The Center for Friction Stir Processing

A Case Study for Managing a Multi-site Industry/University Cooperative Research Center

A supplement to Gray and Walters

by

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Table of Contents

Table of Figures

Preface

The Center for Friction Stir Processing (CFSP) is a multi-university Industry/University Cooperative Research Center (IUCRC) established in 2004 with a collaborative research partnership between the South Dakota School of Mines and Technology (SDSMT- NSF Award 0437396), University of South Carolina (USC- NSF Award 0437341) and, the Brigham Young University (BYU – NSF Award 0437358). The Missouri University of Science and Technology (MUST) was added as a university site in 2005 and Wichita State University (WSU) was added in 2007. In 2009, the CFSP five year renewal proposals were approved to carry the center operations through to 2014.

The CFSP vision is to provide the forum for industry/university cooperative research on the development, validation, and industrial implementation of the emerging solid-state materials joining and processing technologies known as Friction Stir Welding (FSW) and Friction Stir Processing (FSP). Twenty-eight (28) industry and government sponsors from six countries represent the current active membership and provide funding for the research programs. TIE programs have been developed with other IUCRC Centers and REU and RET supplementals have provided additional support. The current membership of the CFSP includes representatives from the aerospace, automotive, defense, energy, and primary materials production sectors.

A global multi-university IUCRC experiences unique management challenges to ensure meeting the needs of the individual universities, industrial sponsors, and NSF. Communications is the primary factor in optimizing center operations. To address this, the CFSP developed a series of "Policies, Procedures, and Practices (P^3)" to implement the IUCRC organizational and management structure recommendations of Gray and Walters[1]. Chapters 1 through 5 of this book document those P^3 evolved at the CFSP to provide for maximum operational control of the center operations. Chapter 6 expands these P^3 into the paperless management arena through development of interactive and dynamic web based management tools which can be downloaded and implemented at other IUCRC centers.

Contributions to the development of these management tools come from the many faculty, students, and staff at each of the CFSP partner university sites. These include: SDSMT- Dr. Anil Patnaik, Mr. Casey Allen, Mr. Dale Skillman; Dr. Michael West, Dr. Stanley Howard, Dr.

Karim Muci, Dr. Damon Fick, and Ms Colleen Gustafson; USC- Dr. Anthony Reynolds; BYU- Dr. Tracy Nelson and Dr. Carl Sorensen; MST- Dr. Rajiv Mishra; WSU- Dr. Dwight Burford.

Significant inputs from the CFSP Industrial Advisory Board guided the development of these tools to meet the needs and project reporting requirements of the sponsoring membership. The past IAB chairman – Dr. John Wagner (NASA LaRC) and the current IAB chairman - Dr. John Baumann (The Boeing Company) each have contributed giving both a government and industrial perspective on the center operations and reporting needs. The CFSP NSF Independent Evaluator (Dr. Ron Beck) provided inputs and guidance on development of these P^3 to ensure meeting NSF needs.

Of particular importance are the contributions to this Case Study made by the students from the Math and Computer Science (MCSC) Department at the South Dakota School of Mines. Over the past five years of center operations, various elements of the management tools were prepared programmed these students. The 2009 P^3 Team was composed of Ariunaa Chuluunkhuu (MS), Jaelle Scheuerman (UG) Jordan Ritz (UG), Matthew DesEnfants (UG), Garrett Brandt (UG), and Joshua Finch (UG). Previous team members, Christopher Rudolph and Adam Bauerle also made significant contributions. The team, advised by Mr. Roger Schrader (Instructor-MCSC), was responsible for transitions of these downloadable and customizable management tools into the paperless environment offered by the interactive and dynamic CFSP Website (http://cfsp.sdsmt.edu/). Thanks are also due Amy Telford for her help with the formatting and indexing of the final manuscript.

Funding for this IUCRC Management Tools Case Study comes from the National Science Foundation I/UCRC Program Office (Dr. Alexander Schwarzkopf, Dr. Rathindra DasGupta, and Dr. Glenn Larsen). Special thanks go to Dr. Denis Gray (NCSU) in his review of this case study which implements the IUCRC management and organization as originally defined in the "Purple Book" (http://www.ncsu.edu/iucrc/PurpleBook.htm).

This case study is a living document as the CFSP P3 continually evolves to meet the needs of updated center operations and membership requirements. To accommodate this, a wiki of the contents of this book has been created (http://cfsp.sdsmt.edu/guide/Main_Page) and will be available for peer review, comments and updates in the near future. Also,

the downloadable management tools (Chapter 6) are available for potential implementation at other IUCRC Centers. It is the belief of the authors of this case study that early development and implementation of these P^3 tools contributed to the early successes of the CFSP and will increase the successes during the next five years of center operations. It is hoped that this case study will help guide the development of global, multi-university IUCRC in the future.

We lost Bill Arbegast in 2009. He was the driving force behind the CFSP and this book. If there are any significant problems with this manuscript, it is because lesser people had to finish the effort he spearheaded.

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THE CENTER FOR FRICTION STIR PROCESSING

Chapter 1

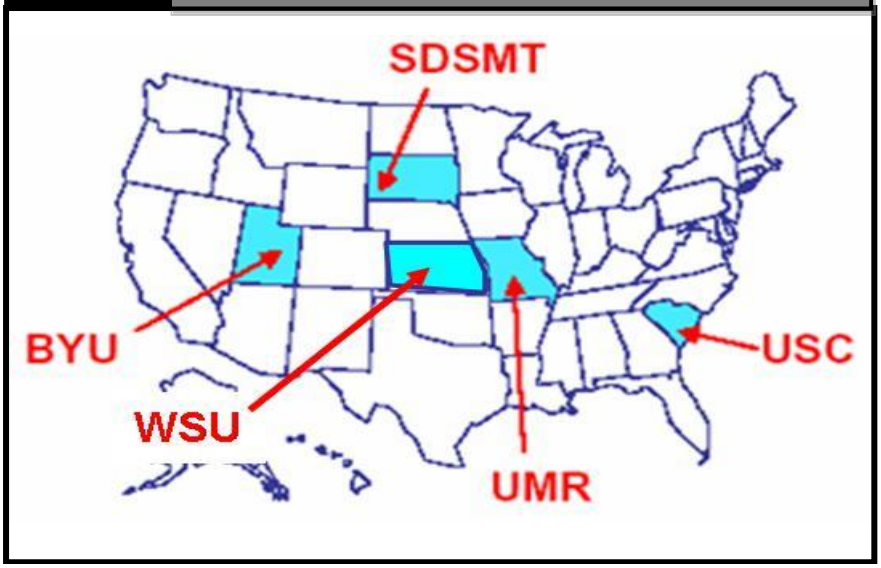
1.0 INTRODUCTION

"The National Science Foundation Industry/University Cooperative Research Center (I/UCRC) program develops long-term partnerships among industry, academe, and government. The centers are catalyzed by a small investment from the National Science Foundation (NSF) and are primarily supported by industry center members, with the NSF taking a supporting role in their development and evolution. Each center is established to conduct research that is of interest to both the industry and the center. An I/UCRC contributes to the Nation's research infrastructure base and enhances the intellectual capacity of the engineering and science workforce through the integration of research and education." [NSF Program Solicitation NSF 01-116]

The Center for Friction Stir Processing (CFSP) is a multi-university Industry/University Cooperative Research Center (I/UCRC) established in 2004 with a collaborative research partnership between the South Dakota School of Mines and Technology (SDSMT), University of South Carolina (USC), and the Brigham Young University (BYU). The Missouri University of Science and Technology (MUST, formerly UMR) was added as a university site in 2005 and Wichita State University (WSU) was added in 2007. Over 25 industry and government sponsors

from five countries represent the current membership and provide funding for the research programs.

Figure 1.1 *Multi -University Partner Site Map for the NSF Center for Friction Stir Processing I/UCRC*



Gray and Walters[1] have detailed the functional requirements of successful single and multi-university I/UCRC and make specific recommendations for center policies, procedures and practices (P3) which have shown proven results. In implementing these methods of Gray and Walters, the CFSP recognized several unique challenges to ensure meeting the administrative and management needs of the university sites, industrial sponsors, and the NSF.

To address these, a series of formal management tools have been instituted at the CFSP. Collectively, these are referred to as the *Center Policies, Procedures, and Practices (P3).* While the *(P3)* has shown to provide an effective management strategy for a multi-university I/UCRC, the CFSP is continually implementing

[1] Dennis O. Gray and S. George Walters, "Managing the Industry/University Cooperative Research Center: A Guide for Directors and Other Stakeholders" (http://www.ncsu.edu/iucrc/PurpleBook.htm)

improvements to incorporate more *"Paperless Management"* tools.

Gray and Walters state that a successful I/UCRC must first establish a *vision; a mission statement; and, a list of objectives*. The vision is the statement of purpose for the center – its reason for being, and how it hopes to impact the future.

> "*The vision, an idea of a possible future to achieve, is probably the most important ingredient in a successful strategy" [Gray and Walters, pg. 119]*

The mission statement defines the goals for the center in broad terms. Gray and Walters note that the mission statement should contain four elements: *who*, *what*, *means*, and *participants*. The objectives are process-oriented and measurable, defining how the center will achieve the goals set forth in the mission statement.

For the CFSP, the defining statements about the center were developed collectively with the university site partners of the center. During the planning grant phase of the program, a meeting of over 30 prospective industrial members representing the leading industrial researchers in the FSP field was convened to define an initial listing of focused research topics. These topics represent the *industry perceived* gaps in the science and technology acting as barriers to more extensive industrial application of the technology. To define a comprehensive *vision, mission, and objectives*, the partner universities and potential industrial partners were identified very early in the planning grant process.

Although the *vision statement; mission statement; and, a list of research objectives* form the foundation of the center, they are not static and should be reviewed and revised by the Site Universities and Industrial Advisory Board (IAB) as the technology advances and the industrial membership needs change.

1.1 CFSP VISION STATEMENT

The Center for Friction Stir Processing (CFSP) vision is to provide the forum for industry/university cooperative research on

the further development, validation, and industrial implementation of the emerging solid-state materials joining and processing technologies known as Friction Stir Welding (FSW) and Friction Stir Processing (FSP).

1.2 CFSP MISSION STATEMENT

The Mission of the NSF Center for Friction Stir Processing is:

- To advance, develop and promote research into the principles and technology of Friction Stir Processing science and engineering through research, development, education, and technology exchange among academic, industry, and government entities;
- To increase the quantity and quality of the professionals prepared to work in the area;
- To involve the faculty of the University(s) in research in areas of common interest to Sponsors and the University(s);
- To perform research that will allow global Friction Stir Processing facilities to be competitive in the world economy

1.3 CFSP RESEARCH OBJECTIVES

The overall objective of the Center is to develop and deliver relevant scientific knowledge that will help its industrial members with future challenges. Center programs are designed to complement the members' in-house research and development in the area of friction stir processing by bringing together theoretical, experimental and application experts from industry and academia. The specific objectives focused on the following:

- *Friction Stir Joining:* Process optimization (parameters, pin tool materials, pin tool designs); process modeling (thermal, forces, metal flow, residual stress, distortion, microstructure evolution); microstructural characterizations; property characterizations (tensile,

fatigue, fracture, creep, corrosion); nondestructive evaluations; new alloy development.

- *Friction Stir Microstructural Modification:* Induced superplasticity; grain refinement; sub-micron and nano particle injection; defect removal.
- *Friction Stir Post-Processing*: Heat treatment; forming (stretch, spin, age, and creep); machining; finishing.
- *Friction Stir Structural Designs and Applications:* replacement of fusion welds and rivets; static and dynamic response of structures; efficient design and analysis methodologies.
- *Friction Stir Intelligent Controllers and Efficient Tooling:* Process sensors; logic-based controllers; reconfigurable tooling.
- *Friction Stir Cost Benefits Analysis:* Business case development and environmental impact assessments.

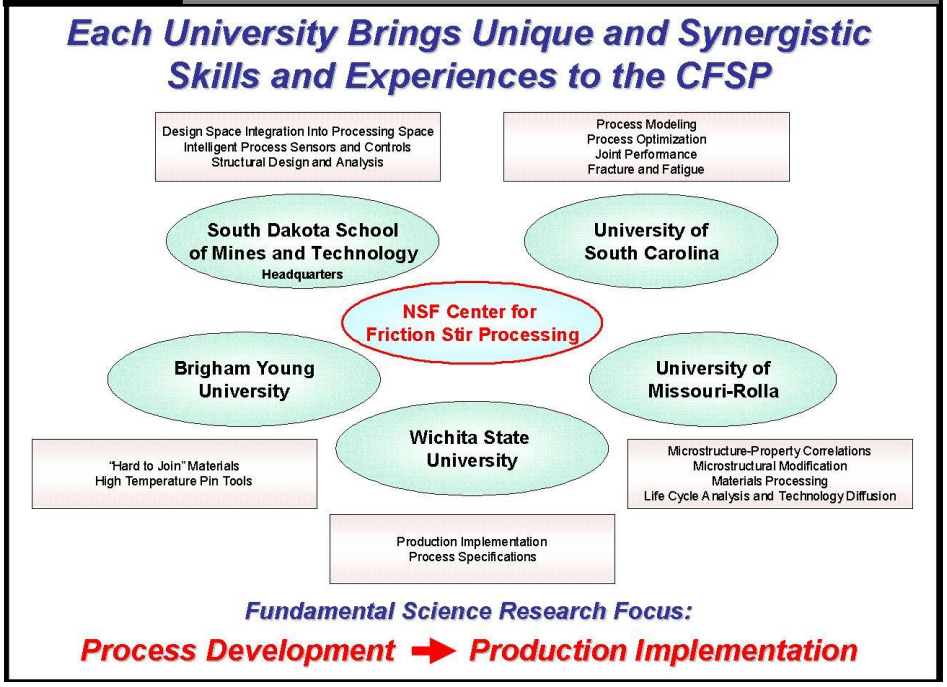
During the Planning Grant process of the CFSP, each potential industry sponsor identified focused research directions for the center that fit into their research resources. The university members then discussed their capabilities – equipment, availability of faculty with desired expertise, external relationships that could be explored – and the group found the optimal match between research initiatives and university capabilities at each site. Programs were then developed along the lines of the identified focused research areas at each site.

1.4 CFSP POLICIES, PROCEDURES, AND PRACTICES (P3)

The following paragraphs outline the operating policies, procedures, and practices (P3) for the Center for Friction Stir Processing I/UCRC. They are coordinated and finalized between the participating universities during the planning phase of the program. Development of P3 follows those recommended by Gray and Walters with inputs from the CFSP Industrial Advisory Board (IAB) and from other sources. The CFSP Center Director may amend these P3 upon recommendation of the IAB, participating university faculty, or university administration.

Approval of all policies and procedures are obtained from the appropriate Dean (or Provost) at the participating universities in accordance with the specific site university policies and procedures.

Figure 1.2 *Complementary and Non-Competitive Focused Research Areas for Each University Site of the Multi-University CFSP I/UCRC*



1.4.1 Membership Policy

Membership shall be open to all corporations, foundations, government agencies and/or other entities who: (1) own FSP facilities in the United States or who (2) directly contribute to support FSP research to make such facilities more efficient and competitive and or who (3) provide FSP products or services useful in FSP. Each Sponsor shall execute and agree to be bound by the terms of a Sponsor's Agreement and the policies and procedures set forth therein.

The membership fee for a Sponsor shall be $35,000 initially and annually. The initial membership term for a Sponsor shall be three years, contingent on availability of sponsor internal funding; thereafter the term shall be yearly subject to a notice of withdrawal of not less than six months. Payment of the membership fee may be made annually, semiannually or quarterly.

1.4.2 Industrial Advisory Board Policy

Each Sponsor shall have the right to designate a representative to be a member of the Industrial Advisory Board. The Industrial Advisory Board shall advise the Center Director and Site Directors regarding (a) research projects to be conducted under the university auspices, (b) the allocation of resources to such projects, and (c) the policies and procedures of the Center. The Industrial Advisory Board will meet at the call of the Center Director, normally twice each year.

1.4.3 Selections of Research Projects Policy

From time to time, the Center Director, Site Directors (Principal Investigator) and Industrial Advisory Board will prepare a list of potential research projects to be performed under the auspices of the Center. Thereafter, the Center will submit to University(s) faculty member's requests for proposals setting forth all appropriate information related to the proposed research projects. Special emphasis will be placed on ensuring that faculty collaboration between multiple university sites is encouraged during the proposal preparation phase.

Upon receipt of all proposals from the faculty, the Industrial Advisory Board, Center Director, and Site Directors will decide which proposals will be funded and which university will be the principal site for the project. Each member of the Industrial Advisory Board having one vote for each project to be considered, subject, however, to the right of each site principal investigator to allocate up to one-third of the participating University funds budgeted for research to projects selected by the principal investigator and the participating University.

1.4.4 Project Principal Investigators Policy

If the Center decides to support a research project, the faculty member(s) who submitted the chosen proposal for such project will be the Project Principal Investigator and will assume the overall responsibility for managing the project. This responsibility will include:

- Organizing and conducting the research project.
- Selecting and supervising the appropriate research associates, graduate students, and technicians to conduct the research.
- Preparing and controlling the project budget.
- Periodically preparing semiannual and annual reports and, as appropriate final reports and external publications of the research findings.
- Organizing and participating in semiannual research review meetings with the Site Industrial Advisory Board and appropriate Technical Representatives to report on progress of the research.

From time to time, the Center Director, Site Director, and Project Principal Investigators of each University will meet with each Industrial Sponsor to review the progress made in the research being conducted.

1.4.5 Regular Reports Policy

Written semiannual reports and more detailed annual reports documenting and summarizing the technical progress of individual research projects will be prepared by the applicable Project Principal Investigators. The Site Director will forward these reports to the Center Director. The contents of these reports may include review articles and bibliography suitable for submission to journals. Oral presentations will be given to the members of the Industrial Advisory Board at the semiannual meetings. The annual Center Report shall also include a description of future research initiatives.

At the completion of each research initiative, each Project Principal Investigator shall prepare a final report completely documenting the goals, objectives, approach, and conclusions of the project. Recommendations for future research initiatives shall be included. The Site Director will forward these final reports to the Center Director. Copies of all semiannual, annual, and final reports shall be forwarded to the Center Director for record retention.

Each year, the Center Director shall prepare a Center Annual Members' report summarizing the research activities of each of the Site Universities. Copies of the I/UCRC Annual Members' report shall be distributed to all sponsors. A bibliography of all site annual reports and center publications shall be provided to all sponsors in the Center Annual Members' report. This annual report shall also include a description of upcoming and proposed research initiatives of the CFSP.

1.4.6 Publication Policy

At any time a Project Principal Investigator may request permission to publish information presented in semiannual, annual, or final reports or arising out of or resulting from research projects. To receive permission, the Project Principal Investigator shall submit to the participating university Site Director the document to be published in substantially the form in which the Project Principal Investigator will seek publication. Publication approval shall be withheld until publication approval is received in accordance with the procedures outlined in the CFSP Membership Agreement (Appendix A).

1.4.7 Patent Policy

All inventions or discoveries first conceived or reduced to practice in the course of research conducted under the auspices of the CFSP shall have the title vested in the Site University, which was the principal site. Multiple site projects shall have the title vested equally in each participating site.

Any invention or discovery which was supported, in whole or in part, by the National Science Foundation or other government agency shall be subject to the terms and conditions of the

agreement by which such federal or state funds were used in the development of the invention or discovery. The CFSP Membership Agreement further defines the patent policy (Appendix A).

1.4.8 Termination of Research Policy

The CFSP Membership Agreement defines the Termination of Research policy (Appendix A).

1.5 CENTER STRUCTURE

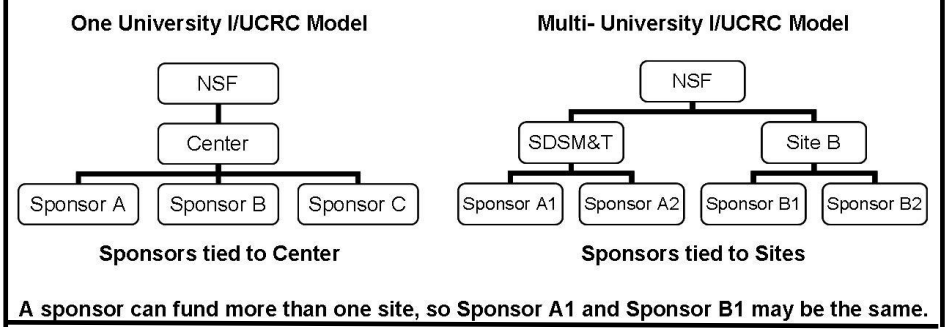
1.5.1 Overall Center Structure

There are several possible models for overall structure of an I/UCRC. One model is for the NSF and industrial sponsors to fund the center as a whole. The model chosen by the CFSP is for sponsors and the NSF to fund particular sites directly. This way a sponsor can attach itself more closely to particular projects at a particular site. A sponsor does have the option of having multiple memberships at several sites if it is willing to provide funding for each membership.

This direct funding of sites by both the NSF and the industrial members does have a negative side – if communications, collaborations and coordination between the university sites are not emphasized to the maximum levels, the potential exists for one site to become an "*island*" and drift away from the overall vision, mission and objectives of the Center. It is the challenge of the Center Director to ensure that this does not happen.

The division of focused research directions among the participating universities prevents redundant efforts as well as reducing the number of communication paths required to perform the work. Note that a research thread may be divided between several universities, but, to the extent possible, project leadership is confined to a single site.

Figure 1.3 *University and Multi-University Models for a I/UCRC (Gray and Walters)*



1.5.2 University Partner Structure

The center is composed of universities and industry partners distributed across the world. From the university perspective, there at five participants: South Dakota School of Mines and Technology (SDSMT), the Missouri University of Science and Technology (MUST), the University of South Carolina (USC), Brigham Young University (BYU), and Wichita State University (WSU). Each is an equal partner with a Site Director responsible for center activities.

The CFSP Center Director is located at SDSMT. Each of the Site Directors is responsible for the operation of the center at their respective university. The Center Director is responsible for overall performance of the center.

Collaborations between other NSF I/UCRC Centers and CFSP participating university sites are possible through Supplemental NSF TIE programs and REU and RET funding define additional research opportunities related to friction stir processing (Section 3.6). Typically, a site university has CFSP IAB approved research projects plus additional friction stir sponsored research programs outside of the purview of the center. The CFSP Site universities are encouraged to collaborate on proposals and research opportunities from these other industry and government sources.

Figure 1.4 *Multi-University Site Structure for the NSF CFSP I/UCRC*

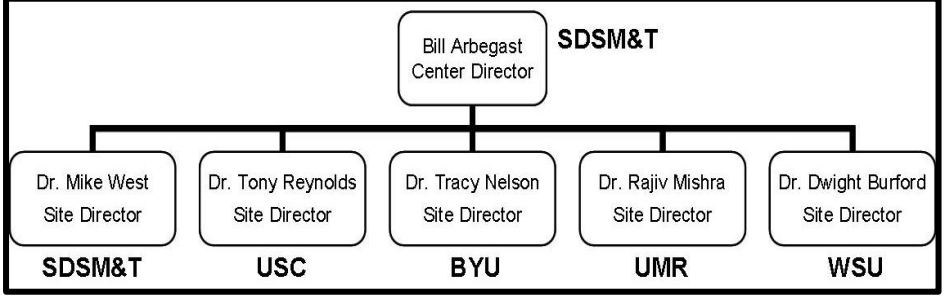
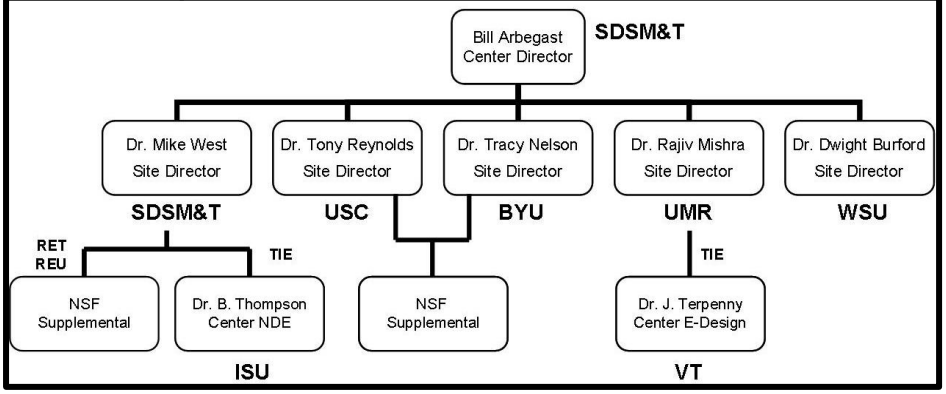


Figure 1.5 *Multi-University Structure for the NSF CFSP I/UCRC Showing Supplemental Funding Collaborations*{ XE "collaboration"} *between Sites and TIE Programs between*



1.5.3 Other Participants: NSF and Industry

Other participants in the I/UCRC process include industrial members and the National Science Foundation. The I/UCRC program was created by the NSF to stimulate research in emerging technologies critical to national economic competitiveness. The NSF provides oversight of the CFSP through the NSF I/UCRC program office (http://www.nsf.gov/eng/iip/iucrc/). The University of Central Florida has "virtually cloned" the corporate memory of the I/UCRC program office with "Ask Alex"

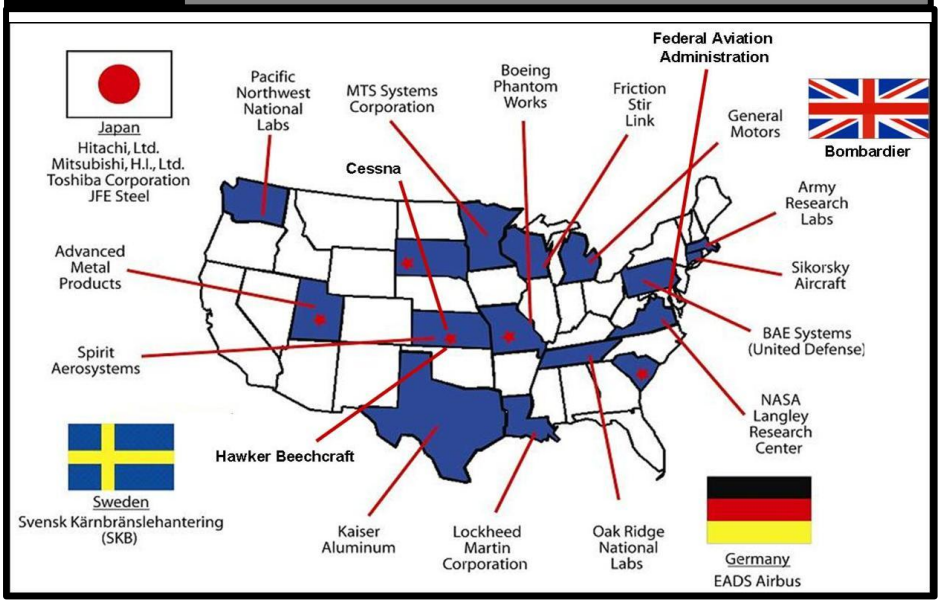
(http://isl.ucf.edu/AskAlex/) where questions can be asked of the NSF I/UCRC program founder, Alex Schwarzkopf.

