

1. Report No. SWUTC/05/473700-00019-1	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle BEST PRACTICES IN A UNIVERSITY ENVIRONMENT FOR HOMELAND SECURITY RESEARCH – TESTING AND EVALUATION		5. Report Date October 2005	6. Performing Organization Code
7. Author(s) David H. Bierling and Stephen S. Roop		8. Performing Organization Report No. Research Report 473700-00019-1	
9. Performing Organization Name and Address Texas Transportation Institute Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS)	11. Contract or Grant No. DTRS99-G-0006
12. Sponsoring Agency Name and Address Southwest Region University Transportation Center Texas Transportation Institute Texas A&M University System College Station, TX 77843-3135		13. Type of Report and Period Covered Research: September 2003 – August 2005	14. Sponsoring Agency Code
15. Supplementary Notes Supported by a grant from the U.S. Department of Transportation, University Transportation Centers Program. Research Project Title: Establishing Best Practices in a University Setting for Testing, Evaluation, and Management of Standards Setting for Products and Processes Related to Homeland Security			
16. Abstract Universities and other academic institutions are among the settings for conducting homeland security research, including testing and evaluation. This report identifies some of the best practices that may be useful for conducting homeland—security—related test and evaluation in university settings. The report includes advantages and disadvantages that may be encountered in academic environments, and suggests processes and practices that may be utilized in test and evaluation research team formation and project execution.			
17. Key Words Homeland Security, Test, Evaluation, Research, Best Practice, Academics, Basic Science, Applied Sciences Extension and Training, University, Program Building, Collaboration, Teaming, Organization	18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov		
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 20	22. Price

**BEST PRACTICES IN A UNIVERSITY ENVIRONMENT FOR
HOMELAND SECURITY RESEARCH – TESTING AND
EVALUATION**

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Report SWUTC/05/473700-00019-1
Project Number 473700-00019

Sponsored by the
Southwest Region University Transportation Center

October 2005

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ABSTRACT

Universities and other academic institutions are among the settings for conducting homeland security—related research, including testing and evaluation. This report identifies some of the best practices that may be useful for conducting homeland security—related test and evaluation activities in university settings. The report includes advantages and disadvantages that may be encountered in academic environments, and suggests processes and practices that may be utilized in test and evaluation research team formation and project execution.

EXECUTIVE SUMMARY

Increased funding availability in the United States related to homeland security has spawned the development of many new products that are marketed to homeland security applications and users, including the transportation sector. The Texas Transportation Institute (TTI) is one of the State of Texas agencies and institutions in The Texas A&M University System (TAMUS), which also includes the Texas Engineering Experiment Station (TEES) and Texas Engineering Extension Service (TEEX), that are currently engaged in homeland security—related research efforts. This report is a summary of some best practices for conducting research on homeland security applications, including testing and evaluation, in a university environment.

The academic community as a whole offers unique capabilities that can be applied to testing and evaluation that may not be found in the business community – in particular, the proximity to personnel trained in scientific analysis and methodology, lower costs and overhead fee structures than many private-sector corporations, and an independent and objective community base. There are also impediments to operating in an academic environment – such as limited perspectives of faculty members, bureaucratic organizational structures, and inability to respond rapidly to customer needs, which can in part be overcome by facilitating effective team formation and following consistent, proven work processes.

Effective team formation is among the best practices for conducting test and evaluation research. In a university environment, the available expertise for team components may come from persons with backgrounds in basic research, applied research, and educational training/extension. Identifying and selecting an appropriate organizational method at the outset of this process is beneficial to maximizing the efficiency of team formation. We identify four methods that can be utilized for team formation in a university environment:

- 1) building a program internally from the bottom up,
- 2) building a program internally from the top down,
- 3) interorganizational collaboration as a lead entity, and
- 4) interorganizational collaboration as a subentity.

Each of these methods has advantages and disadvantages that should be considered. They may have different applications depending upon the size of the program, the target of the program, and the scope of the test and evaluation research effort to be undertaken.

In addition to good team-building practices, following a process for conducting university-based homeland security research is also a best practice that can be identified. Other best practices include having good connections to promote the opportunity for and ability to successfully conduct test and evaluation projects; effectively collaborating across disciplines and organizations; coordination and communications within and across organizational boundaries; and rapid and effective responsiveness.

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ACKNOWLEDGMENTS

Support for this research was provided by a grant from the U.S. Department of Transportation, University Transportation Centers Program to the Southwest Region University Transportation Center. The authors express appreciation to Dr. W. Don Dickson of the Texas Center for Applied Technology, Texas Engineering Experiment Station for valuable input and discussion on the project. The authors also express appreciation to Curtis Morgan, Les Olson, Craig Roco, and Jeff Warner of Texas Transportation Institute for input on team formation issues.

