TEEMS Briefing :: Vice President for Research, Texas A&M University :: March 1, 2007

Re: Proposal to establish a Laboratory for Geospatial and Remote Sensing Sciences, Technology and Application Development (LGRS-STAD)

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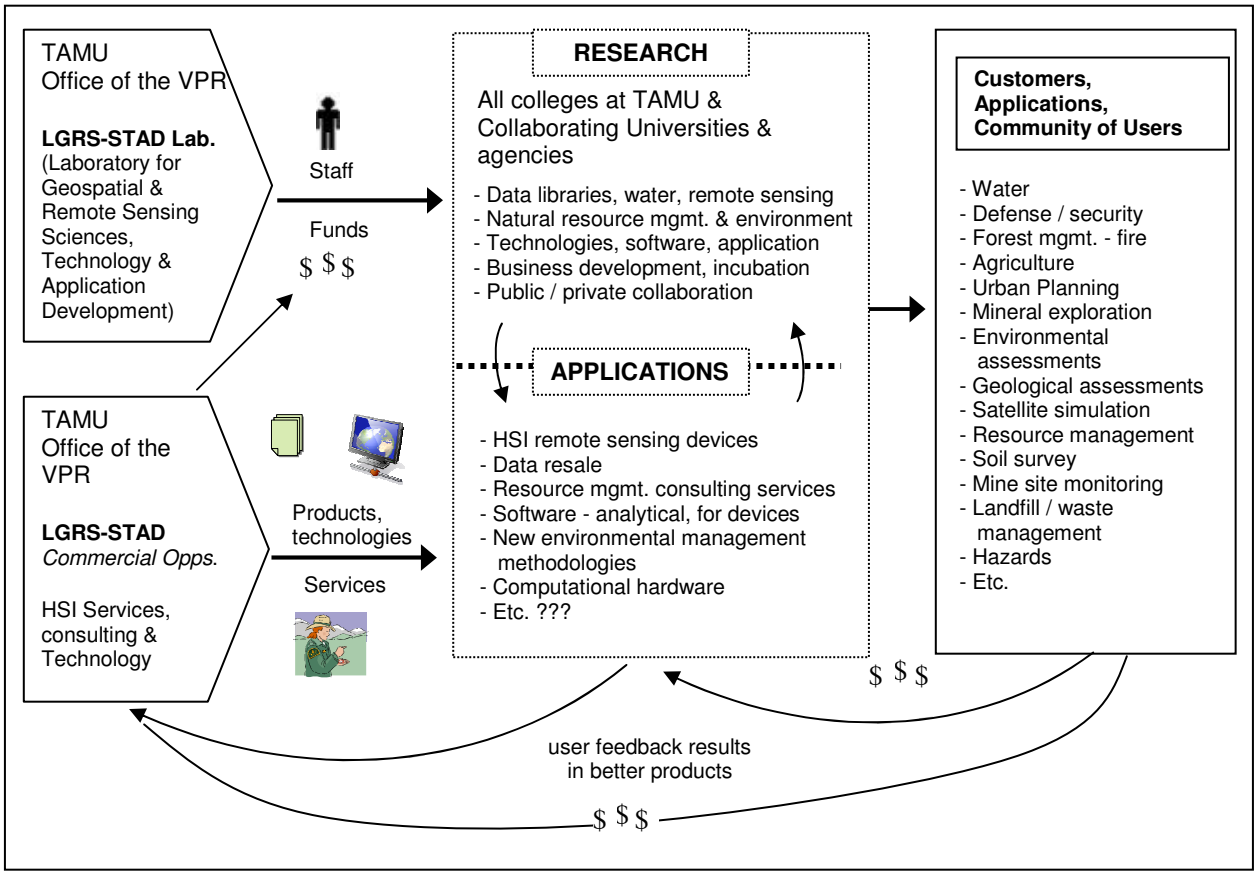
Introduction:
Broad-spectrum Hyperspectral Imaging systems (HSI) provide remote sensed images that can revolutionize how land use management decision makers conduct their activities. HSI can, and have been used for a wide array of projects, including:

- Water resource management
- Military / homeland security
- Forest management
- Urban planning
- Agriculture
- Mineral exploration
- Environmental assessments
- Geological assessments
- Satellite simulation
- Resource management
- Soil survey
- Mine site monitoring
- Landfill / waste management
- Hazards
- Etc.

The TEEMS (Texaco Energy and Environmental Multispectral Spectrometer) System donated to Texas A&M by Chevron/Texaco has created an opportunity for Texas A&M to establish itself as a leader in the nation and the world for the development and application of remote-sensing technologies and analytical processes and services. This document provides an outline for creating a Laboratory of Excellence for geospatial and remote sensing science research and technology development.