A CFSP Center Evaluator (Mr. Ron Beck) provides assistance to the center and to provide additional program oversight. The Center evaluator's annual salary is paid equally by each participating university site. To minimize billing issues, one billing is made to the Lead CFSP University site (SDSMT) and funding is invoiced and transferred from the participating university sites to cover their portion of the salary. The North Carolina State University maintains an I/UCRC Center Evaluators web site (http://www.ncsu.edu/iucrc/) where the evaluator's roles and responsibilities are described and improvements in the NSF I/UCRC program best practices are posted and discussed.

The global CFSP Industry membership is listed on the CFSP web site (http://cfsp.sdsmt.edu/). As of the writing of this document, they are Army Research Laboratory, Boeing Phantom Works, BAE Systems (UDLP), MTS Systems Corporation, Pacific NW National Labs, Sikorsky Aircraft Systems, EADS Airbus, Kaiser Aluminum, Lockheed Martin Corp., NASA Langley Res. Center, Spirit Aero Systems, Advanced Metals Prod., Hitachi, Ltd., JFE Steel, Mitsubishi, H.I., Ltd., Swedish Nuclear Fuel & Waste, Management Co, Friction Stir Link, General Motors, Bombardier, Cessna, FAA, and Hawker Beechcraft. Members come from the USA, Japan, Sweden, United Kingdom, and Germany.

The CFSP Membership Agreement (Appendix A) defines that there will be an Industrial Advisory Board (IAB) for the Center composed of one representative of each of corporate sponsor. The CFSP Bylaws (Appendix B) clarify this by saying that if a company has paid for more than one membership, they have one vote on the IAB for each paid membership. Companies can send more people to the meetings than they have memberships, but the number of memberships limits the number of votes that can be cast by the representatives of the company.

Figure 1.6 *Membership Map showing the Global Nature of the Industry and Government Sponsors of the Multi-University CFSP I/UCRC*



There is an IAB Chairman who is elected by the IAB for a term of not more than two years. The bylaws give the IAB Chair two duties. First, is to work with the Center Director and Site Directors to establish the schedule of activities and meetings for the Center as well as the agenda for the meetings. Also, the IAB Chair can speak for the IAB, working with the Center Director and Site Directors, to approve an interim research program funded by a new corporate sponsor of the center. Otherwise, funding from a new sponsor must be applied to a previously approved project. The IAB Chair also serves the usual role of a chair of a board, acting as the point of contact and running meetings.

All sponsors participate in the strategic planning of the Center. The IAB assists the participating faculty in identifying pre-competitive, generic, industry-related, research problems in friction stir welding and processing; recommend research projects for future work; assist in identifying appropriate industrial internship opportunities for graduate students and postdoctoral students; assist the Center Director and Site Directors in

identifying new sponsors; review the research and educational accomplishments of the Center; and recommend restructuring and/or redirecting of on-going programs to meet IAB needs and concerns. [Appendix B – Bylaws: 4.3]

The CFSP Center Director is responsible for all Center activities and reports directly to the Vice President for Research at the South Dakota School of Mines and Technology and is responsible to the IAB. The Site Directors at the lead and site universities are responsible for Center activities at their university and report directly to their respective university administrators and to the Center Director.

The Site Directors also provide liaison between the Center and the appropriate academic departments of the partner universities. Site Project Principal Investigators manage specific research projects funded by the Center and report directly to the appropriate Site Director, the appropriate university administrators, and to the sponsors supporting the project. [Appendix B – Bylaws: 4.4 - 4.6]

The CFSP has formed an ad-hoc multi-university administrative oversight and policy committee consisting of the Vice President or Provost of Research (or his/her designee) at each university to resolve any and all Center administrative issues, including review of academic standards, recruitment strategies, retention issues, funding issues, space requirements, and equipment requirements related to the Center. Additionally, the committee ensures that the lead university and each participating university have provided a reasonable level of clerical and accounting support staff for Center operations. A major role of the committee is to ensure faculty recognition for participation in the Center in tenure and promotion decisions, and ensure that the research is appropriate for graduate education. This committee is convened at the request of the CFSP Center Director to resolve center related issues. [Appendix B – Bylaws: 4.9 - 4.10]

1.6 CFSP PARTNER SITE OUTSIDE RESEARCH—THE SDSMT AMP CENTER

A university participating in the CFSP I/UCRC retains the right to pursue contracts related to friction stir processing which are outside of the purview of the center. All of the universities in the

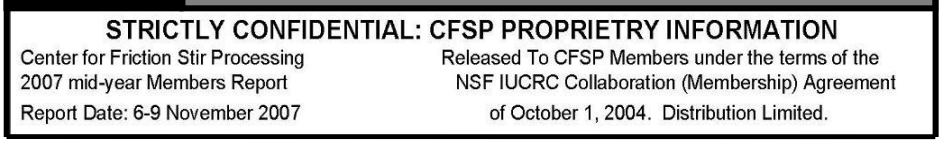
CFSP have such outside activities. Note that there is a "handshake" agreement between university Site Directors that they will not compete for the same outside funding- but will pursue collaborative funding whenever possible.

At SDSMT, the Advanced Materials Processing Center (AMP) (http://ampcenter.sdsmt.edu/) is the local entity for friction stir processing activities. Colloquially, all friction stir processing activities are referred to as AMP, but the research and experiments conducted under AMP for non-CFSP members must be scrupulously separated from other center work products.

CFSP Industry sponsors expect their experiments, results, and ideas to be kept confidential and proprietary, and experiments run for AMP cannot be used for CFSP sponsors and vice versa. This sometimes means the same experiments must be run twice for different sponsors because to do otherwise would be to share results between competing industry sponsors. This distinction is critical when designing policies, procedures, practices, and automated management tools for the center.

All CFSP experimental data, reports, posters, and presentations contain a proprietary information banner to identify and restrict distribution. Web and database security is also a prime consideration to prevent non-center members from viewing test results paid for by CFSP members.

Figure 1.7 *University and Multi-University Models for a I/UCRC (Gray and Walters)*



1.7 ELECTRONIC RESOURCES

A multi-university I/UCRC faces significant communication challenges. When managing the center, methods of communicating and disseminating information, along with the protocols for each, need to be established. Tools that are indispensable are an interactive web site, a shared database, and document management systems.

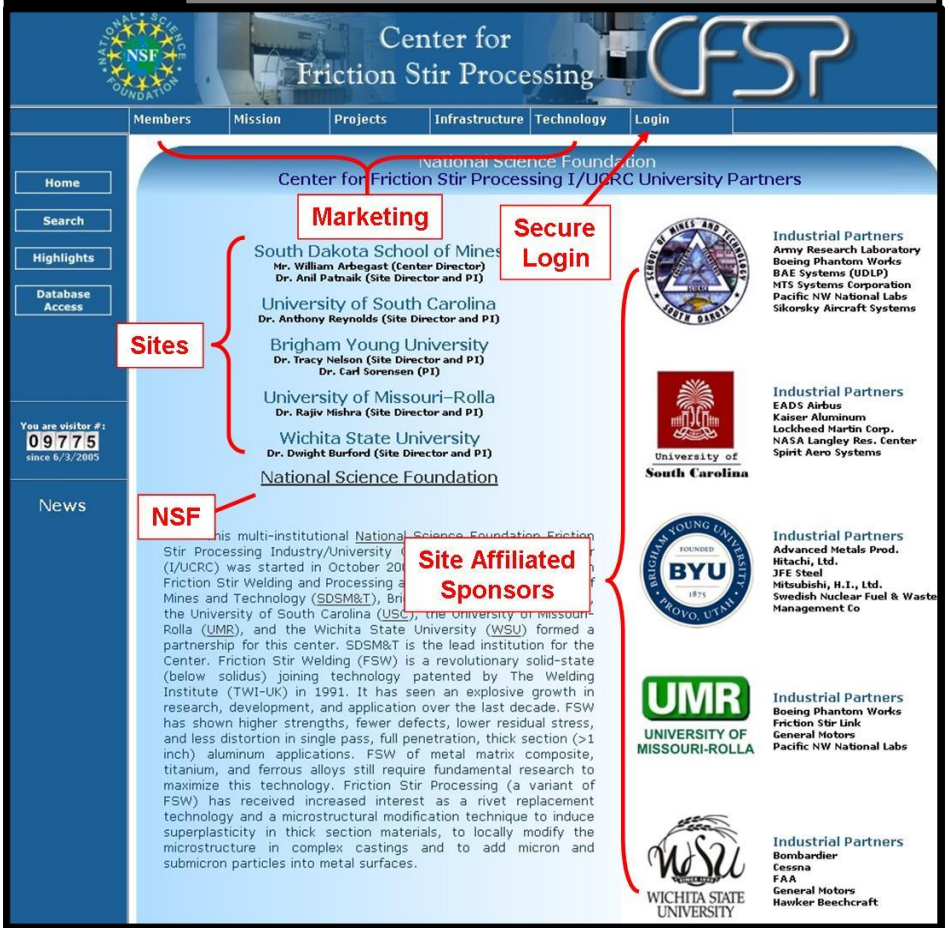
1.7.1 Web Sites

The official CFSP web site (http://cfsp.sdsmt.edu/) is the primary program management and communications tool used and described in detail in subsequent sections of this case study. This web site is a secure web site available to university sites and IAB members through password controlled access. However, a few design considerations are generally applicable to any I/UCRC.

- Marketing materials and general information should be available to non-center members to encourage new sponsors to join the center. The educational mission of a center also dictates dissemination of information about the research and technologies developed by the center to as wide an audience as possible.
- Proprietary materials and private communications need to be behind the password-protected section of the web site. Multiple layers of access are desirable if the web site is dynamic, that is, if content can be edited by multiple individuals with the proper authorization.
- Restricting editing privileges to a system administrator creates delays in the dissemination of information. At least one individual for each site should have the ability to upload documents, fix errors in web pages, and post news items.
- A communication mechanism should be set up to automatically notify interested parties when a document is added to the web site. For example, when a Quarterly Report is added, the industry sponsor would be automatically notified via email or RSS feed or through a messaging system. Although reports posted to the web site often require prior approval by the Site Director, automatic notification that the report was actually posted is desirable. Tools that prepare summaries of posted reports and missing reports will also facilitate student oversight.
- Meeting information, action items, reports, proposals, publications generated by center members, and other administrative documents are logical items to distribute via the web. Pages which display these items can be

dynamically generated to reduce administrative overhead for web maintenance.

Figure 1.8 *Official CFSP Web site (*http://cfsp.sdsmt.edu/*) Showing Secured University and Industry Login*



A dynamic web site is most often implemented by storing the page entries in a database. This can be a simple engine or even done with files. The main page of the CFSP web site contains the marketing information of Center mission, vision, objectives overview, university affiliates and sponsor information and is available for review by non-CFSP members. A secure login portal is provided for both CFSP member and university sites to gain

access to the proprietary CFSP documents and reports, and the comprehensive CFSP database.

1.7.2 Databases

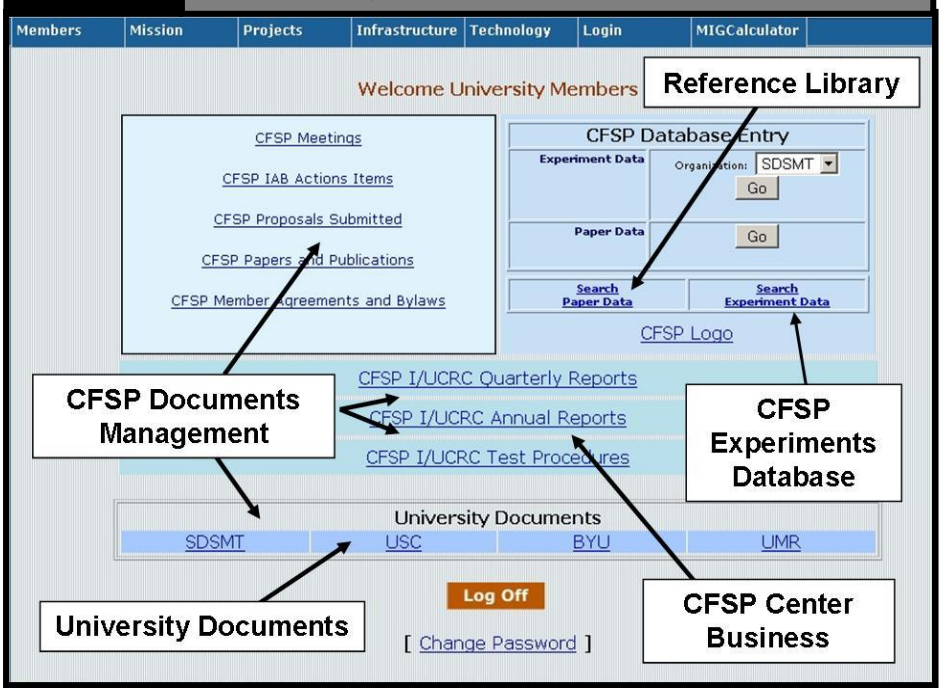
The ability to store, share, retrieve, and mine experimental data is crucial to fully utilizing the work products of all sites. Design of the database should occur very early in the center planning process (call your computer science department as soon as possible) for two important reasons: (1) it is often difficult to adjust the table structures once population of the database begins and (2) as noted above, each site may have independent research which may be, or already is, stored in a database. Coalescing distributed, heterogeneous databases is a non-trivial task which may be avoided with advanced planning.

Typically, each site would host a database for its non-center work and also contribute to the central CFSP database. To reduce the complexity for students, a common data entry interface is desirable. It is also optimal for all sites to select a common database engine.

The first task is to decide the information to be stored in the joint database, taking into account that some fields may exist solely to facilitate the use of a common interface for local (non-center) experiments and center experiments. Database security must be part of the initial design. This includes preventing access to the data by non-members, segregating center from non-center data if the same database is used for both, and restricting editing privileges.

The database is useful for building a reference library for center members. The reference library (Section 3.4) is essentially a distillation of papers read by students, faculty, and other center members to facilitate scholarly activity. Summary information stored in a database, coupled with a keyword search, provides a powerful mechanism for locating reference materials.

Figure 1.9 *Official CFSP Web site (*http://cfsp.sdsmt.edu/*) behind the Secured University and Industry Login Portal showing the Database, Reference Library, and Document Management Features, (University Site Portal Shown- Industry Site Portal Similar)*



1.7.3 Document Management Systems

In addition to a mechanism for storing experimental data, a Center may find it useful to design a document management system for tracking work products. The final form of Center related documents (Annual Members' reports, NSF Annual Reports, LIFE Form Reports, Center Publications, IAB Presentations and Posters, Members' Agreement, By-Laws, and Center Action Items) is posted on the web site and available for members to download.

In addition, the AMP Center has developed PaDMS, the Paperless Data Management System, for controlling documents related to individual research projects and tasks. A unique project identifier using the CFSP naming conventions (Section 3.11) is

assigned to each research project and each experiment is conducted under a formal work order control number (Section 3.8.4) and is the primary key that ties all related documents together.

The work order also contains the project designation which is used as a reference into the experimental data database. The student assigned to perform each experiment under the work order is required to prepare a laboratory report in a standard format to describe the results of the experiment before approval and closure of the experimental task is authorized by the Project Principal Investigator or Site Director. Use of PaDMS is described in Chapter 3.

1.8 BUDGETS AND MIPR

Each university site has unique budgetary procedures to control funding from the NSF and the Center Sponsors. The CFSP IAB has requested that budgetary information related to each project be included in all project reviews. To accommodate this, a simple "division of efforts" approach has been instituted at each site.

Under this method, the Site Director has the option of defining and distributing how much of the sponsors membership fees are allocated for each project. Likewise, distribution and control of the NSF funding, including the award and Military Interdepartmental Purchase Request (MIPR), is allocated at the discretion of the Site Director. At the Annual IAB meeting, these distributions are presented to the board and are subject to their approval.

At the SDSMT site, individual top level research project topics approved by the IAB are identified and the budgets are monitored individually by the university accounting system with separate accounting codes. Within each project, subtask budgets are allocated at the discretion of the Site Director and are not monitored and controlled to this level.

At other CFSP university sites, this level of control may not be applied with all members funding placed into one university accounting code and allocation of funding is controlled by the Site Director. The IAB have found both of these systems acceptable and generally is satisfied when knowing the top level of funding allocated to each project task and subtask.

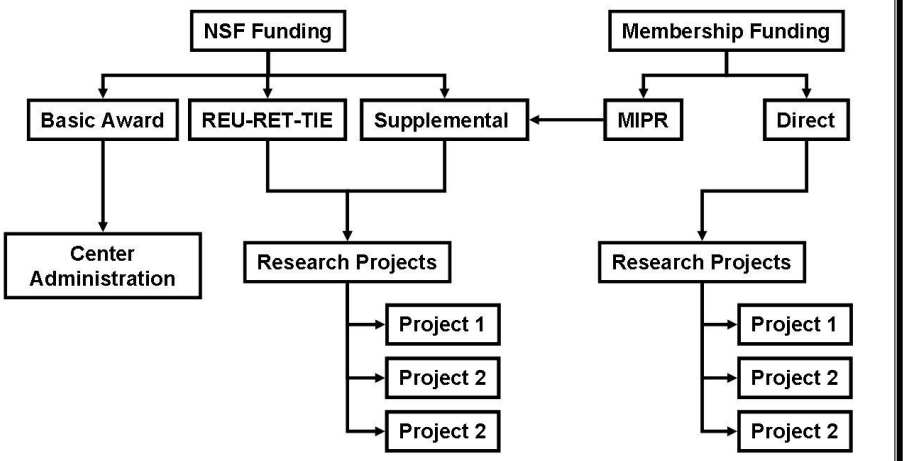
Figure 1.10 *Example of Spreadsheet used to Monitor and Control AMP Center CFSP Site Project Budgets. Projects Budgets Shown, Similar Spreadsheets Available for Actual Expenditures and Estimates to Complete*

PROGRAM BUDGETS - 2007				As of Feb 2007
Contract Name	NSF FSP IUCRC 04 Adm Yr 5	NSF FSP04 IUCRC AMP02 (MIPR)	NSF FSP IUCRC 04 REU	NSF FSP IUCRC TIE
Banner Code Number	440177	440178	440179	440180
1. Labor Costs (Personnel)				
Senior Personnel	$ 91,829	$ 41,089	$ -	$ -
Lab Administrative Support	$ -	$ -	$ -	$ -
Under Grad	$ -	$ -	$ 13,333	$ -
Phd Students	$ -	$ -	$ -	$ -
MS Students	$ -	$ -	$ -	$ 26,405
Fringe Benefits	$ 13,823	$ 4,243	$ 1,067	$ 2,295
Total Labor Costs (Personnel)	$ 105,652	$ 45,332	$ 14,400	$ 27,709
2. Supplies and Materials	$ 10,775	$ 4,643	$ -	$ 2,380
3. Equipment	$ -	$ -	$ -	$ -
4. Travel Costs	$ 31,588	$ -	$ -	$ -
5. Publications and Report Costs	$ -	$ -	$ -	$ -
6. Sub-award costs	$ 30,000	$ -	$ -	$ 425
7. Equipment User Fees	$ -	$ -	$ -	$ -
8. Communication Costs	$ -	$ -	$ -	$ -
9. Other Direct Costs	$ -	$ -	$ -	$ -
Tuition Remission - GRA's	$ 11,680	$ 36,802	$ -	$ 8,314
Total Non-Labor	$ 83,043	$ 41,445	$ -	$ 11,119
10. Overhead	$ 40,405	$ 18,079	$ 3,600	$ 11,175
Total Budgeted Funds	$ 230,000	$ 104,856	$ 18,000	$ 50,000
NOTES:	4-30000	4-30001	4-30002	4-30003

Funding for the center can come from many sources. Under the basic I/UCRC award from the NSF, funding for center administration is received separately for the center lead institution and each university partner site. Additionally, each site may receive REU, RET, TIE and Supplemental funding which is added to the basic award by the NSF (Section 3.6). These funds are, however, to be used for center research and not center management.

At SDSMT, the university accounting system is used to separate these funds using unique account codes for each REU, RET, TIE, and supplemental received rather than inclusion into the accounting code for administration. This allows tracking and reporting of these NSF funds to the IAB as they are expended for each project.

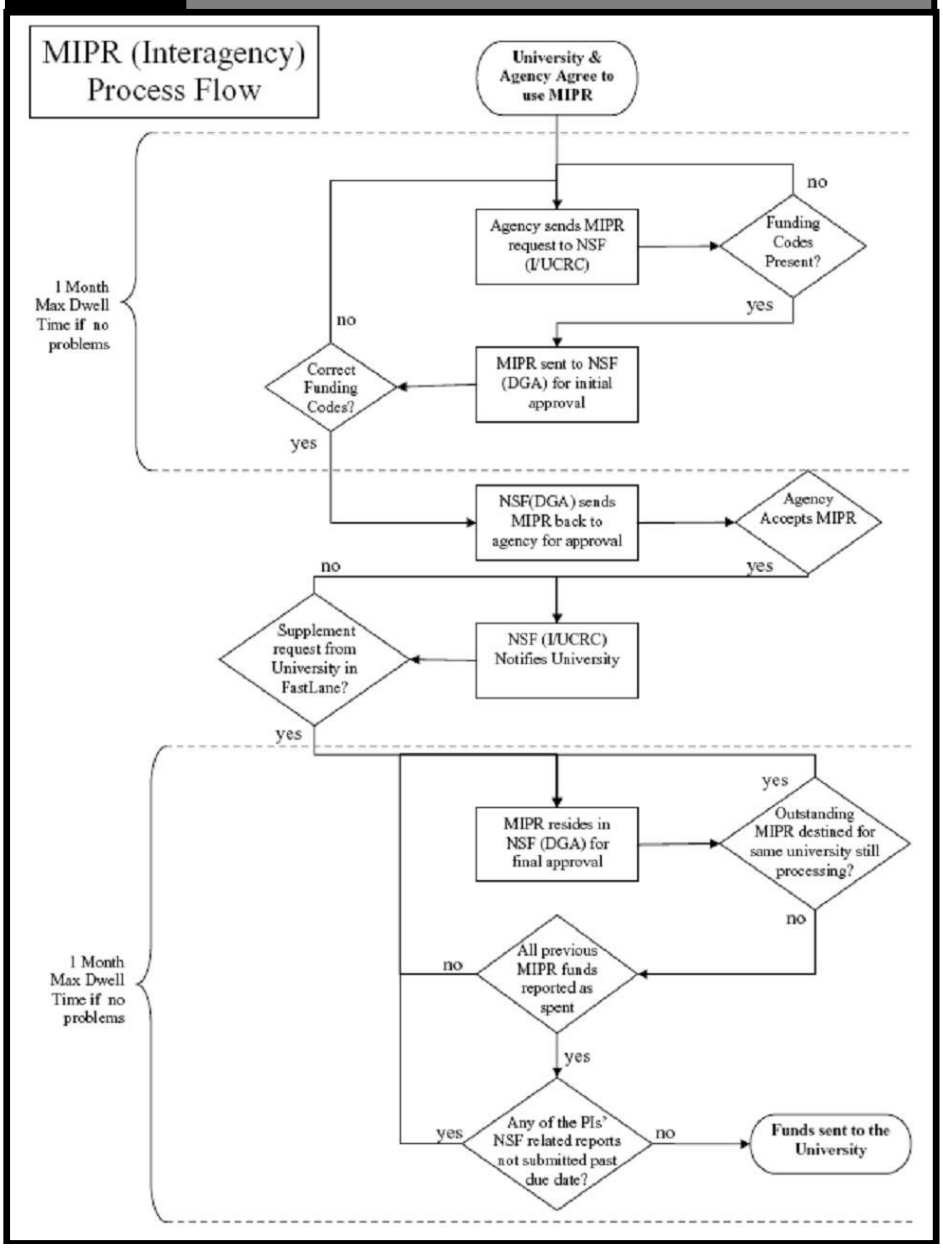
Figure 1.11 *Sources of Funding For the Multi-University CFSP I/UCRC*



Likewise, direct membership funding is split and distributed into unique accounting codes for each project currently being conducted. Membership fees from government entities (DOD, DOE, and NASA) are typically transferred to the center using DD Form 448 – Military Interdepartmental Purchase Request (MIPR). Under this process, the government member transfers its membership fee to the NSF which in turn sends it to the appropriate university site as supplement to the basic award. Special rules apply to MIPR funds transferred to the center in this manner which can be found at http://www.nsf.gov/eng/iip/iucrc/mipr.jsp.