BEST PRACTICES IN A UNIVERSITY ENVIRONMENT FOR HOMELAND SECURITY RESEARCH – TESTING AND EVALUATION

INTRODUCTION

Programs of testing and evaluation can serve a function to validate the suitability and application of products to the needs of the user community. Programs of testing and evaluation have long been present in the business community, in which analysis is performed internally to support product development, or is performed externally through laboratories (e.g., Underwriters Laboratories) and independent advocacy groups (e.g., Consumers Union). Another location for testing and evaluation activities is found in universities and the academic community.

The Texas Transportation Institute (TTI) is one of the State of Texas agencies and programs in The Texas A&M University System (TAMUS) that are currently engaged in homeland security – related research efforts. TTI and other TAMUS agencies, such as the Texas Engineering Experiment Station (TEES) and the Texas Engineering Extension Service (TEEX), employ both full-time research staff and Texas A&M University faculty.

Increased funding availability in the United States related to homeland security, including the transportation sector, has spawned the development of many new products. However, there exists a need to identify not only whether new products will perform under controlled laboratory scenarios, but whether products are viable and will meet homeland security needs in operational environments.

This report is a summary of some of the best practices that may be useful for conducting homeland security test and evaluation research – for transportation-specific and other applications – in a university environment.

TESTING AND EVALUATION RESEARCH TEAMS

The testing and evaluation needs of the homeland security community are broad and various. They most commonly will be focused on *specific products* or the evaluation of *systems of products* designed to work together. However, testing and evaluation can also be considered to extend to methods of approaching and overcoming problems encountered in the field or to understanding of behaviors and social implications.

Because of the nature and complexity of testing and evaluation, it is likely that these activities will not be the work of one individual, but rather a team effort of individuals across disciplines and expertise. *Effective team building* is among the best practices for conducting test and evaluation research. In a university environment, the available expertise for team components may come from persons with backgrounds in basic research, applied research, and educational training and extension.

Basic Research

OMB Circular A-11 (1999), Section 84 states, “Basic research is defined as systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind” (1). Because of its orientation towards an “academic” perspective of “knowledge for knowledge’s sake,” basic research occurs in nearly all facets of university programs. Specifically for homeland security, basic research programs with particular applicability include engineering, physical sciences, social sciences, liberal arts, agriculture business and economics, medicine, or political and military science.

Applied Research

OMB Circular A-11 (1999), Section 84 states, “Applied research is defined as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met” (1). That is, applied research does not seek knowledge for the sake of advancing knowledge, but seeks to apply knowledge discovered in basic research to specific applications. Many programs in a university environment include facets of applied research, and this type of research is directly applicable to solving homeland security test and evaluation problems. In some university systems, such as at TAMUS, specific agencies focus on applying basic research principles to applied needs. Faculty in university departments are also frequently engaged in applied research, in addition to basic research. Specifically for homeland security, applied research programs with particular applicability include engineering and technology, medicine, operations, human factors, planning, and policy and law.

Educational Training and Extension

Webster’s Online Dictionary references the Wikipedia definition of *educational training* as that which “tends to the vocational or practical and relates to specific useful skills”⁽²⁾ and references the WordNet Dictionary definition of *extension* in an academic environment as “an educational opportunity provided by colleges and universities to people who are not enrolled as regular students”⁽³⁾. Specifically for homeland security, educational training and extension programs with particular applicability include emergency services, medical sciences, physical sciences, agricultural sciences, engineering sciences, and social sciences. The expertise of personnel, as well as an understanding of the operating environment, can be an important facet of homeland security testing and evaluation programs. TEEX is an important and leading facet of homeland security—related activities at TAMUS.

¹ OMB Circular A-11 (1999) Section 84, p. 271. Available online at <http://clinton2.nara.gov/OMB/circulars/a11/s84.pdf>.

² Available online at <http://www.webster-dictionary.org/definition/training>.

³ Available online at <http://www.webster-dictionary.org/definition/extension>.

ADVANTAGES AND CHALLENGES OF WORKING IN THE ACADEMIC COMMUNITY

The academic community offers unique capabilities that can also be applied to testing and evaluation processes that are not generally found in the business community. Positive aspects include:

- the proximity to personnel trained in scientific analysis and methodology;
- access to dedicated research personnel and staff resources;
- a readily available supply of graduate students to work on projects;
- lower costs and overhead fee structures than many private—sector corporations;
- well-developed and established peer communities;
- an independent and objective community base; and
- access to numerous private and public entities through alumni, other academic institutions, etc.

