fragrance release, drug delivery or other specified, high value applications are sought. Integrated systems should be capable of releasing appropriate doses of chemicals, have a mechanism for replenishing or regenerating the supply of those chemicals and/or responding to external stimuli or on-demand request for release. Proposals should present system-level concept of operation and address any system power requirements.

Fabric Optical Communications

Proposals are sought for fabric systems that enable optical-based communications to provide overt or covert communications outside RF bands of energy. Fabric optical transmitters and receivers operating in wavelength ranges from UV-Vis through NIR to long-wave IR are of



interest. Responses must address system transmit and receive data rates, size, weight and power requirements. Presentation of an optical communications link budget for a scenario of the proposers' choice is required. Analysis of system noise, vulnerabilities to electromagnetic interference and methods to reduce transmit error rates in an electromagnetically-cluttered environment is desired.

Touch/User Interfaces

Fabric systems that enable new, natural user interfaces to existing electronic devices are sought. These systems can be based on capacitive/touch, motion, sound or other user generated actions. Output of the interface should be compatible with existing technologies such as hard wire, Bluetooth or WiFi. Year 1 prototype systems will demonstrate control of a current generation device with fabric-based user interface.

Energy

Many emerging technologies in textiles will require consistent, reliable, safe and potentially washable power sources. The development of energy delivery fabrics can greatly accelerate the delivery of new fabric technologies to the consumer for applications from self-powered shelters to drop and charge fabrics. The objective of this topic is to produce a fabric system capable of generating, storing and/or supplying power to relevant, modern electronic systems. The prototype systems should demonstrate useful charge/discharge rates and safe power cycles generation. Of interest are working prototype fabric systems that can generate energy through solar, triboelectric, thermoelectric, piezoelectric or other means with requisite electrical connections to supply power to a representative device. Also of interest are fabric systems that can store energy through supercapacitors or batteries that are incorporated into the fabric system itself. Systems should interface with existing electronic devices and provide power outputs suitable for the application they were designed. Fabric systems that can charge devices wirelessly regardless of specific area of contact through inductance or other means are of particular interest. Analysis of power generation per unit size and weight of fabric (Watts/m²/kg) is desired.



Engineered Properties

Fabric systems with engineered properties that demonstrate a major change over state of the art are sought. Systems may include the ability to self-clean, change shape, remember shape, control moisture, self-heal, react or respond based on surface properties, control and vary permeability or other properties.

4. Funding Expectations

Project Call 1.0 is expected to distribute \$3-8M in project funding on an annual basis with individual projects funded from \$500k to \$1M per year. Not all topic areas may receive an award. Year 1 prototypes should achieve at least an MRL level of 5. For more complex systems, prototypes may be a subsystem, with future year funding for full system manufacturing development. To achieve higher MRL levels, projects warranting a multiyear investment will have the option to renew funding annually, pending successful project review and completion of milestones. The average successful project is expected to run 2-3 years and advance technology from MRL 4 to MRL 7. Two project calls per year are expected to be released.

All projects are expected to provide cost share match to the federal investment through cash or in-kind. The amount of cost share is one criteria for proposal evaluation. With all other factors being equal, projects will be awarded to teams with the larger committed cost share. In-kind contributions constitute the value of non-cash contributions that benefit a federally assisted project. These contributions may be in the form of real property, equipment, supplies and other expendable property, as well as the value of goods and services directly benefiting and specifically identifiable to the project or program.

5. Proposal Evaluation Criteria

Proposals will be evaluated based on technology, learning capture assessment and cost based on criteria detailed below. Technology and learning capture assessment criteria takes priority over cost criteria.



- MRL before and after and credibility of MRL assessment
 - Product prototype scales currently
 - Scaled manufacturing process identified and demonstrated in Year 1
 - Producibility assessment performed
- Strength / uniqueness of background IP and know how
- Alignment of technology with AFFOA's mission
- Business model enabled
- Performers:
 - Know-how and facilities in proposed manufacturing process
 - Commercialization record
 - Manufacture USA commitment
- DoD / Dual use capability
- Commercial viability (e.g. \$/lb)
- Extensiveness of learning capture assessment
- Commercialization plan
- IP management and licensing plan (address background and foreground and willingness to license)
- Data sharing plan (e.g. what data will become shared knowledge and what will be maintained as proprietary, address background and foreground)
- Program management plan
- Total cost, cost share match and cost realism

6. Proposal Process

Timeline

Request for White Papers released: November 30, 2016

AFFOA Project Call Day: December 15-16, 2016

White Papers Due: January 17, 2017

Notification of down selection of White Papers for Full Proposal: February 17, 2017 (expected)

Full Proposals Due: March 17, 2017 (expected)



The proposal process will occur in two steps. White papers are submitted and reviewed by subject matter experts and market analysts. This step is designed to minimize the time spent in preparing proposals outside of AFFOA's scope. The template for white paper submission is posted on AFFOA's website (<http://join.affoa.org/project-call-december-2016/>). Within a month, proposers can expect to receive feedback and notification of down selection. Participants with selected white papers will be asked to submit full proposals and address feedback generated in white paper review stage. AFFOA's All Stakeholders Counsel will vet and approve the proposal package for Project Call 1.0. Specific proposals can be rejected at this stage. Distribution of funds to organizations whose full proposals are selected will be contingent on entering into a subaward agreement with AFFOA under its prime award with the government.

Program Management

Each team must identify a lead program manager (PM) of the project from a company and an organization-specific PM from each of the other team members that is accountable for deliverables and milestones. An AFFOA PM will monitor project performance with oversight and input from subject matter experts, market analysts and industrial members. Monthly short reports, full quarterly reports and a final report will be required. Updates to Learning Capture will be required as part of normal reporting workflow but do not require release of any proprietary or confidential information.

Membership Requirement

All participants must be AFFOA members at time of proposal submission. Only the suppliers from whom standard parts, components, or materials are acquired based on a part number from their catalog are exempted from this requirement.

Work Requirements

In order to submit a response to Project Call 1.0 and subsequently to be considered for an award, the following requirements must be met:



- Proposal teams shall include at least one corporate/industrial organization and should be industrially led. Non-profit institutions and universities are encouraged to apply for funding but must partner with a for-profit company and demonstrate scale up of their technology in a manufacturing facility in Year 1
- The company or composite team of companies/government labs/academics must have a significant presence in the US in the form of R&D activities (non-profit institutions) and manufacturing (for-profit entities). 100% of the work activity (funds) must be spent within the United States operations
- The total project funds must be matched with a preference of greater than 1:1. Teams may determine how to divide that requirement among their members

Submission and contact information

White paper submissions and questions or communications during the proposal process should be sent by email to proposals@affoa.org.

7. Additional Resources

AFFOA Project Call 1.0 White Paper Template: <http://join.affoa.org/project-call-december-2016>

In-kind cost share regulations: Applicants should refer to 2 CFR §200.434 for regulations regarding the valuation of in-kind donations and contributions, available at Electronic Code of Federal Regulations, <http://www.ecfr.gov/>. Cost share must be allowable, allocable and reasonable to qualify.

MRL/TRL level definition: http://www.dodmrl.com/MRL_Deskbook_V2.pdf

MRL/TRL definition webinar from NextFlex:

<http://www.nextflex.us/wp-content/uploads/2016/05/NextFlex-MRL-Webinar.pdf>