First, the NSF may "tax" this transfer at a 3% level which reduces the total funding to the center. It is often requested, therefore, that the government member increase the amount transferred to the NSF by this amount so that the money flowing down to the center is compliant with the total membership fee. Secondly, MIPR monies must be tracked separately to ensure that it is spent during the fiscal year it was awarded. Failure to ensure that this money is spent each year will delay funding of subsequent year MIPR funding. At the SDSMT, a unique university accounting code is assigned to all incoming MIPR monies to track and control the expenditures.

Figure 1.12 *MIPR Flow Chart for Government Membership Fees (Source: NSF I/UCRC Program Office)*



CONSTITUTING THE CENTER

Chapter 2

2.1 ESTABLISHING A CENTER VISION AND MISSION

The I/UCRC Program was begun in 1973 to develop long-term partnerships among industry, universities, and government. A Center is composed of one or more institutions with multiple industry and government sponsors with a single Industrial Advisory Board (IAB) reviewing all the researchers' activities. The proposal to create a center starts with a letter of intent sent to the NSF. If this is approved by the program director, a planning grant proposal and then a center proposal are prepared by the center and sent to the NSF. [Complete information about the proposal process can be found at the NSF web site, http://www.nsf.gov/eng/iip/iucrc/]

The mission of the CFSP is to advance, develop, and promote research into the principles and technology of Friction Stir Processing science and engineering through research, development, education, and technology exchange among academic, industry, and government entities. It is also the mission of the center to increase the quantity and quality of the professionals prepared to work in the area; to involve the faculty of the University(s) in research in areas of common interest to Sponsors and the University(s); and to perform research which

will allow global Friction Stir Processing facilities to be competitive in the world economy. [http://www.nsf.gov/eng/iip/iucrc/directory/csfp.jsp]

2.1.1 Identifying Technology Development Needs of the Sponsors

During the I/UCRC planning grant phase, it is essential to identify those focused technology needs of the potential industrial and government sponsors – both near term and long term – which are compatible with the research resources of each of the site universities. To accomplish this, a planning grant "kick-off" meeting was held between the university Site Directors to define the focused research areas, or "area of expertise", to be associated with each university site. These research areas relate directly to the stated research objectives of the CFSP.

Shortly thereafter an interim Industrial Advisory Board was established with representatives of the leading industry and government researchers in the field of friction stir processing. Also during the planning grant phase, this interim IAB met with the site universities in Salt Lake City to identify and discuss the research and development needs of these potential center members. At this meeting, a list of IAB research and development needs, and identified gaps in the science and understanding of the FSP processes was compiled.

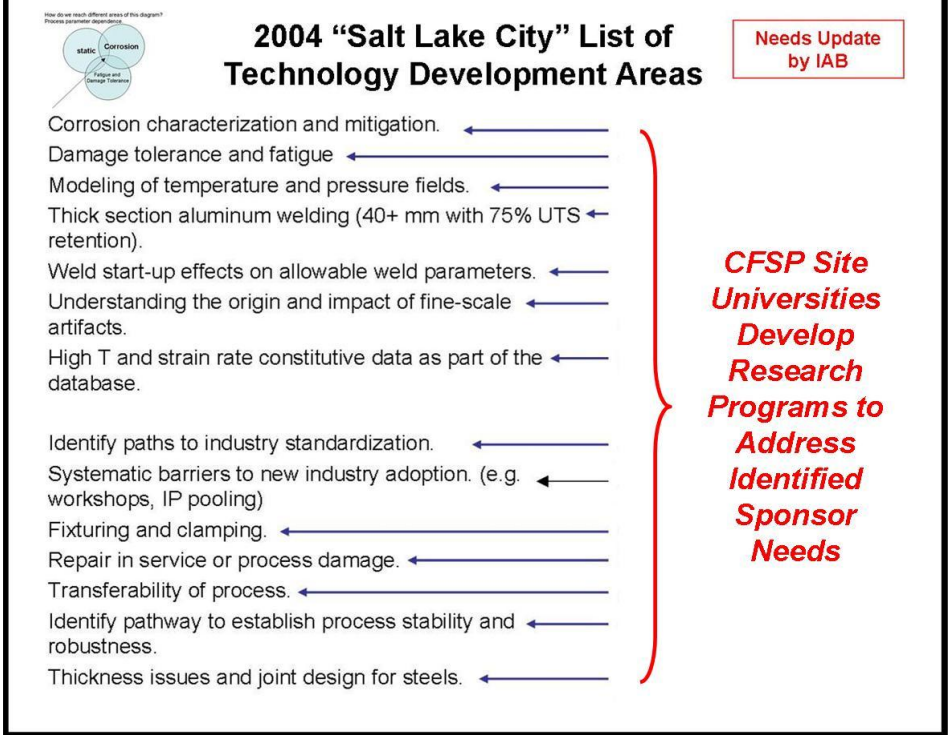
This initial IAB needs list, referred to the "Salt Lake City List", is one metric against which the growth, progress, and success, of the CFSP is measured.

Throughout the year, the Center Director, Site Directors, Project Principal Investigators, and student researchers keep in close contact with the IAB technology representative to evaluate the relevancy of the "list". These discussions often lead to new research directions that are carefully focused to solve current problems for the sponsors.

The Chairman of the IAB conducts a session during the semi-annual IAB meetings to review the "Salt Lake City List" and update as necessary to meet IAB members' current needs. Also, the Annual NSF Evaluator's Report (See Appendix P) gives sponsors an additional opportunity to make their research needs known, and, allows an independent view-point of the Centers

ability to document, communicate, and implement research programs responsive to the sponsor's needs.

Figure 2.1 *Original List of Industry Identified Technology Development Needs from the CFSP Planning Grant Interim IAB Meeting*



2.1.2 Preparing a Long-Term Technology Development Roadmap

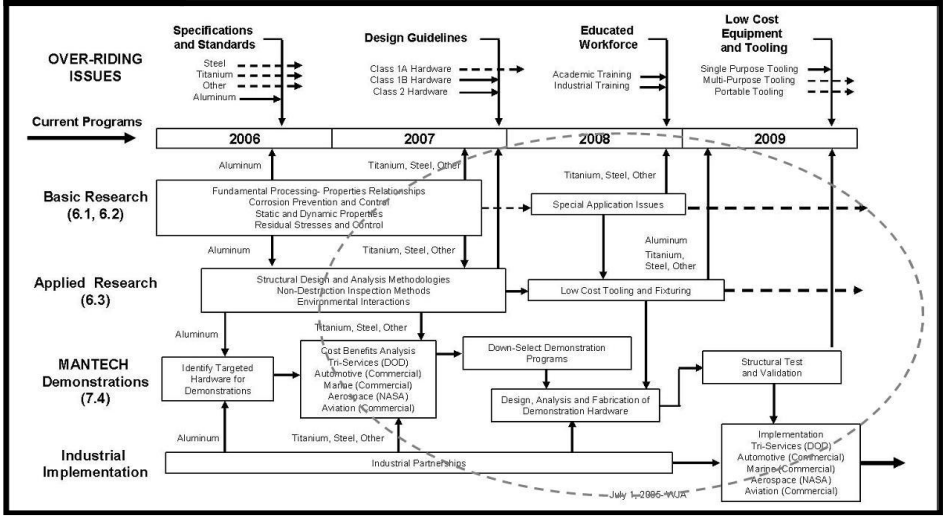
It is interesting to note that not all the Technology Development needs of the "Salt Lake City" list reflect a need for in-depth fundamental science developments. It becomes a challenge for the Center Director, Site Directors, and Project Principal Investigators to develop research projects that, while meeting the sponsor's needs, are of sufficient detail in the science and technology to qualify as graduate research resulting in a thesis and journal grade publications. To facilitate the development of these research projects, a long term technology development roadmap is prepared for the CFSP.

From page 122, chapter 5, of Gray and Walters:

> *"Most centers will find goals and objectives adequate for planning, but some centers prefer more detail …. They create a roadmap in block diagram form of the current state of science and technology, the vision of the future, and road blocks and research activities to resolve them. The power of the technical roadmap is not only its visual appeal, but also the ability to identify the order of action, such as which research activities and questions are on the critical path for another set of questions, and thereby ought to be addressed first. Unfortunately, technical roadmaps may sometimes serve as an obstacle to attempts to revise or re-invent a research area."*

The fundamental underlying issues associated with the IAB "Salt Lake City" list were evaluated and broken into a series of basic research, applied research, technology demonstration, and industrial implementation issues. Several overriding issues acting as barriers to more extensive industrial implementation of the technology are also identified. From this analysis, the CFSP technology development roadmap was prepared in block form. Note that this roadmap is updated at the IAB meetings as the industry research needs change.

Figure 2.2 *CFSP Technology Development Roadmap Developed from the Initial Salt Lake City Needs List*



2.1.3 Identifying the Focus Research Areas for Each University Site

Each CFSP university Site Director identifies its specific focused research areas it wishes to pursue based on their current resources and research interests. These are evaluated against the "Salt Lake City" list and the Technology Development Roadmap to ensure compliance with IAB needs. Projects that are outside of these research guidelines are given specific scrutiny by the IAB and may be rejected. Care is taken to ensure that overlap in identified research areas between sites is avoided to maximize the distribution of efforts and maximize the membership investment. Research collaborations between university sites are, however, emphasized.

Continued development of CFSP research programs requires continuous communication between the university Site Directors and Project Principal Investigators. The Site Directors use their contacts within their university to develop faculty and student researchers. Telecon, web-based meetings, and conference attendance are extensively used to develop and expand the research into new areas.

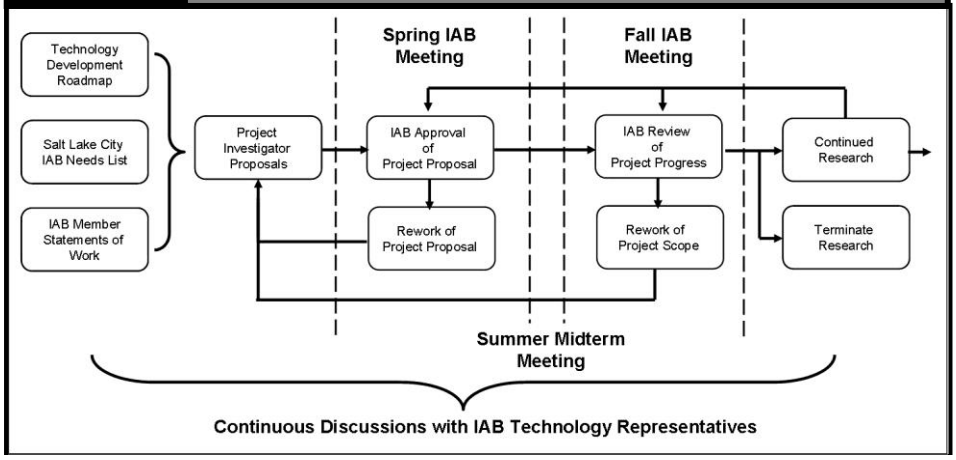
The Center Director also contacts other research organizations to solicit potential new university sites able to contribute to accomplishing the objects and goals of the technology Development Roadmap and "Salt Lake City" list. The key feature here is the extensive, personal communication between the IAB Members, Center Director, Site Directors, Project Principal Investigators, and student researchers to identify, unique, focused research areas for each site.

2.1.4 Identification and Selection of Multi-Year Projects

Article VIII of the bylaws (Appendix B) outlines the selection process for projects. During the first year of CFSP operations, the Center Director, Site Directors, and the interim IAB selected and approved the center start-up projects. Currently, sites report on the status of ongoing projects and propose new projects during the semi-annual meetings of the IAB. During these meetings, the IAB votes on which projects to fund.

Project ideas may originate at either a sponsor or a university and are refined during discussions between the two. To facilitate the process of identification and selection of projects, the Site Directors and Project Principal Investigators at each university site enter into extensive and continuous discussions with the IAB Members (see Meetings – Chapter 4).

Figure 2.3 *CFSP Project Approval Process, Scheduled Meetings, and Relationship to IAB Members Identified Needs List and Technology Development Roadmap*



Throughout the year, the IAB Members may submit statements of work (SOW) to the university sites to help define their particular research needs. The Site Directors then seek and solicit faculty involvement representing the required resources to perform the research. Generally these new project proposals are presented to the IAB for "authorization to proceed" at the Spring IAB Meeting and research efforts commence during the summer months and progress is reviewed at the Summer Midterm meeting.

A detailed review of the research progress is done at the Fall IAB meeting where a "scope change", "authorization to continue" or "termination of research" recommendation is given by the IAB using the LIFE Forms (Section 4.2.2).

2.2 BYLAWS

The bylaws (Appendix B) were adopted at the first meeting of the interim IAB during the planning grant phase and are continuously updated as the needs arise. They specify the purpose of the center, sponsorship rules, and how the center is to be run. Details of the CFSP organization, administration, reporting, meetings, research projects proposals and selection, and how new members are added to the center. The bylaws also include rules on publicity, publication of research, benefits to sponsors, and center outreach.

The bylaws define the formal *CFSP Policy, Procedures and Practices* (P3) and become a contractually agreed upon document between the Site Universities and the IAB Members. The CFSP bylaws were initially approved by the legal consul at each of the participating universities to ensure compliance with university policy. The bylaws are a "living" document. It is important to keep the document current to reflect the actual operations of the center.

At the CFSP, revisions to the bylaws are proposed and discussed at the Spring and Fall IAB meetings. The bylaws can be amended by a two thirds vote of the IAB. Changes to the bylaws are not resubmitted to the university legal consul for review unless major changes to policy are being proposed. The bylaws extend the membership agreement, and are superseded by the membership agreement, if inconsistencies between the two documents exist. Current copies of the CFSP bylaws are made available for Site University and IAB member review behind the secured Sections of the CFSP web site (http://cfsp.sdsmt.edu/)

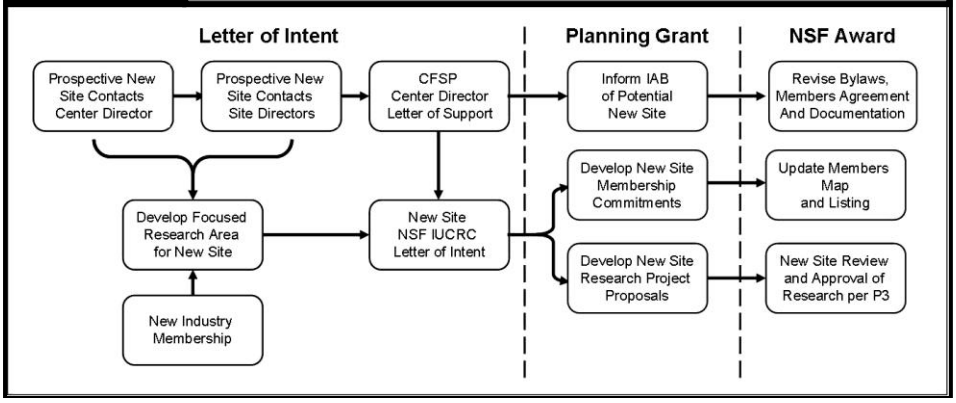
2.2.1 Procedures for Acceptance of New University Sites

Article 12 of the bylaws (Appendix B) describes the process for acceptance of new university sites into the CFSP. First, the new university must obtain consent from the Center Director, the Site Directors at the current university sites, and the NSF I/UCRC Program Manager. The proposed new university site must present a non-overlapping focused research area along the lines of the CFSP statement of objectives, and, agree to comply with the *CFSP Policies, Procedures, and Practices* (P3).

Preliminary research projects that are collaborative and non-competing with the current Technology Development Roadmap and current research projects of the CFSP are proposed by the new university site. Evidence that the new university site can bring new industry membership to the CFSP must be demonstrated. It is understood that these new sites will not encourage existing IAB Members to leave their current affiliated university site to join the new site, but, will encourage these IAB Members to take additional memberships at the new site if desired.

The prospective new university site submits a letter of intent to join the CFSP to the Center Director. Once the CFSP Site Universities agree to accept the new university site, the Center Director will send a "CFSP Letter of Support" to the NSF I/UCRC Program manager indicating that the university sites agree to the new site. During the Spring or Fall IAB meeting, the Center Director informs the IAB of the proposed new university site and emphasizes how the new site adds to the CFSP research capabilities and directions to meet the IAB needs.

Figure 2.4 *CFSP Admissions and Approval Process, for New University Sites*



Adding new university sites is intended to expand the research resources of the CFSP to meet the IAB Membership needs. When a new site is approved, the NSF Planning Grant Process commences according to NSF procedures. The

prospective site should include a copy of the CFSP Letter of Support to their I/UCRC Letter of Intent.

Most recently, this process was followed by the Missouri University of Science and Technology (MUST) in 2005 and by the Wichita State University (WSU) in 2006 to join the CFSP as participating university sites.

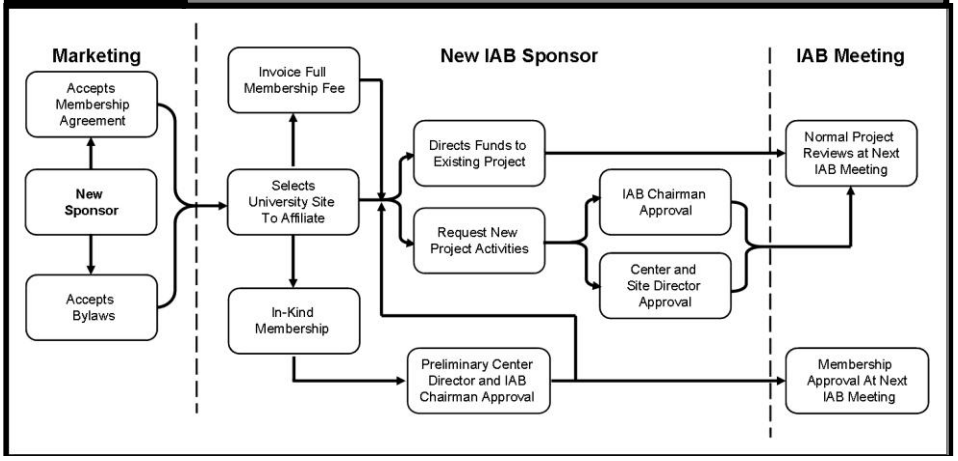
2.2.2 Procedures for Acceptance of New Industry Memberships

Continued growth of the CFSP is indicated by the addition and retention of new industry and government members. This implies a strong marketing program is essential to the success and growth of the I/UCRC. Article 12 of the bylaws (Appendix B) describes the process for acceptance of new sponsors into the CFSP. New sponsors must sign the *existing* membership agreement, abide by the current bylaws, and pay a non-prorated annual membership fee. The legal departments of new member organizations oftentimes desire to change the membership agreement to meet their standard formats – within the CFSP, this is not allowed since all members must sign and agree to the same Membership Agreement (Appendix A).

While this insistence on a common membership agreement can constitute a nuisance during membership negotiations, it is often useful to stress to the industry legal departments that their company most probably has entered into similar agreements with other I/UCRC centers and university research organizations. It is also useful to point out that the agreement follows the recommendations of the NSF I/UCRC Program Office and has been used for many years in essentially the same form without any legal ramifications.

The CFSP allows new members to join, or affiliate, with a single, or multiple participating, university sites. A graduated membership fee scale is provided whereby the initial membership fee is $35,000 per year and the secondary memberships are billed at an annual fee of $30,000. While not included in the CFSP P3, a progressively increasing membership fee scale should be considered which increases at the same rate as the inflation in faculty and student salaries.

Figure 2.5 *CFSP Admissions and Approval Process, for New Industry Sponsors*



During the initial year of membership, the sponsor may direct its fee to an existing project at a university site, or, may request that a new, interim project be initiated. If this is the case, the CFSP Center Director, Site Director, and IAB Chairman may authorize this interim project and fund it with the new members' fees. This interim project is subject to review and approval at the next upcoming IAB meeting according to the established CFSP IAB project approval procedures.

Additionally, "in-kind" support can be substituted for cash payments. A detailed listing of the materials and equipment dollar value to be contributed to the CFSP university site as "in-kind" is presented at the semi-annual IAB meetings. The IAB must then approve all "in-kind" membership fees before a sponsor is allowed to join under these provisions. It is noted that "services" is generally not accepted as an in-kind contribution since these are hard to quantify into a specific dollar value. Also noted is that the CFSP does not have a special membership fee structure for small and disadvantaged business as do other I/UCRC centers and that "in-kind" fees have been generally applied in this case.

2.3 MEMBERSHIP AGREEMENTS

The Membership Agreement (Appendix A) specifies the terms and conditions under which the CFSP operates and is the formal agreement between the site university and industry sponsor. (Note that government sponsors of the CFSP are not required to sign the membership agreement) The same membership agreement is used by all sites to ensure consistency of expectations from the sponsors. The provisions cover the overall organization of the CFSP, the membership fee, a reference to the bylaws, and intellectual property rights. The Membership Agreement is signed by the appropriate representative of the sponsor and the university affiliate that the sponsor is supporting. The Membership Agreement supersedes the bylaws in any case where there is a conflict between the two.

The CFSP Members' Agreements is patterned after that recommended by the NSF I/UCRC Program Office. Initially, during the planning grant phase of the CFSP, the agreement was reviewed and coordinated between the legal consuls of the participating universities. Thereafter, changes to the membership agreement are reviewed and approved at the semi-annual IAB meetings according to the procedures defined in the bylaws. These changes are not re-submitted to the university consul for approval unless major changes to the documents are incorporated. Current copies of the CFSP Membership Agreement are made available for Site University and IAB member review behind the secured portals of the CFSP web site (http://cfsp.sdsmt.edu/).

2.4 INTELLECTUAL PROPERTY AGREEMENTS

The Intellectual property (IP) rights of the university and sponsors are specified in the membership agreement (Appendix A). In general, each university holds title to any IP generated through research activities conducted at that CFSP I/UCRC Site – any patents that are derived from center research are held by the university member that generated the invention. IP generated by more than one CFSP University Site is titled equally between those sites. Application for IP protection is conducted using the established site university procedures. CFSP IAB Members can

obtain royalty-free rights to such patents by paying their share of the costs of obtaining and maintaining the patent.

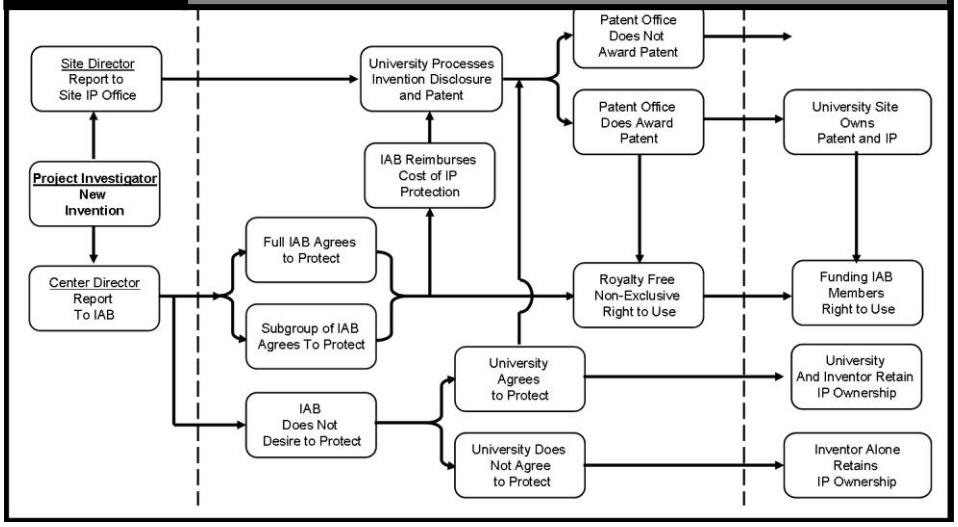
At the SDSMT CFSP site, when new IP is anticipated, the invention is disclosed internally and confidentially to both the University Office of Technology Transfer and the CFSP IAB at the next scheduled meeting. According to the Membership Agreement, the IAB or a subgroup of that IAB has the right to secure a non-exclusive license to the disclosed invention if it pays all expenses incurred during the process of securing patent protection and creating a license agreement.

If the IAB Membership, or, a participating subgroup of that membership, instructs the CFSP Center Director and Site Director to pursue the appropriate Intellectual Property protection, the university will process the appropriate patent application according to established university policy using established legal venues. Upon completion of the patenting process, the CFSP IAB participating membership will reimburse the site university for all expenses incurred in executing the patent application, regardless of whether or not a patent was issued. Additionally, the CFSP IAB Members will reimburse the costs associated with securing a license agreement with the participating CFSP Membership.