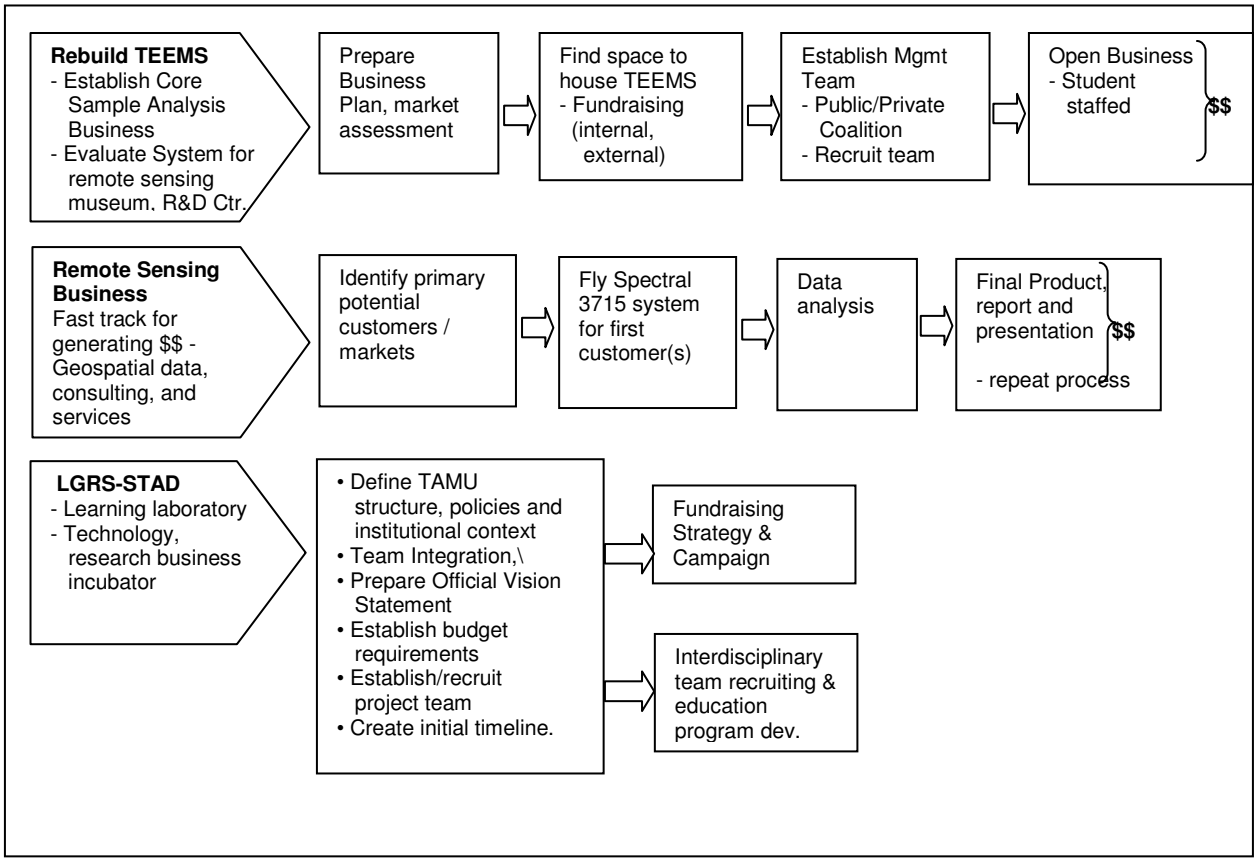
The laboratory will have four primary purposes:

a) creating a focused, pragmatic initiative to generate commercialization opportunities for Texas A&M,
b) creating exceptional hands-on and real-world learning opportunities for graduate and undergraduate students,
c) "pushing the envelope" of research into the geospatial and remote sensing sciences in concert with technology development and commercialization, and
d) delivering experienced and educated students to the workforce, and to extend research findings, data delivery and analysis services, and business opportunities into the public sector.

Pragmatic Business Oriented Approach

Remote sensing technologies and services utilizing Hyperspectral (HSI) technologies is essentially an untapped opportunity that could open up a multitude of business markets.

The following diagram depicts an approach combining the strengths and opportunities afforded through a collaborative public-private research and technology development initiative. A primary aim of the LGRS-STAD initiative will be to generate financial returns as quickly as possible. This approach will fulfill two primary purposes a) validate that there are significant business opportunities for HSI technologies and their application, and b) generate funds that can perpetually support growing the LGRS-STAD initiative.



