

INSTITUTE FOR MAINTENANCE SCIENCE AND TECHNOLOGY (IMST)

NORTH CAROLINA STATE UNIVERSITY (NC STATE)

CHARTER

1.0 Goals and Objectives

The mission of the IMST, a Research Institute, is to (1) sustain the life of aging equipment used by the military and its commercial counterparts by infusing new technology, methodologies, materials, and training into maintenance and rework operations and (2) develop the educational resources to address the knowledge gap.

Leveraging the broad technical base of expertise at NC State and IMST's commercial partners, the IMST will identify the technical resources to develop and implement appropriate solutions. The highly interactive and multidisciplinary technical capabilities of the IMST will be applied to resolve the on-going support problems associated with both immediate and long-term sustainment of equipment subjected to extreme environmental conditions. The disciplines of materials science, mechanical, aerospace, chemical, electrical, and computer engineering, as well as the physical and biological sciences, will be employed.

The IMST will have a strong educational mission consistent with that of NC State, promoting the educational, research, technology transfer, and outreach goals of the University by developing and providing education and training in engineering and science to bridge the anticipated knowledge gap in maintenance science and technology.

1.1 Specific Objectives of the IMST

- a) Advance the science and technology of maintenance for sustaining the working lifetime of aging aircraft, land-based vehicles, and sea-based equipment in both the military and commercial sectors
- b) Build partnerships with the military bases in North Carolina, commercial companies, and the U.S. Navy, Air Force, Army, and Coast Guard as well as other federal agencies. Leverage the individual strengths of these partnerships to create new knowledge in maintenance science and technology and transfer that knowledge to the military bases and military contractors for the economic benefit of the State of North Carolina.
- c) Serve as a model for expanding the research and educational mission of NC State by establishing a new paradigm for solving real time problems and developing implementable technologies through collaboration of NC State faculty with the engineering workforce at military bases in North Carolina who are responsible for maintaining fleet readiness
- d) Serve as a resource for retaining and creating jobs that will promote the economic growth of the State of North Carolina.
- e) Identify and develop new technologies for potential commercialization by existing and start-up companies for use by the military

- f) Facilitate interdisciplinary interaction across many departments and colleges of NC State
- g) Provide new educational opportunities for NC State students in the latest maintenance science and engineering technologies through research and technology transfer
- h) Provide formal graduate education and training to enhance the knowledge base of technical personnel within the military and its commercial counterparts through the on-site and distance education programs
- i) Develop new courses across a wide spectrum of disciplines including materials science, mechanical and aerospace engineering, chemical engineering, electrical and computer engineering, and computer controls as well as physical and biological sciences
- j) Develop and offer short term training courses, seminars, and workshops on campus and remotely to address near-term needs in specific technical areas
- k) Initially focus on several research areas for advancing the science of maintenance
 - Reverse engineering and rapid prototyping technologies
 - Sensors for predicting corrosion, stress, vibration, and impending material failure
 - Non-destructive testing and inspection (NDI)
 - Vibration and balancing technologies as applied to vertical lift aircraft
 - Advanced atmospheric plasmas for cleaning and paint stripping
 - Oil contamination analysis and detection
 - Advanced coatings for arresting corrosion and erosion
 - CAD and predictive modeling tools

The above goals cannot be achieved without establishing the IMST to provide the framework that facilitates the required interactions taking place.

2.0 Relationships

At this time there are no existing Centers, Institutes, or Academic Programs in the University of North Carolina system that have the unique mission of the proposed IMST for sustaining the readiness of aging aircraft and other military equipment. The goals and objectives of the IMST to advance the science and technology of maintenance and provide the educational opportunities for NC State students and personnel at military bases in North Carolina and throughout the United States can only be achieved through the proposed interdisciplinary structure and interaction across many Departments and Colleges of NC State and in conjunction with the military and commercial sectors.

3.0 The Director, Co-Directors, and Advisory Committees

3.1 Director and Co-Directors

Dr. Jerry Cuomo will be the Director of the IMST. Dr. Cuomo is a Distinguished Research Professor in the Department of Materials Science and Engineering, a member of the National Academy of Engineering, and a National Medal of Technology Laureate. He has an international reputation in the development of advanced materials and processes for industrial applications, ion beam and sputter deposition, enhanced plasma processes, diamond-like carbon films, and super hard coatings.

Dr. Roger Sanwald and Dr. John Strenkowski will be the Co-Directors of the IMST. Dr. Sanwald is a Program Manager and Senior Engineer in the Department of Materials Science and Engineering and expert in materials engineering, failure analysis, materials selection, and production quality control. Dr. Strenkowski is a professor in the Department of Mechanical and Aerospace Engineering and Associate Dean for Research and Administration in the College of Engineering. He has technical expertise in modeling of parts and processes, optimization of machining processes, design of tooling and fixtures, and testing of mechanical parts and components.