Should the CFSP IAB opt to decline pursuit of a patent on the disclosed invention, the university will not initiate Intellectual Property protection process unless the CFSP Site Director makes a compelling case to the university to secure IP on the disclosed invention. If the Site Director does not choose to make a compelling case to pursue IP on the invention in question, the university will notify the Site Director of their intention not to pursue and will provide a formal release of any claim to the any rights to the IP in question. At that time, the inventors involved must make a personal decision as to how, or if, to secure IP protection.

Also, consistent with the existing agreements and policies, the CFSP IAB has the right to request a delay, for a prescribed period, on public disclosure or publication of information on the disclosed invention. Similarly, universities shall hold the copyright to any software developed through center research. Corporate members will have the right to request royalty-free internal use of any such software and can negotiate with the developing university the right to sell such software.

Figure 2.6 *CFSP Patents and Intellectual Property Identification and Approval Process*

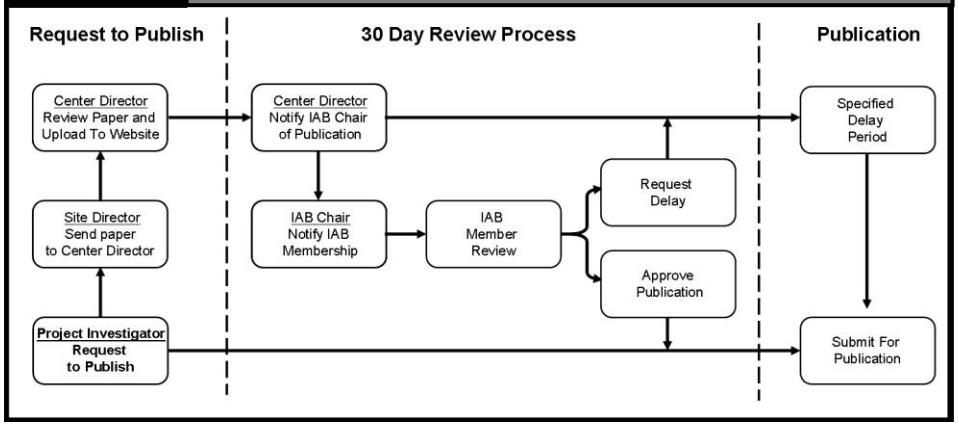


2.4.1 Protection of Proprietary Information

The results of research programs being conducted under the CFSP I/UCRC are available equally to all IAB Members in good standing. From time to time, however, confidential and proprietary information may be provided by a sponsor to a university site in the course of specific research projects. This has continued to be a point of discussion among the CFSP IAB since corporate members may have several internal levels of confidentiality and sensitivity of information, and, it is not always clear how these map into center business.

This is especially true for applications-related projects. Under these conditions, this information may be provided under the protection of an independent confidentiality agreement between the sponsor and the appropriate university. [See Section 2.4.3] The restrictions on use of information critical to a specific research project shall not, however, be unduly restricted from the other IAB Membership if it is critical to the understanding of the science and technology underlying the research. Universities are allowed to publish results of center research after corporate members have read the proposed papers.

Figure 2.7 *CFSP Publications Identification and Approval Process*



The official CFSP web site (http://cfsp.sdsmt.edu/) includes a section behind the secured log-in portal where the Site Director and Project Principal Investigator upload the paper to be published in essentially final form. The IAB Membership is notified by email that the paper is ready for review and can be downloaded from the web site. The IAB Members then notify the Center Director that approval to publish is granted or that a period of time is requested before publication. Corporate members can delay publication for up to 90 days by making such a request within 30 days of receiving the draft publication.

This provision may be applied to graduate student theses in that publication of a thesis can be delayed, but defense of a thesis will not be unreasonably delayed. If a longer delay is requested, the Project Principal Investigator and Site Director determine a reasonable period of time to withhold publication to meet the IAB member's needs. Note that withholding publication for longer periods is generally requested only in the case where company proprietary information is involved or to allow time for the patent process to initiate.

2.4.2 Protection of ITAR/EAR Restricted Information

Since foreign nationals may be used in various aspects of the CFSP programs, it is a goal of the center to limit the scope of the research programs to "Fundamental Research" and not targeted to a specific EAR/ITAR restricted technology (ITAR/EAR Regulations are found at www.bis.doc.gov*).* Per Paragraph 734.3.b.3 (ii) of the Export Administration Regulations (EAR) "Fundamental Research" is not subject to regulation (with certain restrictions).

2.4.3 Nondisclosure Agreements

The use of Nondisclosure Agreements for control of company sensitive or proprietary information is not specified by the CFSP membership agreement or the bylaws. Any nondisclosure agreement that needs to be negotiated between the sponsor and a university site is done independently of the CFSP. Most universities have a standard non-disclosure agreement that they prefer to use. The SDSMT Site of the CFSP uses the Non-Disclosure Agreement (NDA) shown in Appendix C.

From time to time, non IAB Members may be invited to attend the semi-annual IAB meeting, or visit a laboratory where CFSP research is being conducted. To protect the information that these persons may view, a personal non-disclosure agreement (Appendix D) may be used. Non-CFSP member government employees are not required to a sign a personal NDA.

CENTER OPERATIONS

Chapter 3

3.0 INTRODUCTION

Each university site of the CFSP performs focused research in support of the specific needs of the IAB Members affiliated with that site, and, as approved by the entire IAB as a whole. In order to have an informed IAB knowledgeable to make these project selection decisions, and, to make meaningful adjustments to the long term Technology Development Roadmap (Section 2.1.2).

It is imperative that all IAB Members be made aware of all the research being conducted at each of the university sites. The CFSP policies, practices, and procedures (P3) are designed to maximize the communication between the faculty, staff, and student researchers at the university sites and the technical representatives of the IAB Membership.

Engaging active participation by the IAB Membership such that they take *"*ownership*"* of current research and proposed new research directions are critical to the center growth and member retention. For a multi-university I/UCRC such as the CFSP, Center Operations can be described as the business of communication of the status and health of the center, and, the status and direction of the research, to the IAB Membership. Budget and funding management, although reportable to the NSF

and the IAB, is generally performed using the existing university site procedures.

There is great flexibility in the use of local management tools to meet the documentation and reporting needs of the sites as requested by the university and IAB Membership affiliated with that site. However, reporting at the Center level requires standardization of documentation across the university sites. Standardization of documentation and reporting ensures all information has a common content and format for transmittal to the IAB. Several management tools have been designed and implemented at the CFSP to accomplish this.

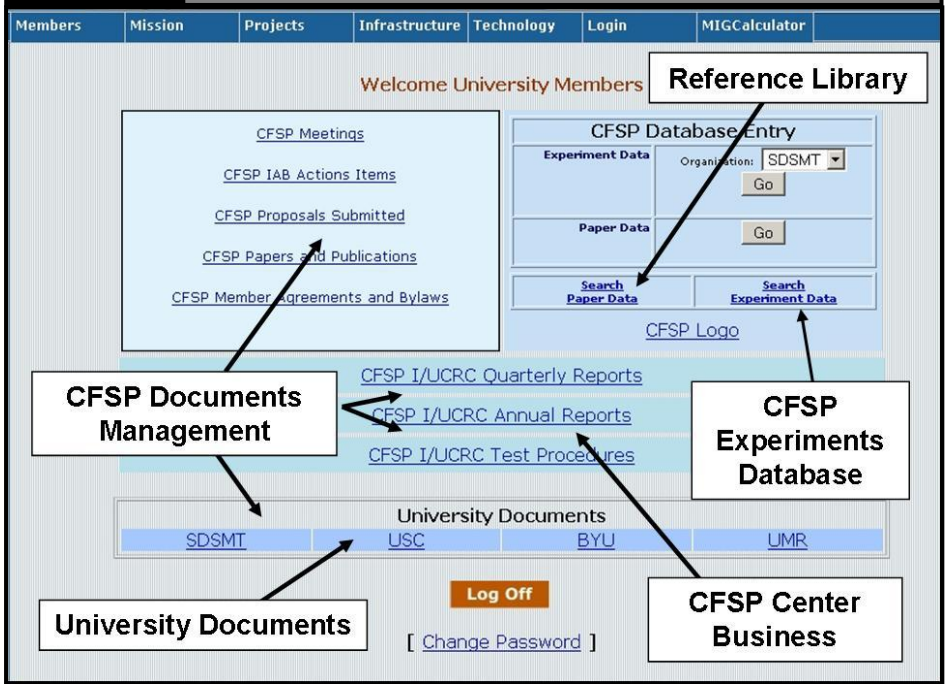
3.1 DEVELOPMENT OF AN INTERACTIVE WEB SITE

The web has become a communication tool of choice throughout industry. During the first year of the I/UCRC award (2004) the members of the CFSP IAB approved a multi-university proposal to develop a secured, interactive web site for the CFSP. This web site is designed to be the official communication tool between university sites and the IAB Membership. The CFSP web site (http://cfsp.sdsmt.edu/) was developed by the Missouri University of Science and Technology and revised by SDSMT with funding provided by all CFSP sites.

To accomplish this, since MUST was not officially a member of the CFSP at this point, funding was transferred to the SDSMT by invoicing the BYU and USC sites and SDSMT awarded a subcontract to MUST to develop the web site and database. For project tracking and reporting purposes, the Database and Web Site Development project was identified as a SDSMT Site project.

The public areas of the official CFSP web site (http://cfsp.sdsmt.edu/) contain general information about the center as well as marketing information useful to prospective sponsors, including information on university members, sponsors, the mission of the center, and center news/announcements. In addition, each university has its own web presence describing activities specific to its local activities. Each university local web site links to the CFSP site, and the CFSP site links back to each local site. Likewise, links are created to the sponsors' web sites.

Figure 3.1 *The interactive CFSP Web Site is the main management tool used in the development, retention, and distribution of the official CFSP documentation.*



Users with access to the restricted portions of the site login as either industry or university members to access the following information:

- IAB Meeting Agenda and Presentations (Chapter 4)
- Action Items (Section 4.3.1)
- Proposals Being Submitted (Section 3.3.8)
- Papers And Publications (Section 3.4 and 3.7)
- Member Agreements and Bylaws (Sections 2.2 and 2.3)
- Project Quarterly Reports (Section 3.3)
- Annual Members' and NSF Reports (Chapter 5)
- LIFE Form Reports (Section 4.2.2)
- CFSP Database Access (Sections 3.2 and 3.3)
- Supplemental University Documents (Section 3.5)
- Center Test Procedures

The web site provides a mechanism for sharing agreed upon standards for testing and for document preparation. For example,

the link labeled “CFSP I/UCRC Standard Test Procedures” provides links to agreed upon standards for conducting special experiments such as the “cut compliance residual stress procedure” developed by the USC CFSP Site. That file provides detailed instructions on how to prepare the sample for welding, how to clamp the sample, how to acquire data during the weld, and includes a MathCAD worksheet for computing the residual stress profile for the data gathered.

Publishing the procedures and examples of how the procedures are applied aids new students and faculty researchers in understanding the management methods of the CFSP and improves the standardization and quality of the data generated across all participating university sites. Oftentimes, these special test methods can be implemented within the IAB Members’ organizations.

The CFSP web site provides a vital communication link between the site universities and between universities and the sponsors. The four main functions of the web site can be summarized as:

- Marketing Information for Non-Center Members (External)
- CFSP Document Management (Internal)
- CFSP Experimental Data Management (Internal)
- CFSP Center Business Management (Internal)

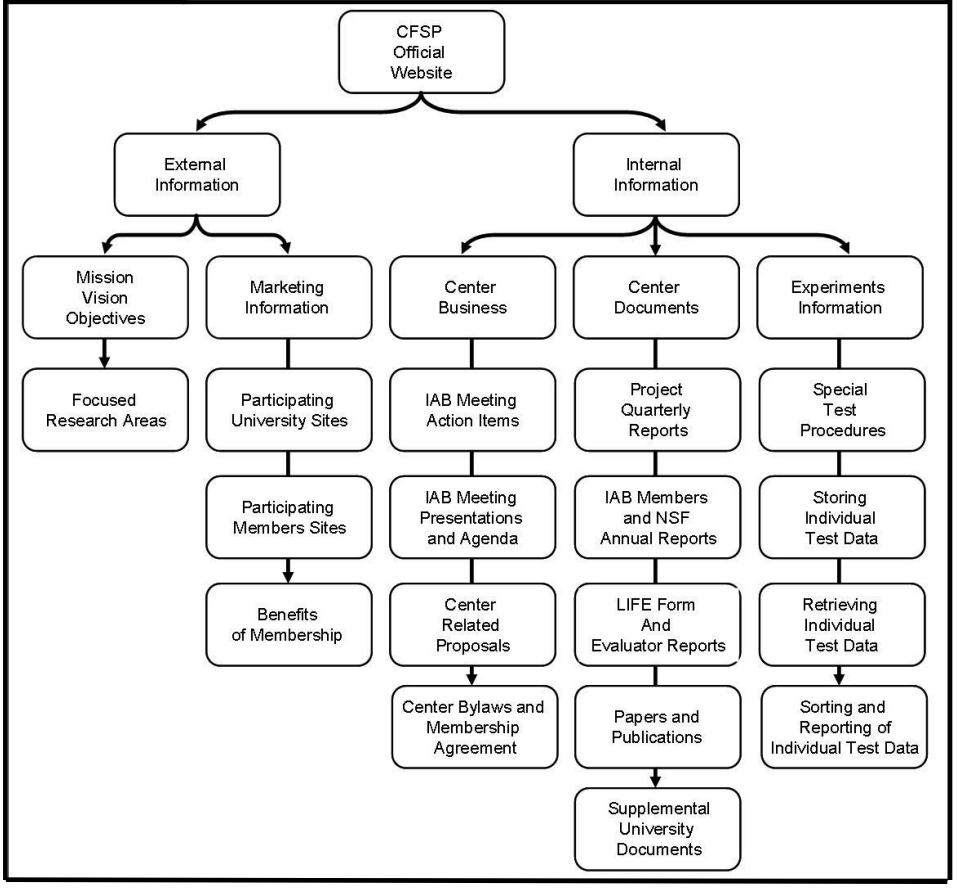
3.2 COMMON SEARCHABLE DATABASE OF TEST RESULTS

In a multi-university I/UCRC where the sites are separated by large distances and the focused research at each site is complimentary to achieving the overall research and development objectives of the IAB, the sharing of experimental data between sites is important, and, often difficult. The Site Directors and industry partners need to reach agreement over the information most likely to be useful to all center participants and, a system must be developed that will facilitate collection and storage of that information.

Most importantly, a mechanism needs to be defined and implemented to allow for specific experimental information to be

retrieved in a meaningful summary data format. Retrieval and review of the detailed experimental data is also available to the IAB Membership should they desire.

Figure 3.2 *The interactive CFSP Web Site is the main management tool used in the development, retention, and distribution of the official CFSP documentation.*



The CFSP is primarily interested in sharing experimental data and results on the friction stir welding and processing research being performed at each site. The information is stored in a web-searchable database. All participants need to agree upon the data to be stored. The required fields are identified and integrated into the data storage interface. The data fields represent the union of all data sets that might be requested by the CFSP University Sites or IAB Members.

However, only a small number of fields were identified as "required" with local procedures put in place to define the population of "non-required" fields but are considered important to the work. For example, in the CFSP database, the database stores information according to the following table:

- Basic information including: the experiment (run) id, the date the run was made, the machine used, the organization, and the operator.

- Project information and experimental definition
- Run parameters
- Pin Tool information
- Anvil information
- Fixture information
- Test results information, including the ability to upload separate data files associated with the experiment.

The required fields for entering information into the experimental database are listed in the table below. The Run ID is a particularly critical piece of information since it is the unique identifier (the primary key) for storing the data. The naming convention (Section 3.11) used for selecting a Run ID is: SSS-CFSPYY-NNNN where SSS is the site identification code (ex: AMP, USC, BYU, MST or WSU) of the site performing the experiment; CFSP is the standard abbreviation for the Center for Friction Stir Processing; YY is two digits to indicate the year the experiment was conducted, and NNNN is a sequential four digit designator representing the number of the experiment run so far this year. For example AMP-CFSP06-0011 is the eleventh experiment made in 2006 at the AMP center CFSP site.

Figure 3.3 *Required Fields for Data Entry into the Searchable Database of CFSP Test Results*

Run ID	Project ID *	Operator Name *
Joint Type *	Anvil Type *	
Pin Tool *	Pin Tool S/N	Pin Tool Model
Fixture *	Fixture code	
Number of run parameters	Number of test results	Number of parts Tested

* Represents Dynamically Altered Pull Down Menu Fields

To aid in data retrieval, the required fields utilize a menu driven input to prevent multiple spellings or designations for the same items whenever possible. For a menu-based input field, it is unlikely that all field values will be known in advance. Thus the menu must be dynamic, either allowing for an administrator to input new values into the menu or automatically adding new elements as they are entered.

If the menu is altered by users inputting data, or if a non-menu input is allowed, it is desirable to search for similar values to prevent duplication. For example, entering "alunimum" should produce a match with "aluminum". This is a common tool available on most web search engines. For the CFSP experimental database, the project ID, joint type, anvil, operator, tool, and fixture fields are dynamically altered menu entry fields. Any user can add an option to the drop-down menu when entering data for these.

Standard error checking is employed for the remaining fields. The database users also need to identify the standard queries for data retrieval that need to be implemented. For the CFSP, the database tables are searched for a string entered by the user. Any number of tables can be selected, or all can be used for the query. A database query screen and typical results of a search are presented below.

Figure 3.4 *Search String Capabilities of the Searchable Database of CFSP Test Results.*

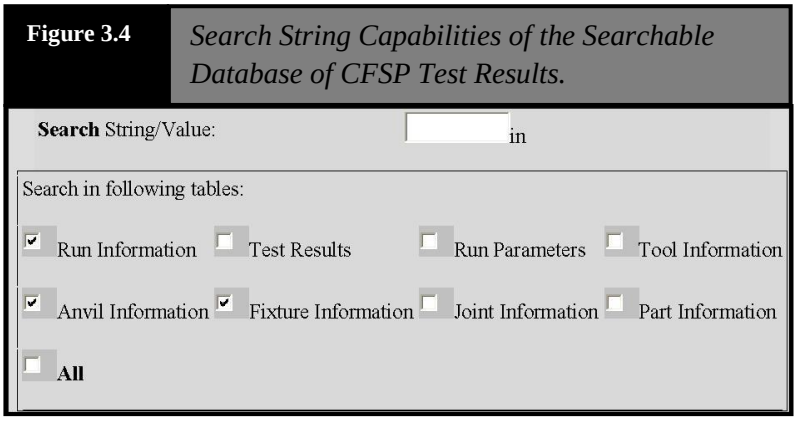


Figure 3.5 *Example of Experimental Database File of Individual CFSP Test Results*

Run Id: UMR-6111L.01.1500.10	**Run Date:** 01-MAR-06	**Run Time:** 08:00	**Machine:** Robot
Program Data: N/A		**Process Data:** N/A	
Surface Appearance: N/A		**Tool Information:** N/A	
Notes: N/A		**Run File:** N/A	
Organization: U of Missouri-Rolla, 1870 Miner Circle, Rolla, Missouri -65409, Ph:(573)341-6361, Fax:-.			
Operator: Manasij, 238, McNutt Hall, UMR, Rolla, MO -65401, Ph:573-341-4547, Fax:N/A.			
Project Information			
Project Name: FSP05-UMR-02	**Investigator:** Dr. Rajiv Mishra	**Organization:** UMR	**Description:** N/A
Project Sponsors:	GENERAL MOTORS, N/A, N/A, N/A -N/A, Ph:N/A, Fax:N/A.		

Run Parameters

Run Parameter	Parameter Value
Tool RPM	1500
Tool IPM	10
Travel Angle	1
Work Angle	0
Zero Force	1 kN
Plunge Depth	1.7 mm

Tool Information			
Tool Serial #: A 142	**Tool Model #:** N/A	**Tool Type:** N/A	**Type Description:** N/A
Drawing #: N/A	**Model Description:** N/A	**Units:** N/A	**Drawing File:** N/A
Shoulder Diameter: N/A	**Shoulder Feature:** N/A	**Pin Diameter:** N/A	**Pin Length:** N/A
Pin Taper: N/A	**Pin Feature:** N/A	**Tool Material:** N/A	**Material Ref Spec:** N/A
Tool Material Property #: 1			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	
Tool Material Property #: 2			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	
Tool Material Property #: 3			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	

Anvil Information	**Anvil Id:** FSL01.01		
Thickness: N/A	**Width:** N/A	**Length:** N/A	**Length Unit:** N/A
Anvil Material:	**Anvil Material Reference Spec:**		
Anvil Coating Information	**Anvil Coating Id:** N/A		
Coating Thickness: N/A	**Thickness Unit:** N/A	**Coating Material:** N/A	**Material Ref Spec:** N/A
Anvil Coating Material Property #: 1			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	
Anvil Coating Material Property #: 2			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	
Anvil Coating Material Property #: 3			
Material Property: N/A	**Material Property Unit:** N/A	**Material Test Specification:** N/A	
Minimum Value: N/A	**Maximum Value:** N/A	**Typical Value:** N/A	

Fixture Information			
Fixture Code: FSL01	**Description:** N/A	**Drawing:** N/A	**Photo :** N/A
Test Result Information			
Test Result #: 1			
Property Name: Shear fracture load	**Property Unit Id:** kN	**Test Specification:** N/A	**Value:** 3.12	**Datafile:** N/A

Other database searches are possible. For example, searching on the keyword Run ID reveals the total number of the experiments populating the database from each site. Searching on the keyword "weld" provides a listing of those experiments that performed welding operations (versus those that performed testing of the welds).

Figure 3.6 *Example Listing of Experiments used to Populate the CFSP Experimental Database*

Dakota School of M & T (AMP)	University of South Carolina (USC)	Brigham Young University (BYU)	University of Missouri- Rolla (UMR)
AMP-FSW06055 AMP-CFSP 01 AMP-trial AMP-1234 AMP-CFSP 02 AMP-FSW06001 AMP-test	USC-IUCRC-1449		UMR-1_PCD_DOENG20050307 UMR-6111L.02.1500.10 UMR-FSP05UMR026111 UMR-6111L.01.1500.10 UMR-6111L.03.1500.7.5 UMR-6111L.04.2000.10 UMR-xxnn UMR-cfsp02_001 UMR-cfsp02_002 UMR-cfsp02_003 UMR-cfsp02_004 UMR-cfsp02_005 UMR-cfsp02_006 UMR-cfsp02_007 UMR-cfsp02_008 UMR-cfsp02_009 UMR-cfsp02_009 UMR-cfsp02_010 UMR-cfsp02_011 UMR-cfsp02_012 UMR-CFSP01 001 UMR-CFSP 01 001 UMR-CFSP 01 001 UMR-cfsp0603_0001 UMR-cfsp0603_0002 UMR-cfsp 0603_0003 UMR-cfsp 0603_0004 UMR-cfsp 0603_0005 UMR-cfsp 0603_0006 UMR-cfsp 0603_0007 UMR-cfsp 0603_0008 UMR-cfsp 0603_0009 UMR-cfsp 0603_0010 UMR-cfsp 0603_0011 UMR-cfsp 0013 UMR-cfsp 0603_0014 UMR-cfsp 0603_0015 UMR-cfsp 0603_0016

Figure 3.7 *Example Output of Keyword Search of the CFSP Experimental Database Showing those Experiments that Meet the Search Criteria*

Search Results for **'weld'**
Total number of results: **12**

Run Id	Organization	Date	Time
UMR-cfsp02_002	University of Missouri-Rolla	01-MAR-06	11:5
UMR-cfsp02_003	University of Missouri-Rolla	01-MAR-06	11:16
UMR-cfsp02_004	University of Missouri-Rolla	01-MAR-06	11:23
UMR-cfsp02_005	University of Missouri-Rolla	01-MAR-06	11:27
UMR-cfsp02_006	University of Missouri-Rolla	12-JUN-06	11:47
UMR-cfsp02_007	University of Missouri-Rolla	12-JUN-06	12:0
UMR-cfsp02_008	University of Missouri-Rolla	12-JUN-06	12:9
UMR-cfsp02_009	University of Missouri-Rolla	12-JUN-06	12:16
UMR-cfsp02_009	University of Missouri-Rolla	12-JUN-06	12:16
UMR-cfsp02_010	University of Missouri-Rolla	12-JUN-06	12:26
UMR-cfsp02_011	University of Missouri-Rolla	12-JUN-06	12:30
UMR-cfsp02_012	University of Missouri-Rolla	12-JUN-06	12:35
USC-IUCRC-1449	University of South Carolina	25-MAR-05	09:00

3.3 CFSP DOCUMENT MANAGEMENT AND STANDARDIZED FORMS

The web site and database described in Section 3.2 is used not only for experimental results but also for dissemination of reports and other documents. The CFSP Quarterly Reports, Annual Members' reports, Annual NSF Reports, and research papers produced by center members are stored and retrieved through this site. In addition, supplemental university documents (test procedures, etc) and a reference library of the available published literature from journals and books are managed by the web site and the database. The Annual Reports are described in detail in Chapter 5. The remaining items are discussed below.

Early on in the development of the center, various documents and forms were created to standardize the image of all CFSP letters, reports, and communication tools to emphasize the unity and collaboration between the university sites. An official CFSP Logo was adopted and is included on all CFSP documentation. A downloadable copy of the approved CFSP Logo is available on the CFSP Web Site.