Mission of LGRS-STAD

To enhance the ability of Texas A&M University to fulfill its mission as a Land-grant University. Primarily the Laboratory will advance research and scientific inquiry in the area of the geospatial sciences, and expand the utilization and application of what is discovered for resource management decision-making and for commercialization.

Environmental and natural resource management decision-makers can benefit from remote-sensed (HSI) data and spatial analysis because of its accuracy and cost-effectiveness. Prior to the development of these technologies and capabilities, land and resource management decision-making has been constrained by access to data (images) and analytical tools. The advent and development of

hyperspectral (HSI) and remote sensing technologies afford considerable opportunities to extend and apply these new tools, data, and processes. Potential customers/clients include

- Public land management agencies (water, forestry, mining, agriculture, etc.)
- State, local, regional and national governments (military, border security, water management, COGs, etc.)
- Private land owners and managers,
- Scientists, researchers, and
- Corporations, private businesses

The Laboratory's charter will be aligned with the goals of the Land Grant University system having the three-fold mission to foster education, research and public service (extension). However, this Laboratory will expand on this mission by creating a bridge to business development and technology commercialization opportunities. This aligns with the original mission set forth by the Vice President for Research's (VPR) Technology Transfer Commercialization Initiative (TTCI) that was established in 2003. The Laboratory will help the University better capitalize on business and commercialization opportunities by fostering ideas from the University environment into the public/private sector (patents, technologies, businesses) and by creating an end-to-end product development process from R&D to product and services delivery.

Background

The TEEMS (Texaco Energy and Environmental Multispectral Spectrometer) System donated to Texas A&M by Chevron/Texaco has created a tremendous opportunity for Texas A&M University. An estimated $15 million was invested to develop the TEEMS technology, yet Chevron opted not to pursue further R&D. Having acquired potentially the first and largest "broad-spectrum" multispectral device developed in the private sector puts Texas A&M in a unique position to lay a foundation for the development of new technologies in an area that has seen limited advancement since the device was created approximately 15 years ago.

Contributors to opportunities

Broad-spectrum HSI such as the TEEMS system (5 imaging spectrometers with 200 bands over the UV, Vis, NIR &SWIR) captures a large array of EM data that can be used for a wide range of purposes. Since data storage and computing power are no longer a limiting factor, as they were 15 years ago, the data captured by a hyperspectral system can be placed in a data warehouse and accessed on an on-demand basis, extracting data for conducting specific research and resource management objectives.

A number of factors have contributed to the current opportunities afforded through hyperspectral (HSI) technologies. When these systems were first being developed outside military applications in the early 1990's, computer technologies were significantly more expensive as was the actual system devices. Additionally, data storage, management and manipulation was also a challenge because the hyperspectral data collected by the systems were so large and required considerable computing power to conduct analysis. In the early stages of this type of remote sensing there were a number of industry and institutional players, but interest appears to have dwindled, possibly due to the constraints mentioned above. In the interim, technological advances have occurred with HSI but the devices have been used for specific industries that needed only narrow EM bandwidth HSI. As a result very little R&D, business or market development has occurred for *broad-spectrum* HSI and its application.

Since the 1990s there have been significant technological advances for all components of HSI systems. Some of the more significant have reduced the size of the device to where the system is no larger than a small suitcase (as compared with TEEMS being the size of a small automobile). Additionally, the sensors no longer need to be "super-cooled" as was the case with earlier systems. In addition to the advances with the actual devices, computer technologies have advanced similarly so data storage and analysis are no longer an issue.

Proof of Concept – Projects Underway in Missouri

To validate that HSI technologies are a virtually untapped business opportunity is the fact that the first "environmental" application was completed in 2005 in a collaborative project in Missouri. In this project the Missouri Department of Natural Resources (MoDNR) obtained a grant from the U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response (OSWER), to conduct a pilot project to evaluate applications of airborne Hyperspectral Imagery (HSI) to characterize ground

contamination. The Pilot Project used the Civil Air Patrol's (CAP) new Airborne Real-Time Cueing Hyperspectral Enhanced Reconnaissance (ARCHER) airborne HSI sensor and aircraft in anticipation of the proposed deployment of 16 ARCHER aircraft throughout the U.S. Multispectral Imagery (MSI) and HSI have been available from satellites and airborne platforms, both government and commercial, in increasingly better resolution and spectral coverage for several decades. Many applications to environmental issues have been studied and applied. This project focused on CAP's mission of disaster relief and emergency response; and therefore, ARCHER's potential role in Environmental Emergency Response (EER). At the same time, the Pilot Project explored other environmental contamination characterization applications. This pilot project has already led to inquiries from U.S. Corp of Engineers (COE) for using HSI to identify abandoned mine shafts.