The responsibilities of the Director and Co-Directors of the IMST include:

- Providing leadership in short- and long-term planning
- Insuring proper conduct of research consistent with the objectives of the Institute and the mission of the University
- Collaborating with the Department Head of Materials Science and Engineering
- Recruiting new members of the Institute and establishing collaborative relationships with the military and with commercial companies
- Facilitating interdisciplinary interaction across Departments and Colleges of NC State
- Engaging an External Advisory Board (EAB) to provide vision and direction for the IMST
- Engaging an Industrial Advisory Board (IAB) to assist with managing the IMST
- Coordinating research projects and technology transfer activities
- Budgeting and administration of the IMST funds
- Ensuring compliance with University policy through a University Policy Committee
- Coordinating preparation of the annual report and meetings supportive of the Institute
- Pursuing sources of funds including task orders, grants and contracts, gifts, and institute membership fees

3.2 External Advisory Board – The External Advisory Board consists of individuals from organizations outside of the IMST with the experience to provide vision and guidance for the strategic development of the Institute. The EAB shall meet at least twice per year.

The responsibilities of the External Advisory Board include:

- Reviewing all existing and proposed IMST projects to:
 - Insure the topics address the needs of the industry
 - Identify relevant project milestones
 - Recommend additional potential projects
- Providing the “industry perspective” to University leaders relative to the goals, vision, and priorities of the IMST
- Obtaining feedback from industry and the military to strengthen the IMST program

The EAB shall initially include Mary Beth Fennell (Department of the Navy FRC-East), Pete George (The Boeing Company - Phantom Works), John Gumbel (The Boeing Company – Naval Integrated Logistics), Chris Holder (Department of the Navy FRC-East), Norman Scurria (DRS Technical Services), and Truman Wilt (PPG Industries).

3.3 Industrial Advisory Board – The Industrial Advisory Board is comprised of one representative (or designated alternate) from each governmental and public or private corporate Full Member of the Institute. The IAB will elect its chairperson from among its members and shall meet at least once per year.

The responsibilities of the Industrial Advisory Board include:

- Monitoring the Institute’s financial status
- Helping in the recruiting of new members
- Making recommendations about the expenditure of the Institute’s funds
- Making recommendations about the goals and new directions of the Institute
- Approving changes to the Bylaws and Membership Agreements

3.4 University Policy Committee (UPC) – The University Policy Committee will be chaired by the Vice Chancellor for Research and Graduate Studies, or his/her designee, and comprised of the Dean of the College of Engineering and relevant department Heads of the concerned academic units involved in the Institute. The UPC shall meet at least once per year.

The responsibilities of the University Policy Committee include:

- Providing academic oversight for the Institute
- Ensuring that the Institute’s activities are consistent with the mission and policies of the University

4.0 Budget Estimates and Funding Mechanism

Table 1 provides the expected budget by fiscal year (July 1 – June 30) for the first year of operation along with projections for the following four years. Expenditures, which have been increased by four percent per year, include salaries, equipment and supplies, travel, contract services, and tuition. Sources of funds include state, federal, industry, university, and memberships. This forecast shows the IMST as self-sustaining after five years.

State - Current funding is through a grant from the Golden Leaf Foundation that expires at the end of fiscal year 2007-2008. Other state funds are being pursued, but at present there are no commitments.

Federal – These funds come from various sources:

- a) IDIQ contract with FRC-East to conduct task orders on an as needed basis - The statements of work and timelines are developed directly with the customer. This is the basis for the task order contract that is issued to NC State.
- b) Congressionally directed dollars to support specific DoD missions - An example is the ONR grant from the Vertical Lift Center of Excellence located at FRC-East.

- c) SBIR/STTR programs - These programs with private industry provide federal funding to encourage the growth of small business. We have participated in these programs on an ongoing basis with several companies.

Industry - Two primary means of funding occur through this route; one is through contracts the other is through testing agreements.

- (a) Currently we have contracts with industry to provide process development work. These contracts have typically been approximately one year in duration with amounts up to \$750K for that time period.
- (b) Testing agreements are for services provided, and there is no overhead involved with this type of work. These agreements provide the customer with a specific amount of “testing” over a certain time. These projects are usually less than 75K and are completed within a one year period.

University - Presently there is no specific commitment for funds from the university. However, based on an understanding that we have with John Gilligan, we do have an account set up based on a portion of the overhead that IMST has generated. While this agreement is only for the current year, the expectation is that it will be extended to the follow-on years.

Memberships - The IMST will actively recruit industrial members. A conservative estimate was made beginning with two Full Members and three Associate Members in fiscal year 2008-2009 and then increasing in the succeeding years.

5.0 Space Needs

The IMST plans to lease office and lab space on the NC State Centennial Campus. The initial requirements include space for eleven offices for professional and administrative staff; ten carrels for graduate students; eleven desks for undergraduate students; a conference room; and laboratories for failure analysis, non-destructive testing, and material and chemical characterization. The conference room will include a video conferencing facility for technical interaction between the IMST faculty and staff and personnel at the depots. As the IMST grows in funding, faculty involvement, and industrial membership, additional space will be required.

6.0 Other Needs

In order for the IMST to meet its customer’s needs, a “business like” infrastructure is required. The nature of the work requires relatively short turnaround to resolve many types of engineering problems. Specific needs are for administrative support to handle the variety and number of “work orders”, technician support to maintain and conduct laboratory work, and engineering support to interface with customers and define work plans. In addition, office and basic laboratory supplies are required, together with resources to travel to meetings and trade shows to meet with potential customers.