Standardization of documentation produced from experiments and documentation of project progress is also important to center operations. Documents prepared on a regular basis and those compiled into larger documents follow a standard format with an approved template available on the web site. The web site provides a repository of documents prepared during previous years to serve as examples for future activities. For example, quarterly reports, which detail the progress made on each project, are prepared by each site and stored in the database in a standard format. Using standardized formats for CFSP documentation ensures that each person preparing the item prepares to the same content – across all site universities. Additionally, the IAB Members know what to expect for content. Standardized templates are provided for:

- *Memos and Letters*
- *Quarterly Project Reports* – quarterly progress on each project

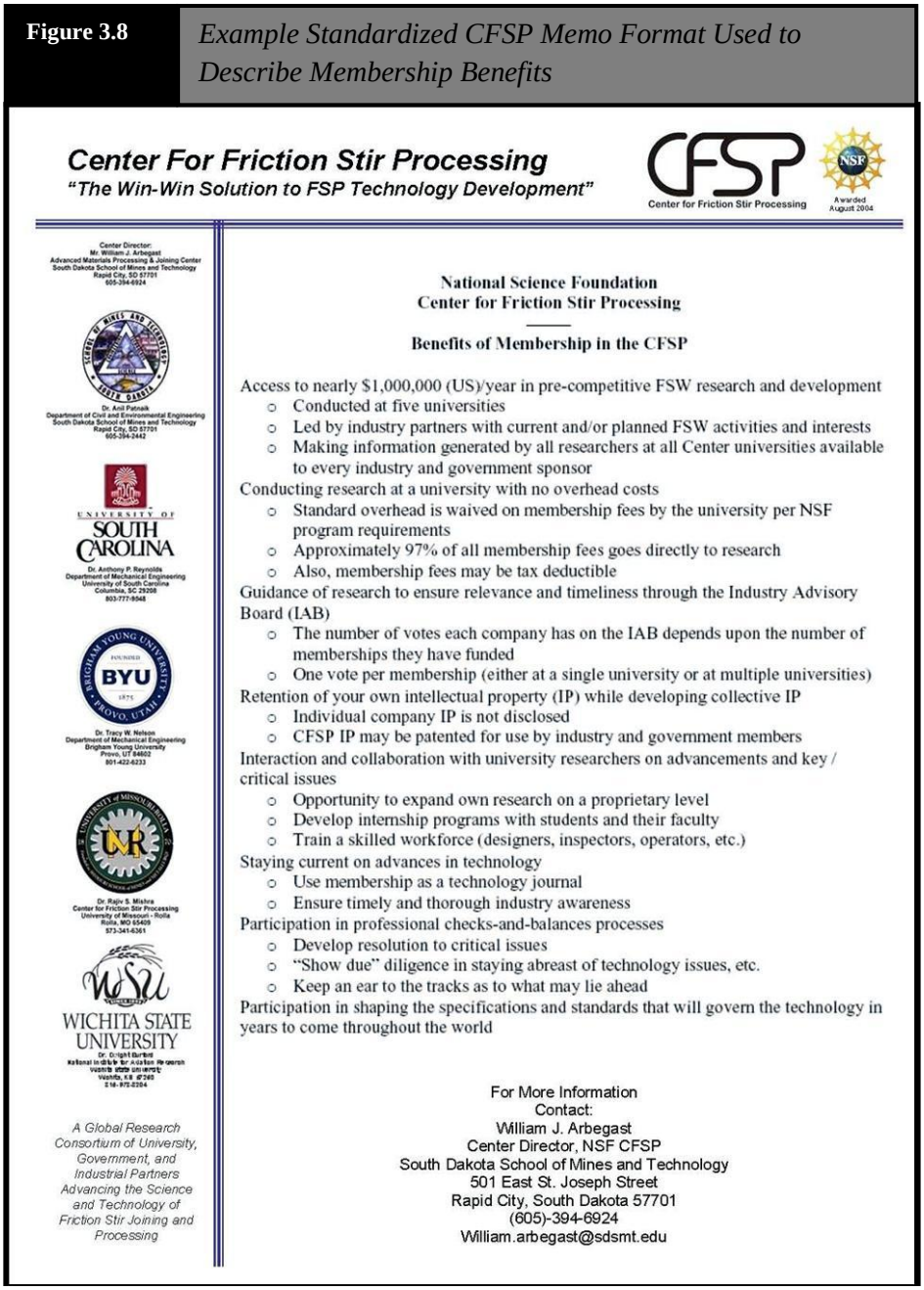
- *Annual IAB Members' reports* – annual summary of progress on each project
- *Annual NSF I/UCRC Repor*t – required by the NSF and includes Evaluator's Annual Report
- *Semi-Annual LIFE Form Response Report* – summarizes IAB Members' comments and Project Principal Investigator responses
- *New Project Proposals* – oral presentations at IAB Meeting
- *IAB Workshop Presentations: Project Technical Review* – oral presentation at IAB Workshop giving detailed review of project progress
- *IAB Meeting Presentations: Project Management Review* - oral presentation of project summary for IAB review and LIFE Form approval at IAB Meeting
- *IAB Meeting Action Item List* – Action items assigned at IAB Workshop and Meeting State of the Center Report – Semi-Annual Assessment of the status, health and growth of the CFSP- prepared by CFSP Center Director
- *Poster Template* – standard format for all CFSP posters
- *IAB meeting attendance and registration form* – Formal Invitation to IAB Meeting
- *CFSP Members Agreements* – common use among all sites
- *Sample Non-Disclosure Agreements*

3.3.1 CFSP Standardized Letter and Memo Format

The CFSP has developed a standard format for formal letters and memos issued under center business and are used during official communication between the CFSP and the site universities, the NSF, IAB Members, and prospective IAB Members. Following is a listing of the benefits of CFSP membership shown on this

standardized format. These are usually signed by the Center Director with appropriate approvals by the Site Directors.

Figure 3.8 *Example Standardized CFSP Memo Format Used to Describe Membership Benefits*



Center For Friction Stir Processing
"The Win-Win Solution to FSP Technology Development"

CFSP Center for Friction Stir Processing — NSF Awarded August 2004

Center Director:
Mr. William J. Arbegast
Advanced Materials Processing & Joining Center
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605-394-6924

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Wichita, KS 67260
316-978-5284

A Global Research Consortium of University, Government, and Industrial Partners Advancing the Science and Technology of Friction Stir Joining and Processing

National Science Foundation
Center for Friction Stir Processing

Benefits of Membership in the CFSP

Access to nearly $1,000,000 (US)/year in pre-competitive FSW research and development
- Conducted at five universities
- Led by industry partners with current and/or planned FSW activities and interests
- Making information generated by all researchers at all Center universities available to every industry and government sponsor

Conducting research at a university with no overhead costs
- Standard overhead is waived on membership fees by the university per NSF program requirements
- Approximately 97% of all membership fees goes directly to research
- Also, membership fees may be tax deductible

Guidance of research to ensure relevance and timeliness through the Industry Advisory Board (IAB)
- The number of votes each company has on the IAB depends upon the number of memberships they have funded
- One vote per membership (either at a single university or at multiple universities)

Retention of your own intellectual property (IP) while developing collective IP
- Individual company IP is not disclosed
- CFSP IP may be patented for use by industry and government members

Interaction and collaboration with university researchers on advancements and key / critical issues
- Opportunity to expand own research on a proprietary level
- Develop internship programs with students and their faculty
- Train a skilled workforce (designers, inspectors, operators, etc.)

Staying current on advances in technology
- Use membership as a technology journal
- Ensure timely and thorough industry awareness

Participation in professional checks-and-balances processes
- Develop resolution to critical issues
- "Show due" diligence in staying abreast of technology issues, etc.
- Keep an ear to the tracks as to what may lie ahead

Participation in shaping the specifications and standards that will govern the technology in years to come throughout the world

For More Information
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3.3.2 Quarterly Project Reports

The CFSP IAB has requested that a single page quarterly project report be prepared for each research project being conducted at the center. This report provides a summary of the progress made during the reporting period. They are prepared by the responsible Project Principal Investigator using the standard template available on the web site.

As shown below, the quarterly report contains project identification information, project objectives, and a summary of the approach taken, progress/achievements, and a schedule of activities. Documents and publications related to this project are listed at the bottom of the form. This document is not to exceed a single page.

Figure 3.9 *Example Standardized Quarterly Report Format Required for CFSP Projects- One (1) Page Maximum*

I/UCRC Site: SDSM&T

Number	Title			Budget
CFSP04-AMP-02	Intelligent Process Control System Algorithms for FSW			##########
Status Date	**Start Date**	**End Date**	**PI and Senior Personnel**	**Students**
July 20, 2007	Feb 1, 2006	June 30, 2007	Mr. William J. Arbegast Dr. Edward M. Corwin Dr. Antonette M. Logar	Enkhsaikhan Boldsaikhan Dhawal Desai

Objectives

- Objective 1
- Objective 2

Approach

Year 1 and 2

- **Task1.** Create algorithm
  - Analyze data
  - Develop an evaluation algorithm
- **Task2.** Hardware development
  - Create a prototype
  - Design appropriate hardware according to the specifications

Year 3

- **Task3.** Create a control algorithm
  - test
  - Improve
  - Compare
- **Task4.** Implementation of control algorithm and hardware
  - Implement
  - Run real-time experiments
  - Optimize

Progress and Achievements

- Statement 1
- Statement 2
- Statement 3
- Statement 4

Schedule and Milestones

Activity	Q3 2006	Q1 2007	Q2 2007	Q3 2007
Determine the best evaluation algorithm				
Test & improve the evaluation algorithm				
Design a control model				
Implement control algorithm & hardware				
Run real-time experiments				
Optimize & improve the controller				

Documents and Publications

Additional Information and Issues

Note: Actual research started in January 2005

For further information contact: Mr. Bill Arbegast, Center Director Email: William.Arbegast@sdsmt.edu Phone: 605-394-6924

Each CFSP Quarterly Project Report contains the following information:

- *Performing University Site*: Three letter university site code (AMP, USC, BYU, MST, or WSU) of site performing the project
- *Project Identification Number*: Each project at the CFSP is identified by a standardized project identifier. The format for this identifier is CFSPYY- ZZZ- XX where YY is the year the project was initiated, ZZZ is the three letter site identifier, and XX is the sequential project number for those projects initiated during that year.
- *Project Name*: Approved project title
- *Budget*: Funding level approved by the IAB
- *Status Date*: Date quarterly report prepared
- *Start Date*: Original start date of the project
- *Completion Date*: Current scheduled completion date of project
- *PI and Senior Personnel:* Project Principal Investigator and supporting faculty
- *Students*: Listing of graduate and undergraduate students working the project
- *Objectives*: Bulletized listing of overall project objectives by year
- *Approach*: Bulletized listing of overall project approach by year
- *Progress and Accomplishments*: Description of progress and major accomplishments made during the reporting period
- *Schedule and Milestones*: Top level schedule of activities organized by tasks

- *Documents and Publications*: Listing of internal and external documents and publications prepared in support of this project

- *Additional information and Issues*: Brief summary of additional information and issues related to the project.

Management of the quarterly reports is done through the web interface to the database. The last four quarterly reports are made available for IAB Members and participating university sites review and required to be prepared and uploaded every quarter. Summary information of report submittals is available through a dynamically generated web page.

From this summary, the Center Director and Site Directors can identify delinquencies in report submittals and will contact the Project Principal Investigator for resolution. As the Project Principal Investigator uploads to the database, the summary page is automatically regenerated to show:

- Project identifiers, sorted by year within site

- Columns for the last four quarterly reports

- Links to Adobe (.pdf) and Word (.doc) versions of each report

- A complete list of all project titles and identifiers

Figure 3.10 *Example Standardized CFSP Quarterly Report Upload Status Summary Page Showing the Last Four Quarterly Reports with Download links to PDF and DOC Versions. Note Standardized Naming Convention and Project*

CFSP I/UCRC
Quarterly Reports

Projects	June 2005	March 2006	March 2007	June 2007
CFSP04-AMP-01	[DOC] [PDF]	[DOC] [PDF]	[DOC]	
CFSP04-AMP-02	[DOC] [PDF]	[DOC] [PDF]	[DOC]	[PDF]
CFSP04-AMP-03		[DOC] [PDF]	[DOC]	
CFSP04-AMP-04	[DOC] [PDF]	[DOC] [PDF]		
CFSP05-AMP-01		[DOC] [PDF]	[DOC]	[PDF]
CFSP06-AMP-01			[DOC]	
CFSP04-USC-01	[DOC] [PDF]	[DOC] [PDF]	[DOC]	[PDF]
CFSP04-USC-02	[DOC] [PDF]	[DOC] [PDF]	[DOC]	[PDF]
CFSP06-USC-03			[DOC]	
CFSP04-BYU-01	[DOC] [PDF]	[DOC] [PDF]	[DOC]	[PDF]
CFSP04-BYU-02	[DOC] [PDF]	[DOC] [PDF]	[DOC]	[PDF]
CFSP06-BYU-01			[DOC]	[PDF]
CFSP04-UMR-01	[DOC] [PDF]			
CFSP05-UMR-01		[DOC] [PDF]	[DOC]	[PDF]
CFSP05-UMR-02		[DOC] [PDF]	[DOC]	[PDF]
CFSP06-UMR-01			[DOC]	[PDF]
CFSP06-UMR-02			[DOC]	[PDF]
CFSP07-WSU-01				[PDF]
CFSP07-WSU-02				[PDF]
CFSP07-WSU-03				[PDF]

Project Titles

CFSP04-AMP-01: Design and Analysis of Build Up Structures (Patnaik)

CFSP04-AMP-02: Intelligent Process COntrol Algorithms (Corwin)

CFSP04-AMP-03: AMP FSW Database

CFSP04-AMP-04: REU Program - FSW of Dissimilar Alloy Steels (Surovik)

CFSP05-AMP-01: Effects of Defects on Friction stir welded Al 7075 T7351 Panels

CFSP06-AMP-01: Acoustics Monitoring of Weld Quality during FSW

CFSP04-USC-01: Thermal Management of Aluminum FSW (Reynolds)

CFSP04-USC-02: FSW of Titanium Alloys (Reynolds)

CFSP06-USC-03: Dissimilar Metal FSW of Aluminum to Magnesium

CFSP04-BYU-01: FSW of Ferritic Steels (Nelson)

CFSP04-BYU-02: FSW of Austenitic Steels (nelson)

CFSP06-BYU-01: Design of Convex Scrolled Shoulder Step Spiral (CS4) Pin Tools

CFSP04-UMR-01: Friction Stir Processing of Castings (Mishra)

CFSP05-UMR-01: Friction Stir Microstructural Modification (Mishra)

CFSP05-UMR-02: Robotic Friction Stir Welding of Thin Sheets (Mishra)

CFSP06-UMR-01: E-Design tools for Friction Stir Welding and Processing – A TIE Project with Virginia Tech

CFSP06-UMR-02: Friction Stir Spot Welding

CFSP07-WSU-01: Performance Evaluation of Discontinuous Friction Stir Welding

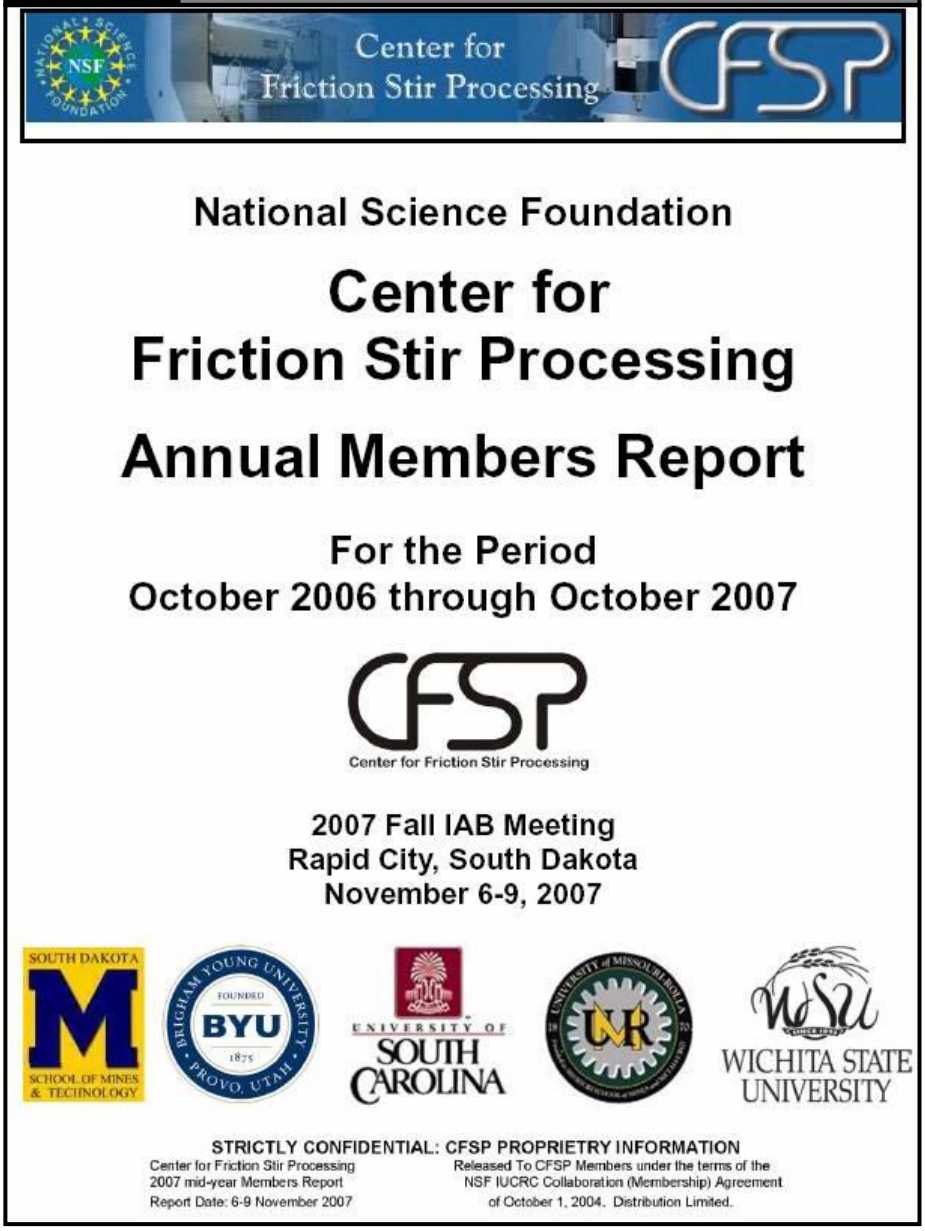
CFSP07-WSU-02: The Effect Faying Surface Treatments in Friction Stir Spot Welds

CFSP07-WSU-03: "Low" Z force FSSW – conventional tool & process development approach

3.3.3 CFSP Annual Members' Report

Each year, and prior to the Fall IAB meeting, a CFSP Annual Members' report is prepared which contains the detailed technical information on each project. The standardized Annual Members' report title page is shown below.

Figure 3.11 *Example Standardized CFSP Annual Members' report Title Page*



As seen in the Table of Contents, the projects are identified by the naming conventions (Section 3.11). Included is a CFSP Program Overview (Section 5.3.1), Technology Development Roadmap (Section 5.3.2), Program Master Schedule (Section 5.3.3), Executive Summaries (Section 5.3.4), and detailed Technical Reports for each project (Section 5.3.5). Information on the standardized formatting of the CFSP Annual Members' report can be found in Section 5.3.

3.3.4 Annual NSF I/UCRC and Independent Evaluator's Report

The Annual NSF I/UCRC Report is submitted to the NSF through Fastlane (http://fastlane.nsf.gov/). It is also made available to the IAB Members via the CFSP web site. The content required is available at http://www.nsf.gov/eng/iip/iucrc/iucrcannualreport.jsp. One single CFSP annual report is prepared by the Center and Site Directors and is submitted concurrently by each site to the NSF. The annual report is due to the NSF 90 days before the anniversary of the center's award. Further information on the standardized content and formatting of the CFSP Annual NSF Report can be found in Section 5.1. In the CFSP NSF I/UCRC Annual Center Report, a copy of the Independent Evaluator's Report (Section 5.4) is included.

3.3.5 Semi-Annual LIFEFORM Response Report and Action Items

At each of the Semi-Annual IAB member meetings, continuing and proposed research projects at each participating site are reviewed and commented upon using the electronic life forms found on the web site at the University of Central Florida (www.isl.ucf.edu/LIFE/). At the completion of the meeting, a standardized LIFE Form Response Report and Action Items List report (Chapter 4) is prepared and uploaded to the web site for IAB Member review.

Figure 3.12 *Example Standardized CFSP Annual Members' report Table of Contents*

NSF Center for Friction Stir Processing
2006 Annual Members Report

TABLE OF CONTENTS

Figure 3.13 *Example Standardized NSF Annual Members' report Approval Page*

Mr. William J. Arbegast
Advanced Materials Processing Center
South Dakota School of Mines and Technology
Rapid City, SD 57701
605-394-6024

Dr. Anthony P. Reynolds
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Center For Friction Stir Processing
University of Missouri - Rolla
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573-341-4361

National Science Foundation

Center for Friction Stir Processing

2007 Annual Center Report

May 7, 2007

Approved by:

William J. Arbegast
CFSP Center Director
South Dakota School of Mines and Technology

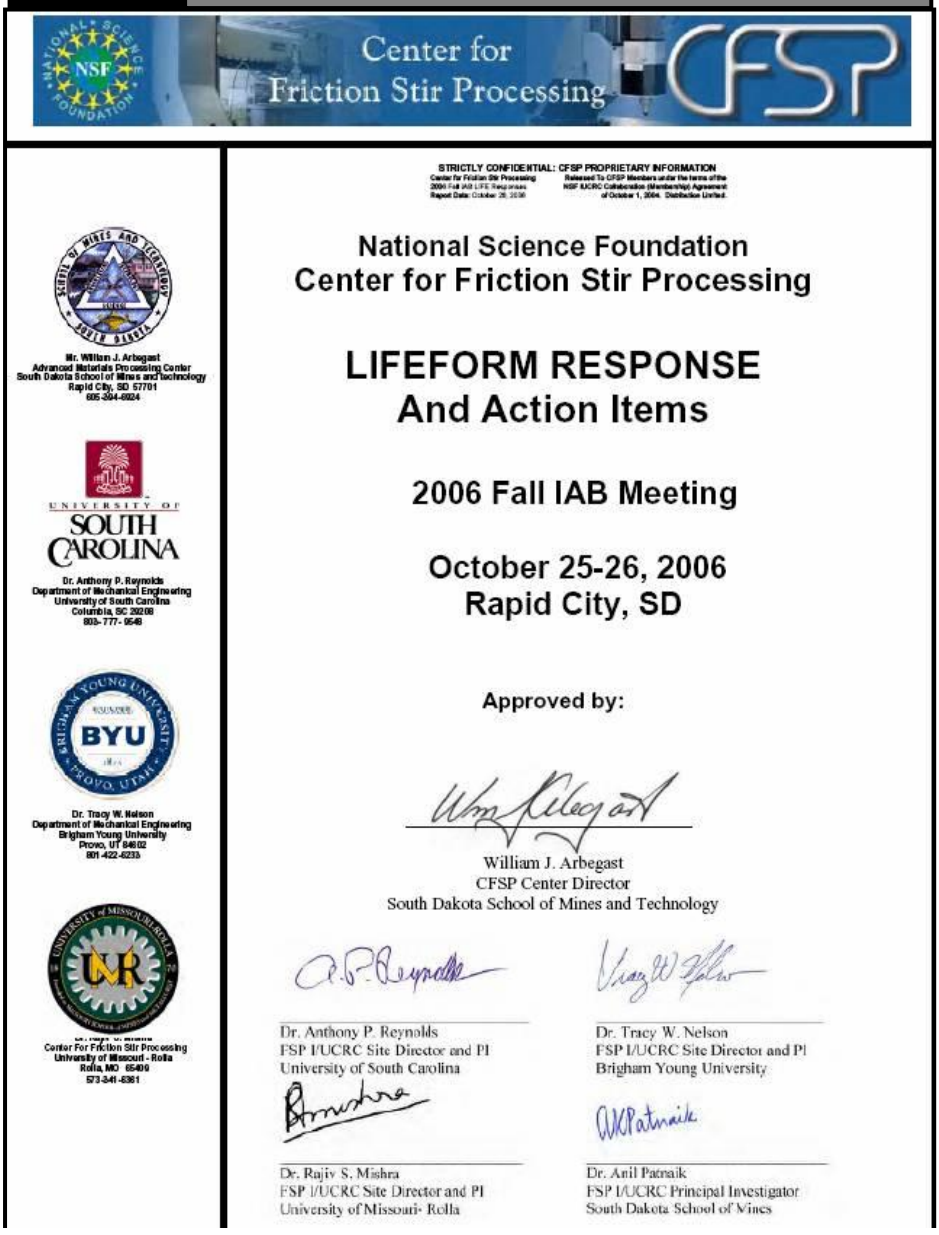
Dr. Anthony P. Reynolds
FSP I/UCRC Site Director and PI
University of South Carolina

Dr. Tracy W. Nelson
FSP I/UCRC Site Director and PI
Brigham Young University

Dr. Rajiv S. Mishra
FSP I/UCRC Site Director and PI
University of Missouri- Rolla

Dr. Anil Patnaik
FSP I/UCRC Principal Investigator
South Dakota School of Mines

Figure 3.14 *Example Standardized CFSP LIFEFORM Response and Action Items Report from IAB Meetings*



Center for Friction Stir Processing

STRICTLY CONFIDENTIAL: CFSP PROPRIETARY INFORMATION

Center for Friction Stir Processing 2006 Fall IAB LIFE Responses Report Date: October 26, 2006

Released To CFSP Members under the terms of the NSF I/UCRC Collaboration (Membership) Agreement of October 1, 2004. Distribution Limited.