In preparing this briefing, a number of interviews have been conducted with experts and scientists that use HSI and the consensus is that these technologies, and their application, are ripe for development. Additional “white-papers” and project reports are available that validate the growing opportunities for HSI technology development and application. The variety of potential applications for research and resource management decision-making seems to be almost limitless.

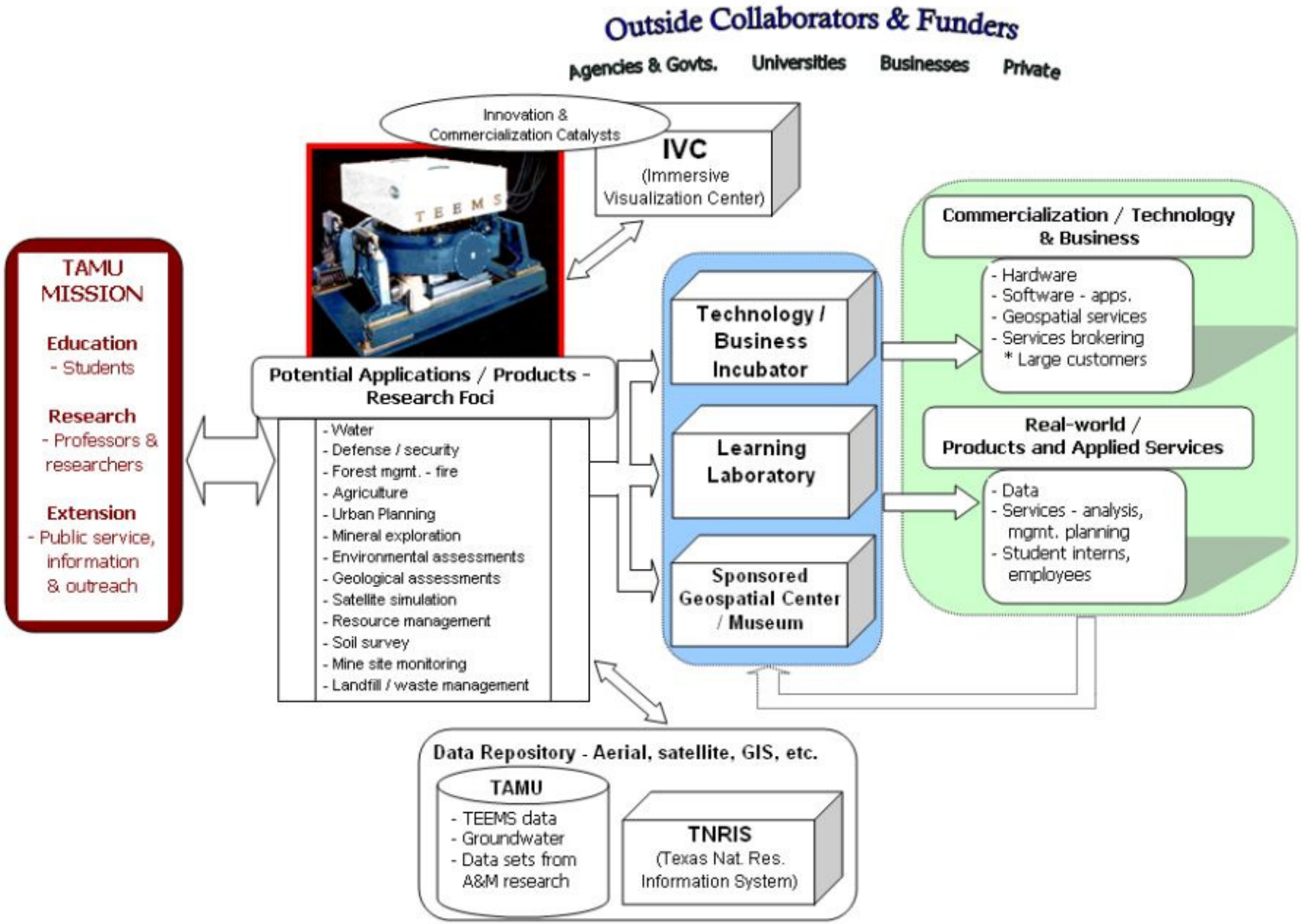


Figure 2. LGRS-STAD Functional Structure & Flow Chart