However, there are also several impediments to operating in an academic environment:

- a theoretical perspective and lack of real-world experience or understanding by some in the academic community,
- bureaucratic organizational structures where rapid response to research needs may not be as flexible as in the private sector,
- difficulty in engaging the interest and participation of faculty in research whose operational paradigm restricts their perspective,
- a learning curve for faculty and graduate students who are not experienced with particular research problems, and
- inability of faculty to dedicate their full attention to the demand of research problems – many faculty have heavy teaching loads and academic appointments for up to nine months out of the year.

Overcoming these impediments can be facilitated by effective team formation and following consistent, proven work processes.

Team Formation

With availability of individuals from widely different backgrounds and training, the test and evaluation research team may be assembled “from scratch,” or alternately from a base of existing research centers and programs at the institution. Identifying and selecting an appropriate organizational method at the outset of this process is beneficial to maximizing the efficiency in progress of team formation.

Given consideration for the test and evaluation process, and the research categories that can be included, we identify four primary methods that can be utilized for team formation in a university environment. These include:

- 1) building a program internally from the bottom up,

- 2) building a program internally from the top down,
- 3) interorganizational collaboration as a lead entity, and
- 4) interorganizational collaboration as a subentity.

Each of these methods has advantages and disadvantages that should be considered. They may have different applications depending upon the size of the program, the target of the program, and the scope of the test and evaluation research effort to be undertaken.

Building a Program Internally from the Bottom Up

Building a testing and evaluation program internally from the bottom up is typically an effort driven by smaller groups of researchers and/or faculty, often within a university-based research program or center, that will be conducting the work. This may be structured around a general area of expertise, or a specific research target identified and made known to one or more of a research team. The smaller group of researchers may seek out other interested colleagues with which to team on developing a capability or targeted response. These colleagues are often located primarily within the same center, department, or campus.

Advantages for the test/evaluation team include:

- The team gets to hand-pick members with knowledge and topic familiarity.
- The team can select the test/evaluation project and associated scope of work.
- Decisions are made at the “grassroots” level by those performing the tasks.
- The project team has greater control of project budget distributions.

Disadvantages for the test/evaluation team include:

- The research team cannot require participation of unwilling external personnel.
- The research team faces increased costs for identification of funding sources.
- The team needs to “sell” or gain support for the project from senior management.
- Researchers entering fields with limited previous exposure may have limited external recognition.
- There is a greater potential for ignorance of the politics associated with projects.
- There is a greater potential for reduced awareness of parallel projects internal or external to the organization.

Building a Program Internally from the Top Down

Building a testing and evaluation program internally from the top down in a university-based research program or center is typically an effort driven by senior management and administration who have identified a research area and can assign subordinate personnel to the task.

Advantages to this method include having a centralized location for coordinating and handling administrative tasks and having the buy-in and support of senior program management.

Advantages for the test/evaluation team include:

- The project already has the support of senior management.
- Senior management has the authority to assign top personnel to the project irrespective of motivation or willingness.

- There is a greater awareness of political implications by senior management, which may be communicated to team members.
- There is an awareness by senior management of the bigger picture regarding similar or other research efforts within or outside of the organization.
- Project funding sources may have been previously identified by senior management: they may have an awareness of alternate funding sources for matching or supplementary funds.

Disadvantages for the test/evaluation team include:

- Senior management may have preconceived notions about the project approach.
- Project team members may be compelled to participate by senior management: there may be interpersonal team conflicts and/or reduced motivation by some team members for participation.
- The research team may have limited ability to select projects of desired participation.

Interorganizational Collaboration as a Lead

Collaborating with other organizations, including those within the university setting that are in another functional division, or public or private components outside the university is another team-building approach. Collaborating as a lead will typically be undertaken by an entity that has well-recognized and extensive administrative, management, and test execution capabilities and expertise in subject areas. They may also desire additional participation due to political reasons, a need for augmenting subject expertise, developing new or continued relationships, or meeting funding program requirements.

Advantages for the lead organization include:

- control of project budget,
- control of project direction,
- ability to define scope and extent of participation in project tasks,
- ability to broaden knowledge base through collaboration with other entities.
- ability to select motivated participants, and
- ability to put forward multi-organizational and multidisciplinary proposals.

Disadvantages for the test/evaluation team include:

- responsibility for all project results, including those over which there is limited control,
- increased project management and contractual complexity,
- increased risk of legal impediments,
- limited ability to compel participation of external participants, and
- project collaboration, which necessitates sharing of budgetary resources.