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National Science Foundation
Center for Friction Stir Processing

LIFEFORM RESPONSE
And Action Items

2006 Fall IAB Meeting

October 25-26, 2006
Rapid City, SD

Approved by:

William J. Arbegast
CFSP Center Director
South Dakota School of Mines and Technology

Dr. Anthony P. Reynolds
FSP I/UCRC Site Director and PI
University of South Carolina

Dr. Tracy W. Nelson
FSP I/UCRC Site Director and PI
Brigham Young University

Dr. Rajiv S. Mishra
FSP I/UCRC Site Director and PI
University of Missouri- Rolla

Dr. Anil Patnaik
FSP I/UCRC Principal Investigator
South Dakota School of Mines

3.3.6 Project IAB Workshop Presentations—Technical Review

At each of the Semi-Annual IAB member meetings, completed, continuing and proposed research projects at each participating university site are reviewed in technical detail during the one (1) day IAB Workshop that precedes the two (2) day formal IAB meeting (see Section 4.1.2). A limited amount of time, generally 1 hour, is allocated to each university site such that all projects may not be included- selection of the projects to present is at the discretion of the Site Director.

A standardized IAB Workshop presentation template (see Section 4.1.3) is provided on the web site for consistency in content and format. Since the time allocated to the university site may be limited, the Project Principal Investigator and Site Director must limit the scope of the information provided to tell a concise story – but within the overall time limit. LIFE form reviews are NOT conducted.

The overall length of this presentation is generally limited to 10 minutes + 5 minutes discussion (10 slides). Student researchers are encouraged to prepare and present these presentations. The CFSP IAB Membership has indicated that they appreciate these student presentations. All IAB Workshop presentations are uploaded to the CFSP web site and are available for the IAB Members to download and review.

A bound copy of all IAB Workshop presentations is provided to each IAB member at the workshop. A bound copy is also sent to all IAB Members not in attendance. The content of the CFSP IAB Workshop Presentations includes:

- *Title Page*: Project Name and Unique Identifier, Student Researchers, Faculty Principle Investigator, Site Director, and proprietary information disclaimer (1 slide).
- *Objectives*: Generally a block diagram chart showing multi-year objectives detailing tasks and subtask objectives (1 slide)
- *Approach*: Generally a block diagram chart showing the approach for the current reporting period. (1 slide)
- *Status*: Discussion of results in bulleted format of the status and major findings stemming from the research

performed during the current reporting period (2 – 4 slides)

- *Immediate Actions*: A detailed discussion in bulleted format of the actions and research to be conducted during the next reporting period (1 slide)
- *Schedule*: The project schedule in timeline format showing the major milestones, tasks, and subtasks for the entire multi-year project. Those tasks that are completed are suitably marked to show progress against schedule. (1 slide)
- *Issues*: A listing of major issues acting as barriers to successful completion of the research project. This may include resource issues or technical understanding issues, and, may include specific requests for sponsor assistance and support in performance of the project (1 slide)
- *Comments and Questions*: At the completion of the IAB Workshop Presentations, the IAB Members provide comments and questions of the researchers, and make recommendations for improvements in the direction of research. This is generally limited to 5 minutes, depending on the total number of time allocated to each site university. (Note that the IAB workshop is held the day before the official IAB meeting and that discussion of the various research projects continue at the evening social events.)

Figure 3.15 *Example of Standardized CFSP IAB Meeting Workshop Presentations Compilation Book*

National Science Foundation

Center for Friction Stir Processing

2007 Fall IAB Meeting
Workshop Presentations

CFSP
Center for Friction Stir Processing

Rapid City, South Dakota
November 6, 2007

SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY · BRIGHAM YOUNG UNIVERSITY FOUNDED BYU 1875 PROVO, UTAH · UNIVERSITY OF SOUTH CAROLINA · UNIVERSITY of MISSOURI-ROLLA UMR · WSU WICHITA STATE UNIVERSITY

STRICTLY CONFIDENTIAL: CFSP PROPRIETRY INFORMATION

Center for Friction Stir Processing
2007 mid-year Members Report
Report Date: 6-9 November 2007

Released To CFSP Members under the terms of the NSF IUCRC Collaboration (Membership) Agreement of October 1, 2004. Distribution Limited.

3.3.7 Project IAB Workshop Presentations—Management Review

At each of the Semi-Annual IAB member meetings, all continuing and proposed research projects at each participating university site are reviewed at management-level detail during the two (2) day IAB Meeting following the IAB workshop (see Section 4.1). A limited amount of time, generally 5 minutes (5 slides), is allocated for each project. A standardized IAB Meeting Management Review presentation template (see Section 4.2) is provided on the web site for consistency in content and format.

Since the time allocated to each project is limited, the Project Principal Investigator and Site Director must limit the scope of the technical information provided to tell a concise story – but within the overall time limit. LIFE form reviews ARE conducted on these presentations for IAB Members' approval of the project according to the project selection procedures (See Section 1.4.3). This management level presentation is conducted by either the faculty Project Principal Investigator or the Site Director. Student presentations are not allowed.

The purpose of these presentations is to obtain IAB approval (through the LIFE form process) to initiate or continue specific research activities. This is NOT a technical review of the project-but stresses the objectives, overall approach, timeline, and budget for the project. Detailed technical discussions of these project should be conducted during the IAB Workshop preceding the IAB Meeting.

All IAB Meeting Management Review presentations are uploaded to the CFSP web site and are available for the IAB Members to download and review. The content of the CFSP IAB Management Review Presentations includes:

- *Title Page*: Project Name and Unique Identifier, Student Researchers, Faculty Principle Investigator, Site Director, and proprietary information disclaimer (1 slide).
- *Objectives*: Defines the specific objectives to be achieved during the next reporting period in bulleted format (1 slide)
- *Next Year Activities*: Defines the specific approach to be taken during the next reporting period in bulleted format (1-2 slides)

- *Timeline*: Proposed project timeline for task and subtasks showing major milestones for the upcoming reporting period and extending over the entire lifetime of multi-year projects (1 slide)
- *Budget*: Total budget dollar allocated to the project from the available site university membership fees including projected numbers of student researchers and funding applied to the project from other, collaborative, sources – REU, RET, Supplemental, university, "in-kind", etc. (1 slide)

3.3.8 New Project Proposals

At each of the Semi-Annual IAB member meetings a proposed new research projects may be presented to the IAB for approval. These are generally proposed, however, at the Spring IAB meeting with research commending during the summer months. The proposed projects at each participating university site are reviewed at both the technical (Workshop) and Management (IAB) level meetings. They are presented in the standard presentation formats used for both the Workshop (See Section 3.3.7) and IAB Meeting (See Section 3.3.8) and are subject to the content and web site upload requirements of both.

The proposed new projects are appropriately identified within the words "Proposed" preceding the project title and the symbol (P) added behind the unique project identifier (see Section 3.11). LIFE form reviews ARE conducted on these presentations for IAB Members' approval of the project according to the project selection procedures (See Section 1.4.3).

3.3.9 IAB Action Item Lists

At each of the Semi-Annual IAB member meetings, the CFSP membership may request certain actions of the Center and Site Directors that relate to Center Business. It is imperative that these action requests be compiled and assigned to specific persons for completion – action requests from the IAB have a high priority and must be addressed to show responsiveness to IAB member

needs and recommendations. A standardized form has been developed to track and monitor these IAB Action Items. As with all CFSP documents, this is under revision control using established document configuration management methods (e.g., Revision B – 12-06-2007).

The CFSP Action Item List is a living document and is continuously monitored and updated by the Center Director. Each new action item is added to the list with a sequential identifier. A description of the action is provided and the person responsible to complete the action is identified. The date that the action was assigned and when the item is scheduled for completion is negotiated with the membership at the IAB meeting. The actual completion date and comments regarding the action is shown. The Center Director coordinates with the Site Directors to ensure that all action items are addressed and closed as appropriate.

The CFSP Action Item List is uploaded to the web site and is available for the IAB Members to download and review. In addition, the CSFP Center Director statuses each action item at the semi-annual IAB meetings during the State of the Center briefing (See Section 3.3.10).

Figure 3.16 *Example of Standardized CFSP IAB Meeting Action Items*

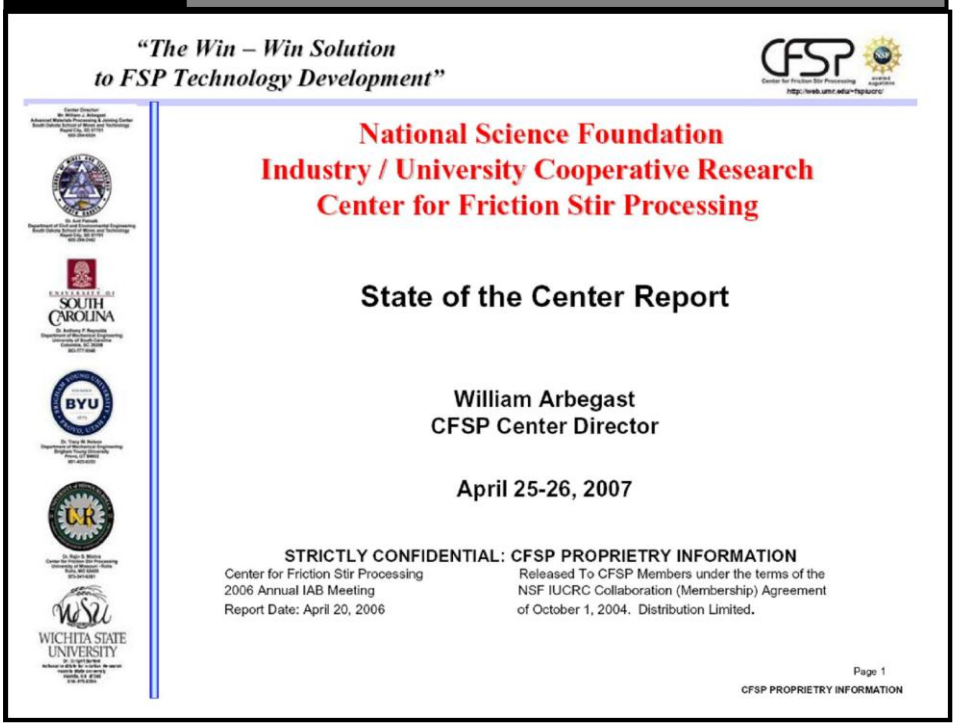
No.	Description	Responsibility	Date Assigned	Scheduled Complete	Actual Complete	Comments
001	Upload all IAB meeting presentations to CFSP website with confidentiality statements	Fletcher Abhinay	10/26/06	11/15/06	11/15/06	Standard Confidentially Developed
002	Upload 2006 Annual Member Report to CFSP website with confidentiality statements	Fletcher Abhinay	10/26/06	12/31/06	12/03/06	
003	Post Non-Disclosure Agreement draft on CFSP website and get approval at the next meeting	Fletcher Abhinay	10/26/06	12/31/06	Complete	Approve at next IAB Meeting
004	Develop policy for one time attendance at the IAB meetings of interested parties to experience what CFSP is about	Arbegast	10/26/06	02/28/07	Complete	
005	Increase length of IAB meeting for better interaction between IAB and Universities, and develop an agenda structure	Arbegast	10/26/06	02/28/07	Complete	A two and half day IAB meeting will allow more time for interaction.
006	Develop a high quality marketing brochure: a. Universities provide Electronic Draft b. IAB Approval c. Final Version to be presented	Nelson/Sorenson Baumann Nelson/Sorenson	10/26/06	01/31/07	Open	Other sites need to provide input/pictures to BYU
007	Update CFSP Roadmap	Arbegast/ Baumann	10/26/06	03/30/07	Open	To be Updated at Each IAB meeting
008	Develop a good recruitment strategy	All	10/26/06	03/30/07	Open	Each Site to Develop at least 2 new members per year
009	Provide a list of publications from each site and upload to the CFSP website	All	10/26/06	02/28/07	Complete	Suggest each university also enter this information in technical paper database of the website
010	Target a new member recruitment goal for next year of FOUR	All	10/26/06	05/30/07	Complete	WSU needs their four or five members to become a viable site
011	Identify/develop success stories including number of students graduated from the center research	All	10/26/06	NA	Open	Need to Input to NSF

Revision B : 12-06-2007

3.3.10 IAB Meeting State of the Center Report

At each of the Semi-Annual IAB member meetings, the CFSP Center Director prepares and presents a State of the Center Report that informs the IAB Membership of the health and growth of the center (see Section 4.2.3). Center funding, membership demographics, participating universities, action items, publications, and performance metrics are discussed. Important issues related to the success and growth of the CFSP is presented for IAB discussions. The CFSP State of the Center Report is uploaded to the CFSP web site and is available for the IAB Members to download and review.

Figure 3.17 *Example of Standardized CFSP IAB Meeting State of the Center Report Title Page*



3.3.11 IAB Meeting—Workshop Posters

At each of the Semi-Annual IAB member meetings, several time periods corresponding to the scheduled breaks are set aside for student researchers to present and discuss their research in poster presentations (see Section 4.2.4). The IAB Members are free to view each of the posters and discuss the progress with the students during these breaks. This provides an invaluable means of communicating the research activities to the IAB – especially in light of the relatively short time available for formal presentations on each project during the technical workshop, and, the management review flavor of the IAB meeting presentations.

The CFSP IAB Membership has found it especially beneficial to discuss the research projects with the students in this informal manner.

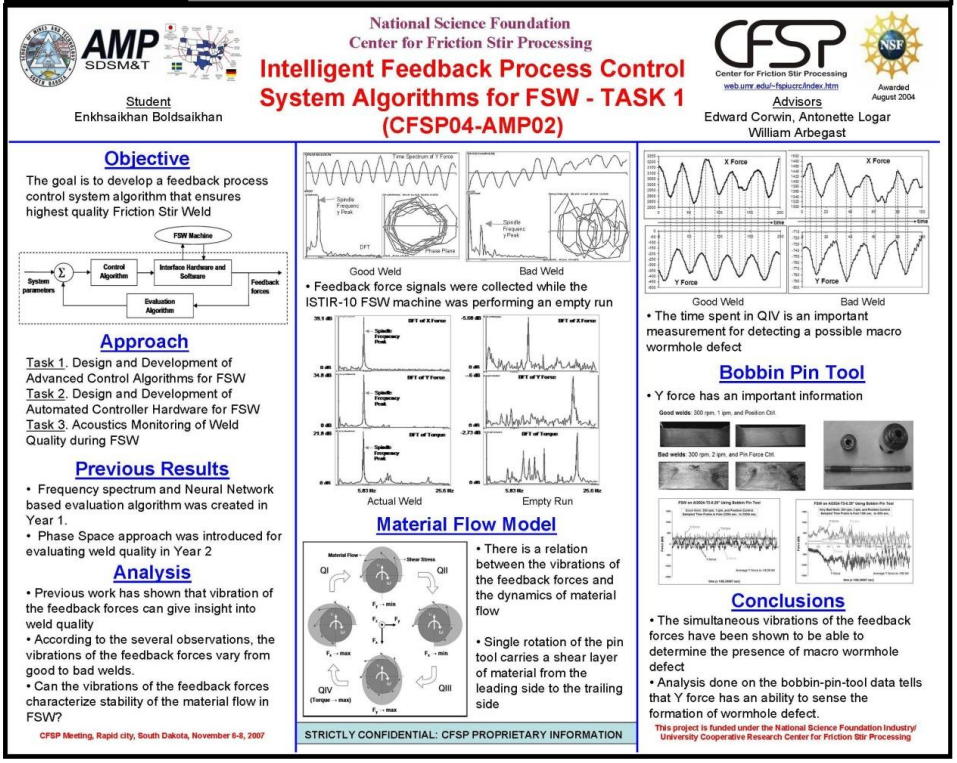
A standard format has been developed for the IAB meeting posters to ensure uniformity in content and image. The basic 3 column format, fonts, and color scheme is provided as a template with modifications to the content adjusted as required for each project.

As a minimum, however, the poster must contain the research objectives, approach, experimental methods, results, conclusions, and recommendation for future work.

Note that the logo for the performing university site is placed in the upper left corner of poster, the CFSP logo is placed in the upper right corner, and, the proprietary information disclaimer is located at the bottom. Both the student researchers and Project Principal Investigator names are shown. The source of funding and the IAB meeting date when the poster was prepared is included.

The students preparing these posters are encouraged to limit “white space” and to use a sufficient quantity of graphics and minimize the use of text. Standardization of the format, content, and appearance of the posters provides for an impressive display and emphasizes the unity of the research among the various university sites. The CFSP IAB meeting posters are uploaded to the CFSP web site and are available for the IAB Members to download and review.

Figure 3.18 *Example of Standardized CFSP IAB Meeting Poster Format*



3.3.12 IAB Meeting and Workshop Attendance Request and Registration Forms

It is the responsibility of the CFSP Center Director to inform and invite the IAB Membership to the IAB Semi-Annual Meetings. A standardized invitation memo (Appendix E) has been developed for this purpose. Two attachments are provided with this memo. Attachment I is an attendance confirmation form requesting the names of the members attending, scheduled arrival and departure dates, special dietary requirements (if any), and updated member point of contact information.

Members not responding to this invitation request are personally contacted by the affiliated university Site Director for this member to provide a personal invitation to attend. The Center Director is responsible for maintaining a current listing of all members, and guests, attending the IAB meetings. Attachment II

provides hotel information and a campus map for the IAB Members' information.

3.3.13 CFSP Membership Point of Contacts List

The CFSP maintains a Members Point of Contacts List (Appendix F). This list is an Excel document that allows for the monitoring and update of membership information – including names of principle points of contact, phone, email, and fax. Additionally, the form can be used to track and monitor the status of document and information transmittals to the IAB Membership specifically requiring IAB Members' responses.

For example, this form can be used to track the invitation and response to IAB Members Meetings (Appendix E), and, track the submittal, receipt, and approval of Requests for Publication (Section 3.7) of CFSP papers, articles, and journal publications. The official version of the Membership Point of Contact List is maintained by the CFSP Center Director.

3.3.14 CFSP Membership Agreements

A standardized membership agreement (Appendix A) is provided for all university sites to use in bringing in new membership. A copy of the membership agreement is posted on the CFSP web site and available for IAB member and university sites to download and review.

3.3.15 CFSP Non-Disclosure Agreements

Although non-disclosure agreements are not used within the CFSP operations, a standardized version of a Corporate NDA (Appendix C) and Personal NDA (Appendix D) is uploaded to the CFSP web site and available for IAB member and university sites to download and review if required (See Section 2.4.3).

3.4 BUILDING A WEB SITE BASED REFERENCE LIBRARY

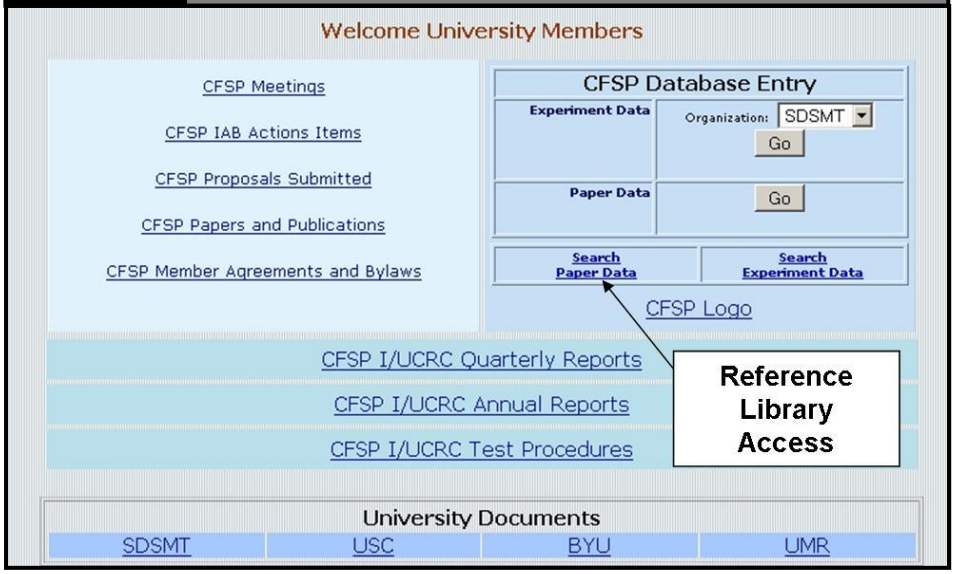
The CFSP web site also provides a location to which students and faculty can upload summaries of journal papers they have found which might be useful to other CFSP students (Appendix G). At the SDSMT CFSP university site, student researchers are required each week to give the Site Director a copy of a paper the student has read related to friction stir processing. Undergraduate students may submit one (1) web based or magazine article. Masters students must submit one (1) refereed journal paper, and, PhD students must submit two (2) refereed journal papers.

The students are required to summarize the paper and upload a summary to the secured portion of the CFSP web site. In this way, the center develops a centralized database of relevant papers that is a valuable resource for students writing research papers and graduate thesis. The IAB Membership has access to this Web-Based Reference Library for viewing only. Care is taken to summarize the papers so as not to violate copyright laws. A complete copy of the paper is not provided. Reference to the source of the paper is provided. Searchable features allow selection of papers for review. With proper reference, selected artwork from the paper may also be uploaded.

The web site contains a link which guides the student through the summary information required. Selecting “Go” to the right of “Paper data” will walk the student through a form for entering information about the paper. The information typically entered includes:

- Author(s) with the author’s affiliation
- Title of the paper
- Citation information (Journal, year etc.)
- An abstract of the paper’s contents
- The type of materials and tool used
- Test results
- The CFSP site that entered the paper (e.g. MST or AMP)

Figure 3.19 *The interactive CFSP Web Site Provides Secure Reference Library Access Where Summary Information on Relevant Journal Papers Is Stored.*



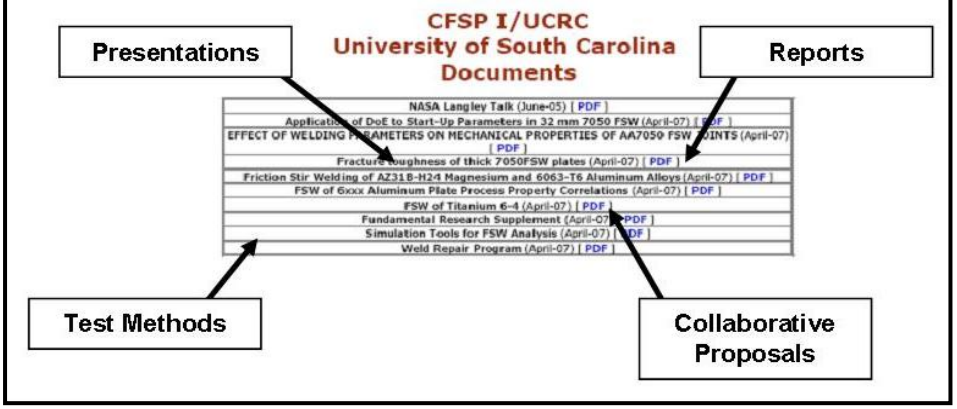
The interface allows users to enter detailed information on the paper content. The information stored for a paper closely mirrors that table structure of the CFSP experimental data storage database (see Section 3.2) to facilitate comparison of experimental results. Once entered into the database, the papers can be searched using keywords or the Paper ID. Paper information can be accessed through the web interface with options to delete, update, or modify the paper summary in the database. Screen images from the CFSP Web Based Reference Library are shown in Appendix G.

3.5 UNIVERSITY SPECIFIC DOCUMENTS

A CFSP site university may wish to share other documents with the IAB or other sites that do not fit into one of the previously discussed categories. A link is provided on the web site associated with each university where these documents can be uploaded and stored behind the secured portal. For example,

recommended test methods, student weekly presentations, or multi-site collaborative project proposals and white papers may be uploaded for other university sites and IAB member review.

Figure 3.20 *The interactive CFSP Web Site Provides a Secure Location Where Selected University Site Specific Documents May Be Stored*



3.6 IDENTIFICATION OF SUPPLEMENTAL RESEARCH OPPORTUNITIES

Throughout the year, the NSF I/UCRC Program Office announces to the Center Directors Research Supplemental research opportunities (http://www.nsf.gov/eng/iip/iucrc/). The Center Director forwards these to the Site Directors and begins discussions of potential collaborative research areas. This is generally done through teleconferencing and ad-hoc meetings at conferences.

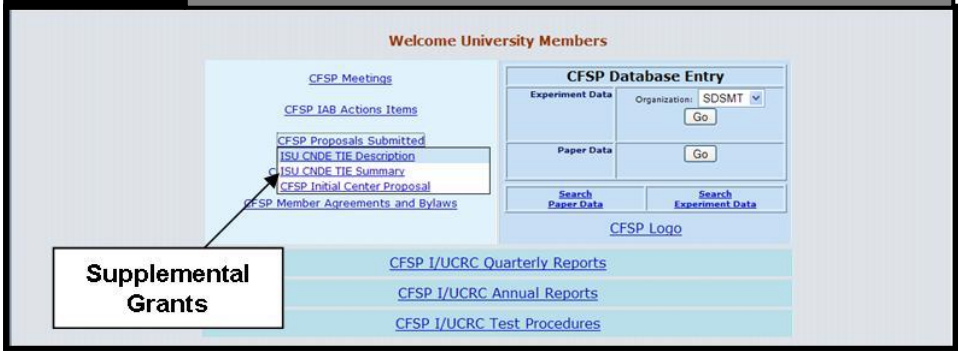
Among those supplemental research opportunities available to an I/UCRC are the Research Experience for Undergraduates (REU) (www.nsf.gov/home/crssprgm/reu/start.htm), TIE, Supplemental Research, and Research Experience for Teachers (RET) grants (http://www.nsf.gov/funding/). Universities RET and REU grants are generally limited to one of each type per I/UCRC center per year. Consequently, in a multi-site center,

coordination between sites is required. If more than one site wishes to submit a proposal, the Site Directors must evaluate them and select the most beneficial proposals to send forward. Universities may also submit REU and RET grants outside of the I/UCRC Program office which are not subject to CFSP P3.