The IMST will rely upon existing facilities on the NC State campus, such as the Analytical Instrumentation Facility, for technical analysis services. As more specialized equipment is required for specific technical projects, it will be purchased on an as-needed basis. This might include, for example, NDI equipment for crack detection; sensors and monitoring devices; advanced coatings facilities; predictive modeling tools for stress, thermal fatigue, and wear; vibration and balancing of rotating components; reverse engineering and rapid-prototyping technologies; and cleaning facilities such as blasting, thermal spray, stripping, and plasma coatings.

Future equipment needs will be explored through equipment loan arrangements with military and commercial members of the IMST, NSF programs such as the Major Research Instrumentation Program (MRI), and other DoD equipment grant opportunities.

No monetary commitments have been made by university or college administrators for capital equipment matching funds.

7.0 Effects on Instructional Programs

An integral part of the Institute's mission is to develop and provide formal graduate education and training programs to enhance the knowledge base of technical personnel within the military and its commercial counterparts. While no new degree programs are planned, the problems and solutions associated with maintenance science originate from a variety of disciplines and dictate that IMST students be knowledgeable in a wide array of subjects.

Courses will be developed across a wide spectrum of disciplines including materials science, mechanical and aerospace engineering, chemical engineering, electrical and computer engineering, and computer controls as well as other physical and biological sciences. IMST students will draw upon existing courses throughout the University as well as newly developed courses that relate more specifically to maintenance science. These will initially include programs in non-destructive testing and inspection, advanced coatings for reduced maintenance cost, and vertical lift technologies. Students in NDI, for example, will acquire knowledge of fracture mechanics, materials science for understanding the fundamentals of material failures due to corrosion and erosion, physics of imaging techniques, computational methods for predicting fracture and fatigue, and electrical engineering for developing sensors and the associated instrumentation.

Graduate courses will be offered through both the NC State on-site and distance education programs. Short term training courses, seminars, and workshops will also be developed and offered on the campus and remotely to address near-term needs in specific technical areas. Educational services will focus on bridging the knowledge gap resulting from increased retirement rates of military and civilian personnel and the rapid pace of technological advances in maintenance science.

8.0 Organizational Structure (See Figure 1)

- The Dean of the College of Engineering will be Responsible Administrator of the IMST

- Dr. Jerry Cuomo will be the Director of the IMST
- Two Co-Directors, Dr. Roger Sanwald and Dr. John Strenkowski, will assist the Director
- An External Advisory Board consisting of individuals outside the IMST – Mary Beth Fennell, Pete George, John Gumbel, Chris Holder, Norman Scurria, and Truman Wilt – shall support the Director
- An Industrial Advisory Board consisting of one representative from each Full Member, with chair elected from among the members, shall support and report to the Director
- A University Policy Committee, chaired by the Vice Chancellor for Research and Graduate Studies, shall support the Director. The UPC will be composed of the Deans of the Colleges with a vested interest in the Institute.

**Table 1 - Estimated Five Year Budget for the
Institute for Maintenance Science and Technology (IMST)**

	Expenditures for Fiscal Year (July 1 - June 30)				
	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Salaries					
Faculty	\$406,000	\$422,000	\$439,000	\$457,000	\$475,000
Engineering Staff	\$316,000	\$329,000	\$342,000	\$356,000	\$370,000
Administrative	\$68,000	\$70,700	\$73,500	\$76,400	\$79,500
Graduate Students	\$173,000	\$180,000	\$187,000	\$194,000	\$202,000
Undergraduate Students	\$94,000	\$97,800	\$101,700	\$106,000	\$110,000
Other Expenses					
Equipment & Supplies	\$225,000	\$234,000	\$243,000	\$253,000	\$263,000
Travel	\$45,000	\$46,800	\$48,700	\$50,600	\$52,600
Contract Services	\$21,000	\$21,800	\$22,700	\$23,600	\$24,500
Tuition	\$235,000	\$244,000	\$254,000	\$264,000	\$275,000
Total Estimated Expenditures	\$1,583,000	\$1,646,100	\$1,711,600	\$1,780,600	\$1,851,600
	Sources of Funds for Fiscal Year (July 1 - June 30)				
	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
State ⁽¹⁾	\$182,000	\$0	\$0	\$0	\$0
Federal ⁽²⁾	\$1,022,000	\$2,562,000	\$2,562,000	\$780,000	\$780,000
Industry ⁽²⁾	\$717,000	\$861,000	\$802,000	\$802,000	\$802,000
University ⁽¹⁾	\$230,000	\$140,000	\$80,000	\$80,000	\$80,000
Memberships	\$0	\$175,000	\$250,000	\$325,000	\$325,000
Total Sources of Funding	\$2,151,000	\$3,738,000	\$3,694,000	\$1,987,000	\$1,987,000
(1) No indirect cost included					
(2) Indirect cost at 48.5%					

Figure 1 - Organizational Structure of the Institute for Maintenance Science and Technology (IMST)