Interorganizational Collaboration as a Subentity

Collaborating with another organization as a subentity will typically be undertaken by an entity that has well-recognized capabilities and expertise in subject areas but that may have limited administrative or management capabilities, or have a minor role in a more broadly scoped project. A subentity may be approached by a lead entity after the lead becomes aware of the subentity's expertise. Alternately, a subentity may approach other organizational components

that have administrative and management resources sufficient to lead large-scale test and evaluation activities.

Advantages for the suborganization include:

- ability to stay focused on core competencies,
- limited project responsibility and reduced liability for project results,
- ability to participate in projects that they might not have otherwise been able to, and
- ability to broaden their knowledge base through collaboration with other entities.

Disadvantages for the suborganization include:

- reduced control of the project budget,
- reduced control of the project direction, and
- reduced ability to define the scope and extent of participation in project tasks.

TESTING AND EVALUATION RESEARCH PROCESSES

In addition to good team-formation practices, following a process for conducting university-based homeland security research is another best practice that can be identified. Dr. Don Phillips of Texas A&M University's Department of Industrial Engineering has defined nine phases of a test and evaluation process as follows:

1. Identify a need for test and evaluation (needs analysis).
2. Bound the test and evaluation process (scoping document).
3. Conduct a domain-specific technology assessment.
4. Select a test set.
5. Design a test plan.
6. Execute the test and evaluation phase.
7. Analyze test data (subjective, qualitative, and quantitative).
8. Rank alternatives.
9. Conduct a “peer review” of results/quality assurance.

Throughout this process, there is a need for standardization and consistency, with an ability to produce repeatable results. Additional best practices based on the experiences of the authors are discussed below.

Connections

Having good connections in academics, industry, the responder community, and government is an important business practice to promote the opportunity for and ability to successfully conduct test and evaluation projects. This is facilitated by being engaged and aware of current issues, as well as knowing persons that are “up and coming” or are leaders in their fields. Input from expert groups and the user community is important to avoid the misguided pursuit of finding problems for solutions. Personal contacts and networking may lead to additional personnel that are interested and available to be involved, sources of funding, or new ideas. Networking and connections (balanced with the right expertise on project teams), awareness of available

resources, as well as good judgment in project feasibility will promote successfully conducting test and evaluation projects in university settings.

Collaboration

Being able to collaborate successfully across disciplines and organizations is probably among the most rewarding, yet most difficult, challenges for any project. This is certainly true in homeland security test and evaluation. Because of its complex nature, homeland security test/evaluation in university settings often involves persons from basic research, applied research, and extension from diverse backgrounds. Effective collaboration requires communicating in common languages, which can take patience and a willingness to explain and understand discipline-oriented terminologies, perspectives, and operational paradigms. It can be enhanced by avoiding “stove piping” and communicating across organizational and discipline-oriented boundaries. As with many organizations, there is often a great degree of competition and politics in the university environment. Focusing on the success of the project as a whole, rather than the success of individual parts, will promote interdisciplinary and interorganizational cooperation. While successful collaboration across disciplines and organizations is a substantial challenge, it is a recipe for project success when it can be successfully implemented.

Coordination

Being able to effectively collaborate requires that the lines of communication be both well defined and used. In more complex test/evaluation activities, it can be helpful for each entity to have defined coordination points that can function as communication hubs and coordinate efforts of closely affiliated units. At large institutions, tracking a multiplicity of test or evaluation activities and their relation to other opportunities for homeland security applications is likely to be challenging, particularly with the variety of disciplines and programs found in the academic environment. Avoiding duplication of efforts or activities may require particular emphasis on coordination. Effective project leadership can direct efforts and function as a point of direction and response to customer needs. At each level – whether it be project, program, or institutional – effective leadership is essential to success.

Response

Particularly applicable to university settings is the need to be flexible and respond rapidly to customer needs. Bureaucracy in academic institutions, like many large organizations, can delay or inhibit the ability to land, carry out, or complete test and evaluation projects. Project leadership needs to be cognizant of such constraints and aware of methods to limit and offset negative impacts. Project personnel should be aware of “ivory tower” perceptions of academia that may be associated with conducting test and evaluation work in university settings. In addition, project personnel need to be able to respond rapidly. Because of their academic affiliations and associated time constraints, university faculty can have a difficult time responding rapidly to customer needs. Involving the right personnel and ensuring effective approaches to addressing customer needs is promoted through networking, collaborating with the right individuals, and good coordination of project expertise and resources.

CONCLUSION

Conducting homeland security—related test and evaluation work in university settings can be both challenging and rewarding. Effective team formation will include identifying the type of expertise required in different facets of a project, as well as understanding the pros and cons of different team-building structures. Conducting test and evaluation work will benefit from following defined processes, as well has having good project connections, collaboration, coordination, and response capabilities.