TIE programs are a mechanism for involving another of the NSF I/UCRC Centers (a list of centers may be found at http://www.nsf.gov/eng/iip/iucrc/directory/index.jsp) in a portion of the CFSP research without the other institution becoming a member of the center. They are limited in scope and duration and are funded with supplemental funding obtained through the NSF I/UCRC Program Office. The decision to participate in a TIE program is made by the CFSP Site Directors.

Supplemental grants submitted to the I/UCRC Program office and TIE grants are posted on the web site. Awards received that are used to supplement IAB funding are reported in the CFSP NSF Annual Report (See Section 3.3.4) and Annual IAB Members' report (See Section 3.3.3) also includes a summary of these supplemental grants.

Figure 3.21 *The interactive CFSP Web Site Provides a Secure Location Where Supplemental Grant Information May Be Stored*



It is important that the Center Director and Site Directors communicate with the various IAB Members to develop CRAD funding for specific (single sponsored) projects developed between the CFSP university sites and sponsor group. This group may or may not desire distribution of data to other CFSP IAB Members.

It is important that document management systems (See Section 3.3) keep separated that research data developed under

one funded source and another if the agreed to contract specifies. Since the same manpower and equipment resources used on CRAD programs may be the same. Procedures must be in place to ensure that all CRAD data and results are kept separately from CFSP results and data.

If these separately funded projects are *not* incorporated into the collaborative CFSP research portfolio and are not reportable to the entire IAB, the agreement is generally implemented according to accepted site university sponsored research practices. (Note: The industry partner may/or may not, be a member of the CFSP); and, if such, the appropriate non-disclosure agreements (See Section 2.4.3) should be put in place early in the project definition process.

For example, if a non-CFSP research partner requests specific experiments that have already been run for under the CFSP program, the experiments may have to be re-run and the results are not mixed. The AMP center maintains a separate Paperless Document Management System (see Section 3.8.1) for both AMP and CFSP documentation. An alternate solution is to encourage the non-CFSP member to join the CFSP and obtain access to the "prior art", generally at reduced costs over CRAD funded projects.

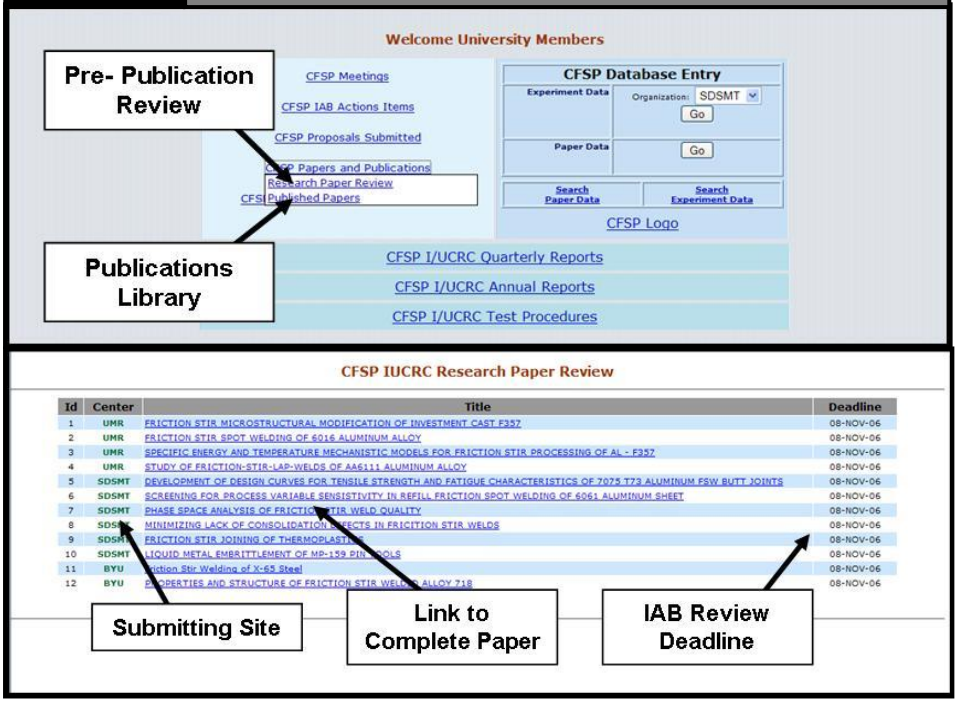
The CFSP site universities do not require IAB approval to pursue NFS supplemental grant funding of CFSP research objectives (see Section 1.4.3). However, all IAB members are kept informed of supplemental NSF funding activity against the NSF I/UCRC award as a courtesy and to illustrate maximum leveraging of the IAB Membership fees.

3.7 PAPERS AND PUBLICATIONS REVIEW AND APPROVAL

Research and scholarly activity is a central objective of the CFSP. Publication, presentation, and dissemination of CFSP research results is a central objective implementing the vision and mission of the center (see Sections 1.1 - 1.3). Distribution of such information is, however, subject to the Publication Approval Procedures (see Section 2.4.1) of the CFSP P3. The CFSP web site provides a mechanism for posting complete copies of research papers that have been prepared for publication and

require IAB approval. The procedure is described in the bylaws (Appendix B) and requires all IAB Members to perform a pre-publications review and approve or disapprove the release of the information contained in the paper within 30 days of notification. The deadline for reviewing the paper is identified.

Figure 3.22 *The interactive CFSP Web Site Provides a Secure Location where Publications are uploaded for IAB Member Review and Approval to Publish. Published Papers are maintained in the Library*



The CFSP Membership Point of Contacts List (see Section 3.3.13) is used to document the notification, receipt, and approval dates for each IAB member. As the time for approval nears, the Center Director or Site Directors may contact the IAB member directly to determine the Pre-Publication approval status. If a member objects to the publication, the publication can be delayed up to 90 days from the date of submission to the members.

Once the research paper has been published, it is uploaded to the secured portion of the CFSP web site and stored in the

Publication Library database. The paper can also be summarized and entered into the Reference Library database (see Section 3.4) where it will be searchable by the IAB, site faculty, and student researchers. Presentation to on-campus audiences, such as a graduate committee meeting and seminars, is allowed even during the review period so that a student's graduation will not be delayed.

3.8 CFSP UNIVERSITY SITE INDIVIDUAL PROJECT MANAGEMENT

The results of site university CFSP research efforts are shared equally between the universities sites and the IAB Members via the center's web-accessible database. However, the local management of projects requires an additional management tool. At the SDSMT AMP CFSP Site, a Project Paperless Data Management System (PaDMS) provides tasks and subtask document control and configuration management and is used to manage projects to a level deeper than that needed for the reporting requirements of the NSF or the IAB.

At the present time, each CFSP site has developed its own internal project management system. The system used at the AMP site is described here as one example of how this might be accomplished.

3.8.1 Paperless Data Management System [PaDMS]

The Paperless Data Management System [PaDMS] was created by the SDSMT Information Technology Systems (ITS) according to the AMP Center specifications. It allows users (students, faculty, and staff) to create and manage multi-level tasked projects via a web interface to an Oracle database. A hierarchal task oriented approach is used to define the overall research project. Each student and faculty researcher is provided password controlled access to the database and are responsible for update and maintenance of their project information. Detail images from the AMP PaDMS are shown in Appendix H.

3.8.2 Creating Projects in PaDMS

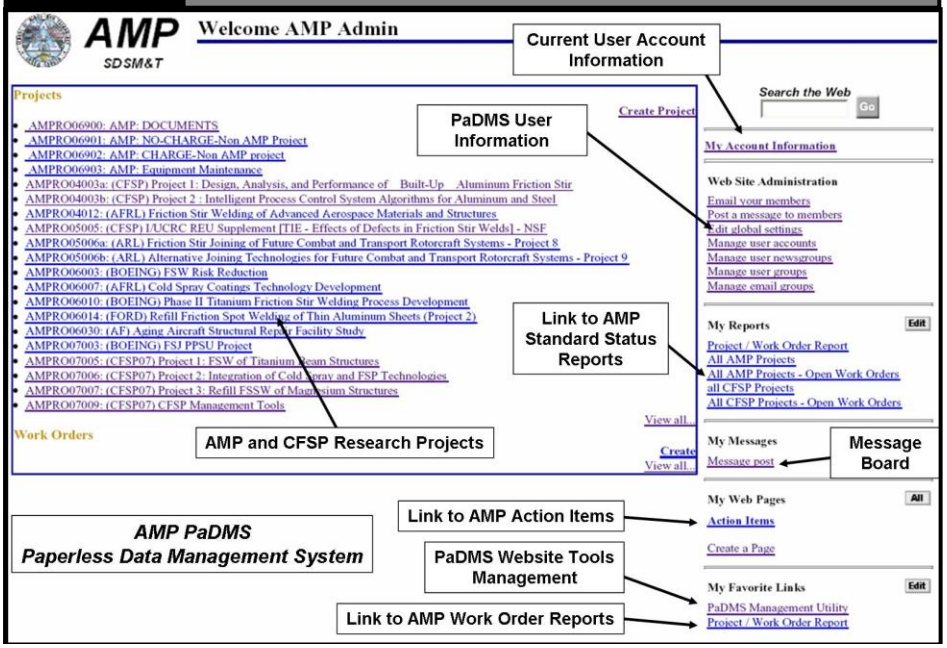
Document and data reporting for the SDSMT AMP Center and CFSP Projects at the SDSMT university site is monitored and controlled using the PaDMS. A project is given a project identifier, and information including title, type (CFSP or AMP), account number, PIs, students, and abstract are input through standardized pull-down menus. Administrative-level security access is required to create a new AMP Center or CFSP research project and populate the pull-down menus in the database. Database update and data population rights at the project level are given to faculty and students researchers assigned to the project.

Top-level program documents can be uploaded and associated with the project including the proposal, statement of work, budget, meeting notes, progress reports, and final report. The faculty and student researchers prepare a task orientated program approach and projects should be broken into tasks which, in turn, may be broken down into subtasks.

Often, the statement of work will specify the tasks and subtasks. If not, the managers of the project need to approve the project work breakdown structure. Accounting codes consistent with that assigned by the university budgetary and accounting procedures are assigned to each project.

During project creation, it is designated as CFSP or AMP or designated as proprietary and ITAR/EAR restricted projects as required. Restriction of access to these projects is accomplished by specifying a list of faculty and students with password-protected access to the project data. The report formatting features of PaDMS allows the printing of project-report information in standardized formats.

Figure 3.23 *The interactive CFSP Web Site Provides a Secure Location where Publications are uploaded for IAB Member Review and Approval to Publish. Published Papers are maintained in the Library*



3.8.3 Creating Tasks and Subtasks in PaDMS

The project approach is designed with manageable tasks and subtask elements that have specific objectives and deliverables. These are given specific start and targeted end dates and are assigned to individuals responsible for the specific tasks or subtask research efforts. A task may or may not be further broken down into subtasks at the discretion of the project managers. Like projects, documents at the task and subtask level can be uploaded including statement of work, progress report, meeting notes, and final report. Work orders are created at the task and subtask level to perform the individual units of work (experimentation) with reportable objectives and deliverables. For examples, separate work orders may be created for the following.

- Friction Stir Welding Trials
- Mechanical Testing

- Metallurgical Examinations
- Optical Microscopy
- SEM Analysis
- FTIR/DSC Analysis
- Other quantifiable test methods

Figure 3.24 *The interactive PaDMS Web Site Provides a Secure Location where new projects are created, security protocols are established, account numbers are assigned and the project is described*

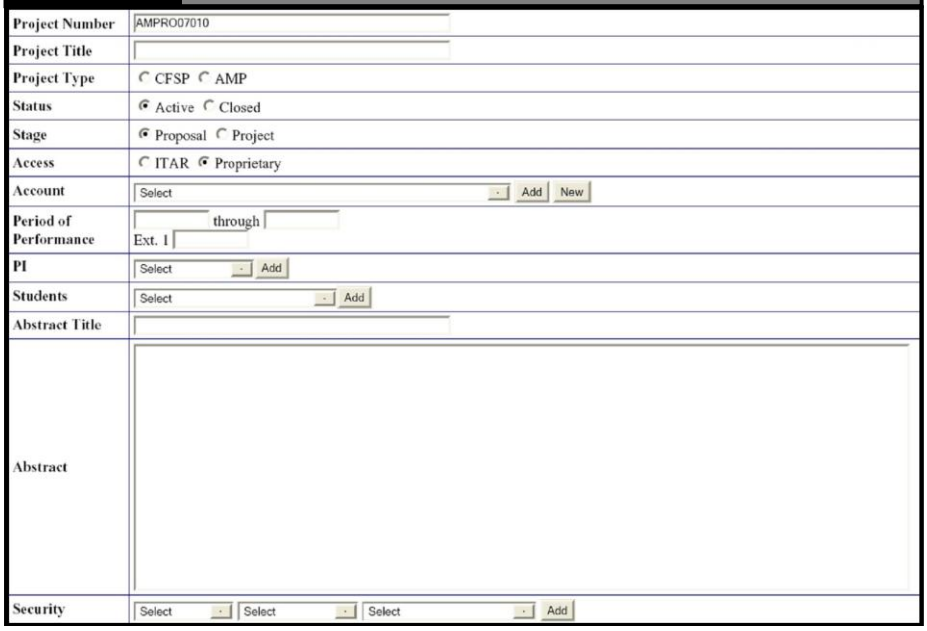
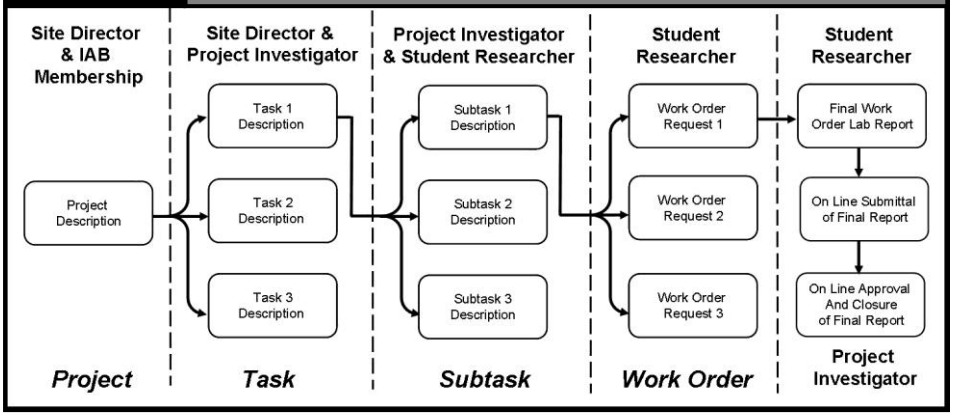


Figure 3.25 *The interactive PaDMS Web Site Provides a Secure Location where new project New Project Tasks, Subtasks, and Work Orders are created and managed*



3.8.4 Creating Task and Subtask Work Orders

A project is broken down into tasks and subtasks and experimental work orders are created. Often, work orders are created by one person describing the work to be done. This work effort may either be done by the originator of the work order or, by others such as other graduate research assistants more familiar with a particular test and methods. In such situations, it is strongly advised that the work order be detailed enough in describing those specific test responses that are anticipated as results. Sufficient detail must also be given to specify those test variables that will have significant affect on the validity of the test results.

Documenting the individual test methods and describing the anticipated results at this level of detail has an added side benefit to the student researchers. He has to plan and think about what the experiment is going to accomplish – far enough in advance to discuss with the faculty advisors and with the other AMP student researchers at the weekly AMP team meeting (see Section 3.10) Work order information is input on the PaDMS web site. Programmatic information is input through pull-down menus while textual information relevant to the experiment is input manually.

- *Project Number*: The project this work order is being conducted under

- *Task*: The task this work order is being created under
- *Subtask*: The subtask this work order is being created under (if applicable)
- *Work Order Number*: A unique sequential identifier for the work order (automatically generated as new orders are created)
- *Cross listed Work Orders*: Work orders which are cross listed with the current one. It is often useful to include work orders for similar testing as reference.
- *Account*: The university accounting code associated with funding for this work
- *Originator*: The individual who created the work order
- *Priority*: The priority of this work (normal/urgent)
- *Date Submitted*: The date the work order is created
- *Date Requested*: The date the work should be completed by
- *Job Title*: Short descriptive title of the work being done
- *Statement of Work*: A complete description of the work being performed. This should tell the individual performing the work everything needed to know how to conduct the experiment. As an alternative, the work order may reference an approved AMP Center Test Plan (Appendix I) which is used to describe a series of related experiments to accomplish a specific project task or subtask.
- *Assigned To*: The individual(s) who have ownership of the work order
- *Closure Status:* Date of approval by AMP Administration of the Standardized Final Work Order Laboratory Report (see Section 3.9) to designate the experiment as complete.

The following pages show an example of the structure of a PaDMS project from the project level through the task and subtask levels down to the work order level. All elements are linked to assist in navigation through the project. Documents populating PaDMS can be viewed from the web or downloaded to the user computer.

Detailed summary and status reports can be created using a variety of search criteria to provide project management with

specific tools to track and monitor the progress of the project. The use of standardized web based input templates ensure that student and faculty produce documentation in a common format for compilation into final reports and thesis. The system provides a central storage location for project specific documents at all levels.

3.9 STANDARDIZED FINAL WORK ORDER LABORATORY REPORT

Each work order registered in PaDMS requires the completion of a Final Laboratory Report (Appendix J) and formal submittal to the AMP and CFSP Administration for review and approval before closure of the experiment is accepted. After uploading the Final Laboratory Report into the appropriate work order report fields and submitting for Admin approval, an email notification is sent to selected faculty recipients for review.

Upon admin approval, the work order status is closed. The admin reviewer may reject the submittal with an automatic email response to the submitter recommending actions or clarifications prior to closure approval. The PaDMS system allows for a detailed database search based on a variety of parameters. It is noted that student researchers benefit from the formal documentation of work order level efforts when it comes time to assemble report, presentations, publications, and theses.

Figure 3.26 *The interactive PaDMS Web Site Provides a Secure Location to Manage Documents at the Project Level*

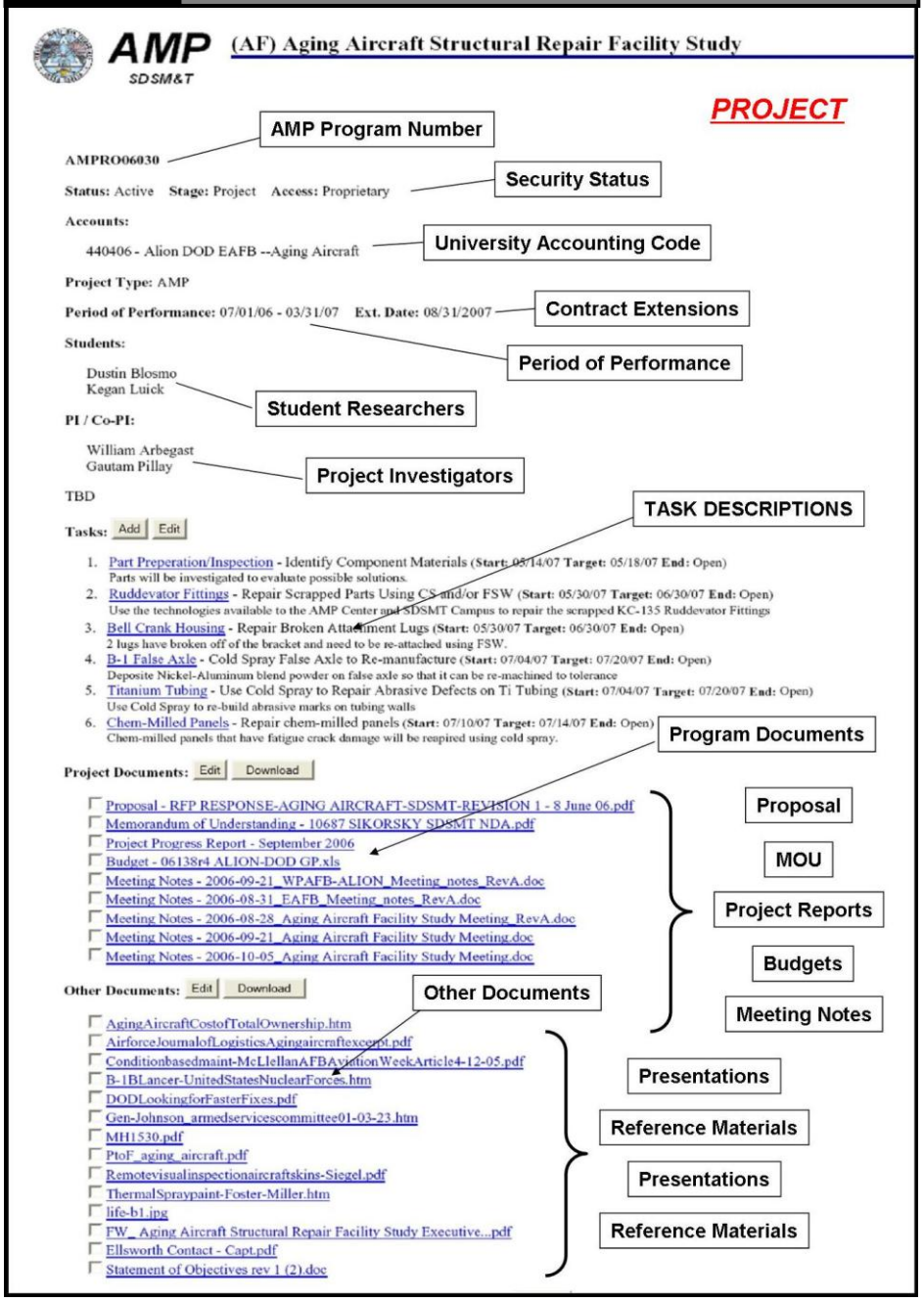


Figure 3.27 *The interactive PaDMS Web Site Provides a Secure Location to Manage Documents at the Project Task and Subtask Levels*

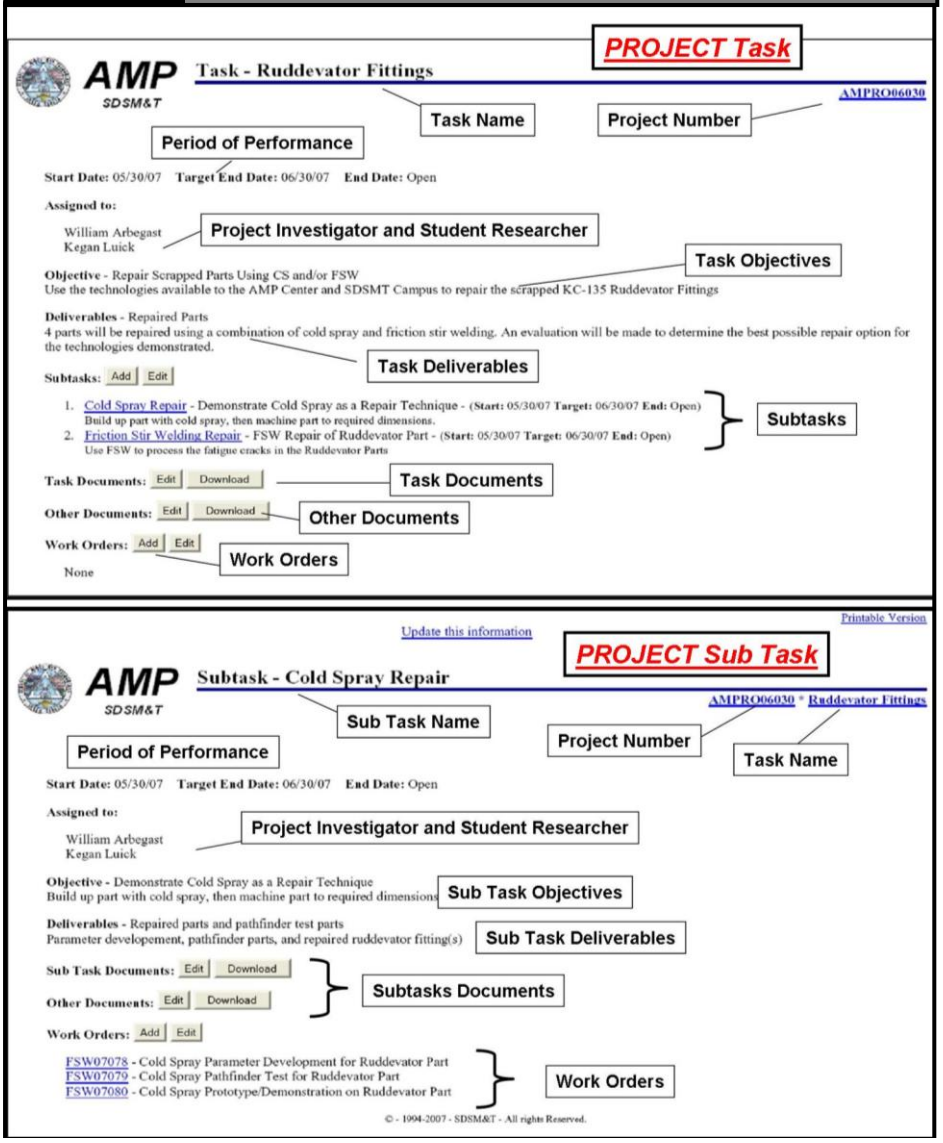
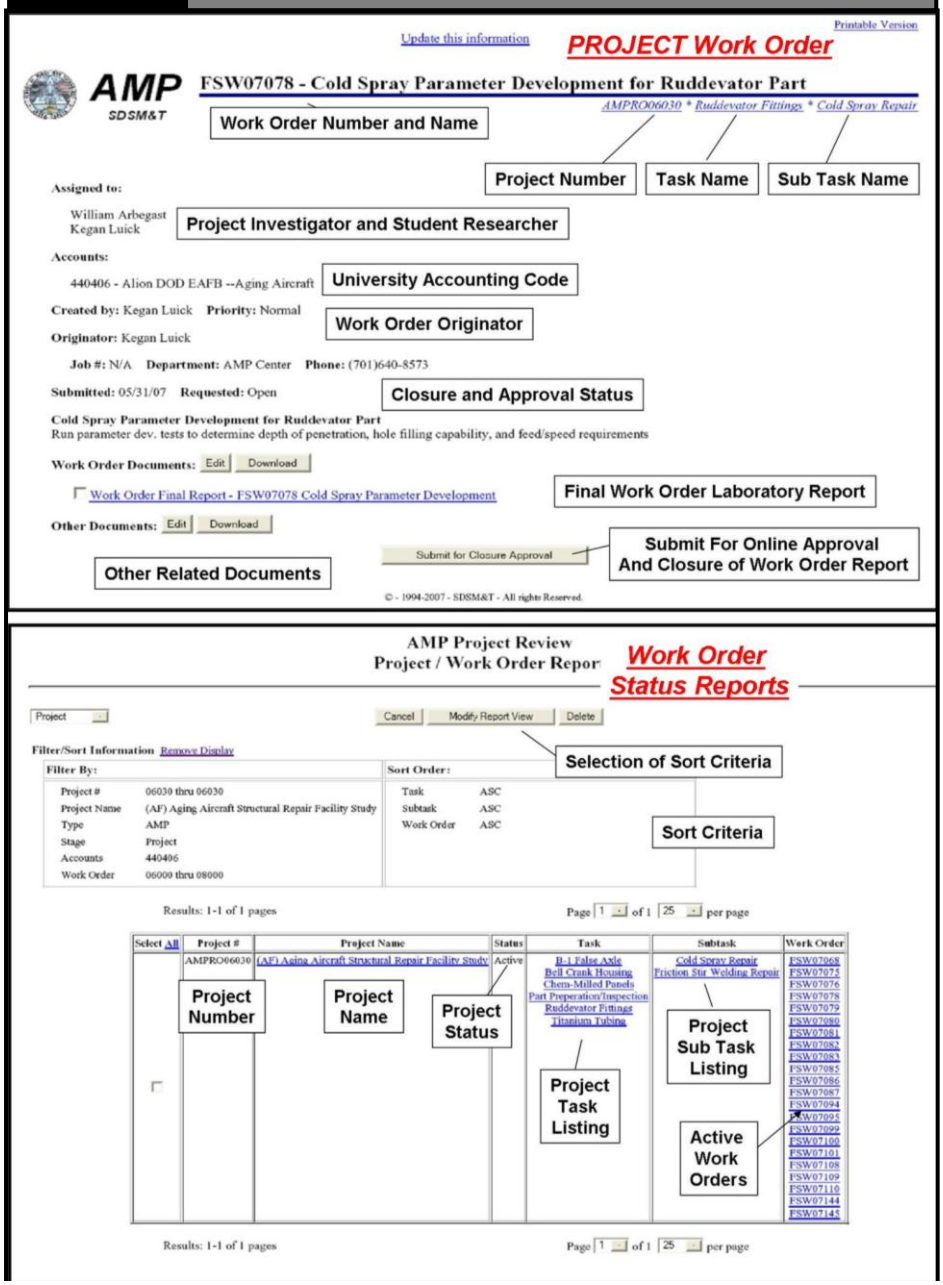


Figure 3.28 *The interactive PaDMS Web Site Provides a Secure Location to Manage Documents related to individual Experiments at the Work Order Level. The search features of PaDMS allow summary listings of all Open or Closed Work Orders for each project, task, or subtask*



3.10 WEEKLY MEETINGS AND REPORTING

Each university Site Director and Project Principal Investigators sets the weekly meeting and reporting schedules at their sites. Site-level project management is often facilitated by research group meetings with student presentations. The format is determined individually at each site. The SDSMT AMP Center CFSP Site requires all students to attend a 2 hour weekly meeting at which local center business and research progress is discussed. The required student weekly paper reviews and submittals may also be discussed at this meeting in an ad-hoc round table manner – tell me what you read ….

The number of graduate and undergraduate research assistants employed under either AMP or CFSP projects at the SDSMT site ranges between 20-25 per academic session with three or four active CFSP and five AMP individual projects ongoing. At the weekly meeting, two to five students give a 15 minute presentation following the general format of the CFSP IAB Meeting technical workshop review (Appendix M) or management review (Appendix L) as appropriate. Each student working on a project will make at least one formal presentation per semester in addition to other weekly status reports as may be desired. Standardizing the format of these weekly review presentations facilitates the collection of information for inclusion in the CFSP Annual Members' report at the Fall IAB Meeting (Chapter 4).

3.11 NAMING CONVENTIONS

The use of standard formats as a management tool is not only applied to the document, but also to the name of the document itself. The use of naming conventions improves the organization and distribution of the many documents required by the CFSP P3. In general, either an AMP or CFSP document is indicated with the year of issue and sequential item number included. When a change to a document is made, a revision letter is added as appropriate. CFSP project names are assigned by the Site Director and Approved by the Center Director and take the form

CFSPYY-ZZZ-XX TEXT Rev New. EXT

Where

YY is the year the project is created

ZZZ is the three letters CFSP Site Code (AMP, BYU, MST, WSU, and USC)

XX is the project number

TEXT is a short descriptor of the content of the document, i.e.

Project Name

Project Task or Subtask name

Work Order Title

Quarterly Reports Inputs (QTR)

LIFE Form Response Report Inputs (LIFE)

Annual NSF Report Inputs (NSF Annual)

Annual Members' report Inputs (IAB Members)

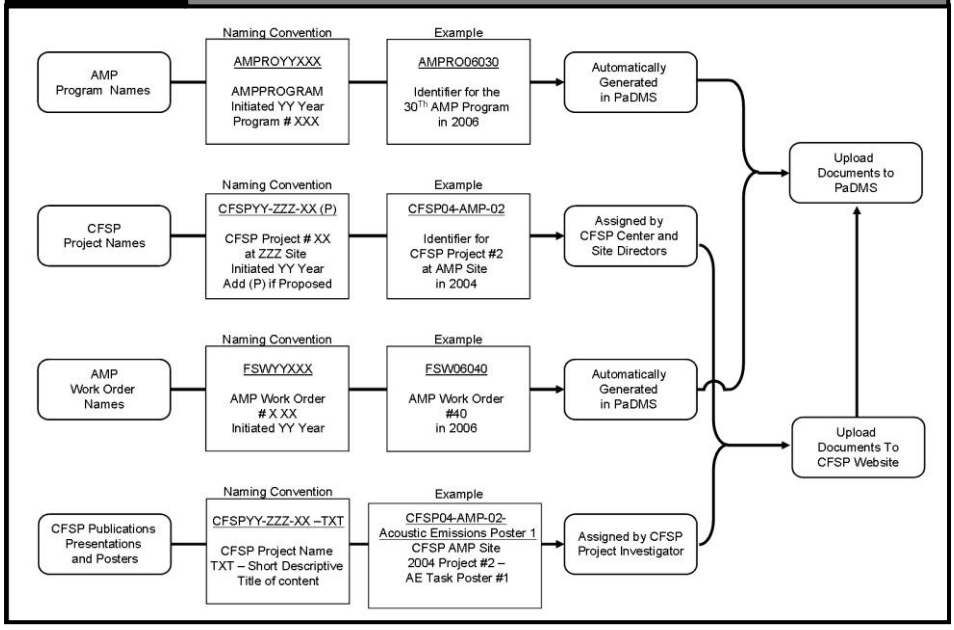
Workshop Presentations (IAB Workshop)

Management Review Presentations (IAB LIFE)

EXT is the document extension (PDF, DOC, XLS, etc)

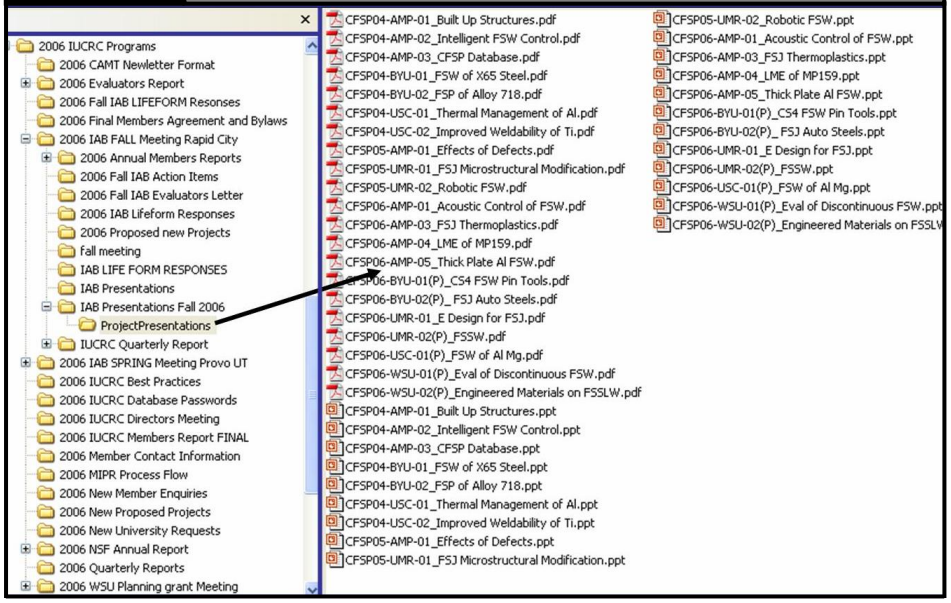
Example: CFSP04-AMP-02 Task 1 Build Up Structures 3 QTR Report Rev New. EXT

Figure 3.29 *Specific Naming Conventions are used for all CFSP and AMP project documentation*



The use of naming conventions is especially important during email submittal of documents to the CFSP Directors office for compilation into the required IAB and NSF submittal formats. Imagine receiving information from all university sites identified as "report.doc". Standardized naming conventions allow the use of the simple search and sort features of folder based desktop systems.

Figure 3.30 *Specific Naming Conventions allow simplified storage and retrieval of CFSP documents in windows based file management systems*



3.12 SOCIAL EVENTS

The CFSP I/UCRC has many purposes defined by the vision mission and objectives, but an overriding goal of the center is education. Students are given a technical education through coursework and through practical laboratory experience within the center. The "soft" skills, the ability to work on teams, the ability to communicate verbally and in writing, the ability to work with colleagues from different cultures, and ethics, are all developed in the center activities.

An important factor is creating a comfortable work environment in which every student is integrated into the team both technically and socially, engaging the students so that they take ownership and pride in their project based learning experiences.

The AMP CFSP site holds an annual picnic at the end of the summer session where students bring food dishes from their native countries, dress in traditional clothing, and share their culture with the other students and faculty. A student favorite is

the high-quality collared work shirts with AMP logo that are provided to each student researcher. The students wear these with pride at meetings, tours, and presentations during the entire year.

The AMP students support the wider campus community through actively participating in design fairs, campus tours, senior design projects, and international student events. Birthdays are not forgotten. The over 25 AMP students and faculty researchers come from 6 different academic departments on campus. AMP students are required to attend the graduate research seminars of other AMP students – regardless of their major department.

Figure 3.31 *The SDSMT AMP/ CFSP Research Team involves faculty, students, and staff from six separate academic departments. Students are from undergraduate (Fr, Soph, Jr, and Sr) and graduate (MS and PhD) programs in these departments*

An essential element of training the next generation of industry leaders is creating a sense of team identity with formal and informal working relationships between the global CFSP university and industry partners. Interacting with the IAB

Members is equally beneficial to the researching students since these are the people with whom they may spend a considerable part of their future career.

During the Annual IAB meetings, the hosting site generally provides for an evening social event to foster communications between IAB members, site directors, Project Principal Investigators, and student researchers with discussions on the various current and proposed CSFP research projects.

The AMP interactive web site (http://ampcenter.sdsmt.edu) is designed to allow the rapid upload and update of information *without* resorting the web page programming. The site is used to advertise local events, provide personnel information, provide downloadable copies of AMP presentations, describe student research programs, describe available laboratory resources, provide a copy of AMP Safety procedures, acknowledge funding sources, list AMP alumni and resumes, and provide pictures of social events.

The AMP Center web site is used as a friction stir welding and processing technology information resource to the outside world. Copies of important AMP Center and the NSF CFSP presentations, and, a list of center publications are provided for download. As with any web site, keeping current is always a problem. The AMP Center employs two undergraduate students on the Federal Work Studies program to assist in web site maintenance and other center business.

Figure 3.32 *The SDSMT AMP Center Web Site provides Marketing and Technical Information to the outside world*

Chapter 4

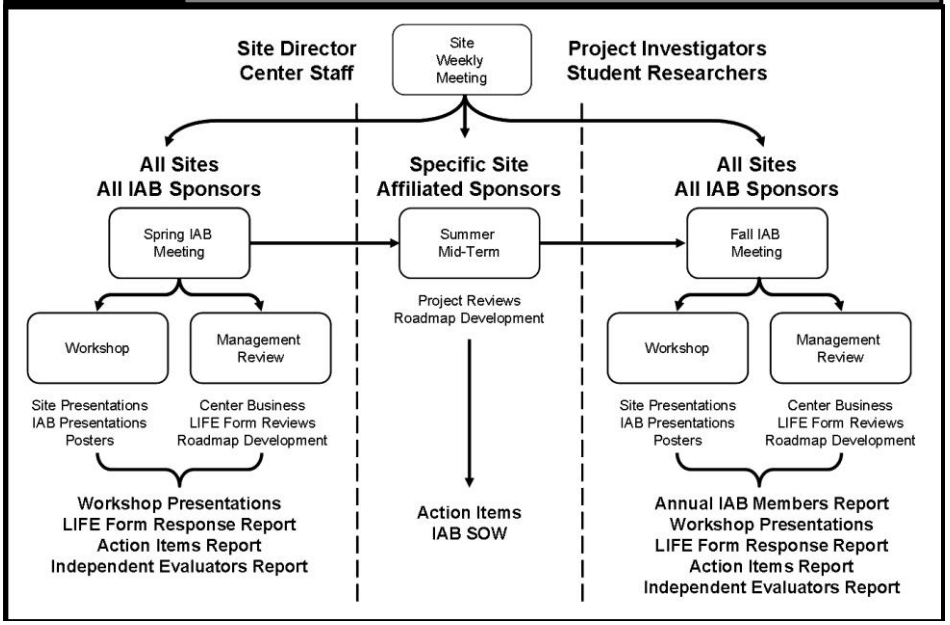
CENTER MEETINGS

4.0 INTRODUCTION

There are three types of meetings that are essential to center operations: Semi-Annual IAB Meetings with the Industrial Advisory Board (IAB), Midterm meetings with site specific sponsors, and weekly meetings at local sites. IAB Meetings are a critical part of the management process. These are the primary method whereby the progress of the center is reviewed and new growth directions may be added to the Technology Roadmap. Various center assessments and reports (Chapter 5) are prepared, uploaded to the CFSP Web Site, and sent to the entire IAB Membership.

During the meetings, new projects may be proposed and accepted. Center business such as new university site applications, new IAB sponsorships, intellectual property issues, paper and publications, etc., is conducted. The meeting serves as the primary mechanism by which all parties review the progress of current projects. All IAB sponsors are invited to the spring and fall meetings, while only the university-affiliated sponsors attend the mid-term meetings.

Figure 4.1 *Three Scheduled CFSP Meetings are held with the IAB Membership – Spring IAB, Midterm (Site Specific) and Fall IAB Meeting*



4.1 SEMI-ANNUAL INDUSTRIAL ADVISORY BOARD (IAB) MEETINGS

The IAB meetings are held twice each year. The fall IAB meeting is held at the CFSP Lead Institution (SDSMT) with the location of the spring IAB meeting rotating between the other university sites. The format of the CFSP spring and fall IAB meeting agenda is similar, with a technical-interchange workshop held the day before the management-review meetings.

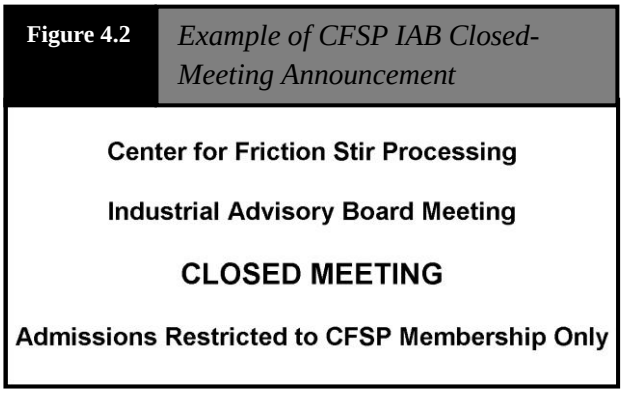
4.1.1 IAB Meeting Participants

Industry sponsors, NSF representatives, the external evaluator, the Center Director, Site Directors, students, and faculty convene at the IAB meetings to discuss current and future projects. Multiple representatives from an industry sponsor are eligible to attend the meeting, but only one vote may be cast per membership. Note, however, that some industry partners may

affiliate with more than one university site, in which case the number of votes is equal to the number of paid memberships.

Although not officially part of the CFSP, representatives from CFSP I/UCRC TIE programs are invited to make presentations on their projects at the meeting. With the exception of these TIE program participants (See Appendix B – Article 7.5), center meetings are closed to the public and limit attendance to those affiliated with the center. A sign is posted on the meeting room doors showing this attendance restriction.

Figure 4.2 *Example of CFSP IAB Closed-Meeting Announcement*



When scheduling a large number of people, conflicts with other obligations are inevitable. A recent addition to the meetings is the use of web meeting tools. These tools, such as GoToMeeting (http://www.gotomeeting.com/) and WebEx (www.webex.com), provide the remote attendee with the capability to broadcast the display to anyone attending the meeting at any location. Thus, a person in Virginia, for example, can control a PowerPoint presentation or software demonstration from his or her machine and have the contents of that computer screen projected at the meeting in South Dakota and viewed by other remote attendees in Germany and Brazil.

To date, the 30-day free trial feature of GoToMeeting has been used for IAB Meetings, but the SDSMT AMP site is considering a subscription that allows all participating university sites to use this, or another, web meeting tool.

If the presentation is being projected to an audience, provisions must be made to amplify the audio portion of the presentation. Note that lack of readability, a common issue with presentations and software demonstrations, can also be addressed

by this software. All meeting attendees, regardless of location, can join the on-line meeting and view the presentation on their individual computer screens.

Again, a conference call or similar web-based audio broadcast must be arranged for participants at remote locations. Managing the group discussions with a large number of members participating via the web is a difficult task and must be controlled by the Center Director. While this off-site IAB meeting participation option is provided, on-site member participation is strongly encouraged.

4.1.2 Setting the IAB Meeting Agenda

A unique feature of the annual meetings as conducted by the CFSP is the addition of a workshop, or technical interchange meeting, on the day before the official IAB meeting is convened. This process, as well as the content of the IAB meetings, is described below.

The agenda is set by the IAB Chair and the Center Director with input from the Site Directors, the NSF Program Director, and Independent Evaluator (Appendix K). The format of the meetings is well standardized with a Pre-IAB Meeting Technical Workshop (Section 4.1.3) followed by the IAB Management Review Meeting (Section 4.2).

Once the agenda is established, it is published on the center's web site at the required time period before the meeting (Appendix B) and sent to the entire IAB Membership using the IAB Meeting Invitation Form (Appendix E).

The agenda for the meeting is set by the board members as described above. A sample CFSP Workshop and IAB Review Meeting Agenda is presented Appendix K. However, certain elements are routinely placed on the agenda. These include:

- The State of the Center Address (Section 4.2.3)
- LIFE form evaluation of projects
- A session on Center business
- A review of the Technology roadmap (Section 5.3.2)

Once the agenda is finalized, it is forwarded to the I/UCRC Independent Program Evaluator (IPE) in preparation of the I/UCRC LIFE Form – Level of Interest and Feedback Evaluation – project-review process (Section 4.2.2). The IPE registers a CFSP IAB Meeting at the University of Central Florida LIFE web

tool (www.isl.ucf.edu/LIFE/) and assists the CFSP Center Director and staff in populating forms with the project numbers, project titles, and investigator names that will be reviewed at the IAB Review Meeting.

All presenters and posters, including Center Business related presentations, are responsible for uploading their presentation onto the center's web site one month before the annual meeting. This allows all IAB technical representatives adequate time to review the information and prepare for discussion. All documents uploaded are identified per the CFSP naming conventions (Section 3.11).

The host site includes a social event with each IAB meeting. The CFSP has traditionally held a group dinner with an event of local significance, such as a trip to Mt. Rushmore or Crazy Horse in South Dakota, a riverboat ride in Missouri, or a trip to a ski resort in Utah. Social events provide an informal venue for conducting business and for creating relationships between sponsors and university faculty, staff, and student researchers.

4.1.3 Pre-IAB Meeting Technical Workshops

The pre-meeting workshop session is scheduled for the day before the IAB management-review sessions at both the fall and spring meetings. This workshop is a technical-interchange meeting where ideas are presented by both university and industry members. The Site Directors select the theme and scope of the presentations for their site – within the strict time limitations of the agenda (Appendix K). Not all projects may be presented. Industry sponsors are encouraged to present their specific research and development needs to the entire group.

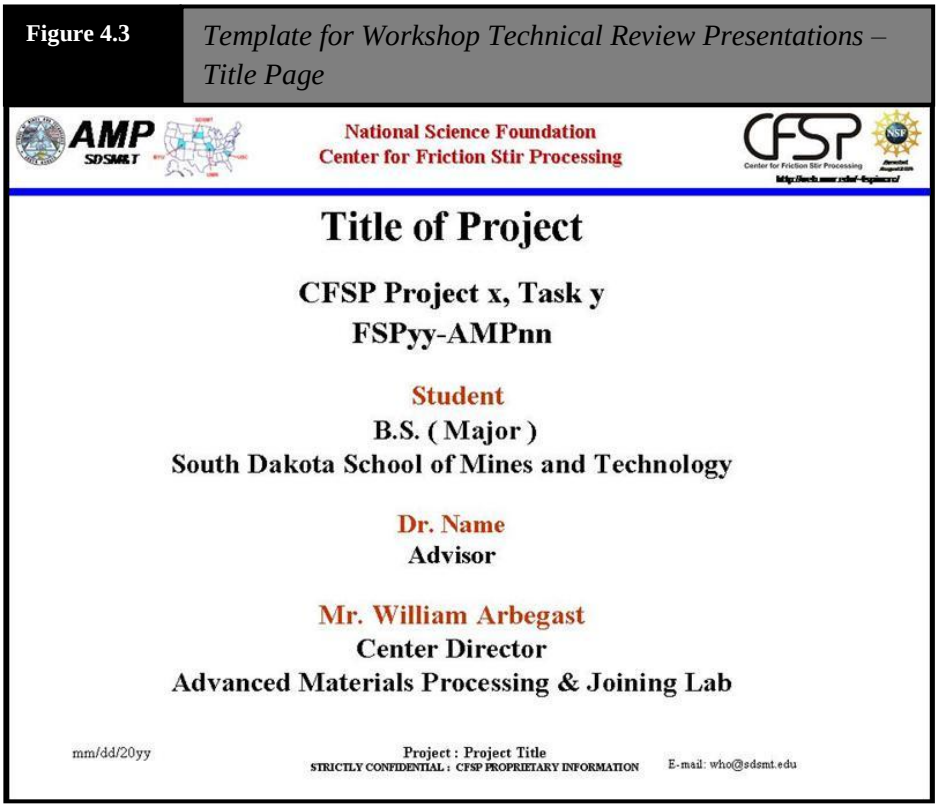
The purpose of these presentations is to make the center members aware of the on-going, completed, and proposed projects from a purely technical perspective. Evaluation, proposed changes, progress toward benchmarks, and other items are discussed at the management-review meeting the following day. Items that are typically covered at workshop include:

- a technical review of projects by site, including completed, in progress, and proposed projects as selected by the Site Directors and site affiliated sponsors
- presentations by industry sponsors on industry needs

- review of projects for which supplemental funding was secured (e.g. an REU to document Best Practices in a multi-site center)

The technical reviews follow a standard template and are loaded onto the web site one month prior to the meeting. It may be necessary to upload a revised version of a presentation after the meeting to incorporate comments and suggestions made by the board. The format for the workshop technical review generally includes the project title and personnel involved the project objectives, approach, status, immediate actions, schedule, and outstanding issues. Each of these sections is subdivided into tasks and subtasks for each year of the project. Projects titles and numbers are in accordance with the naming conventions of the center (Section 3.11).

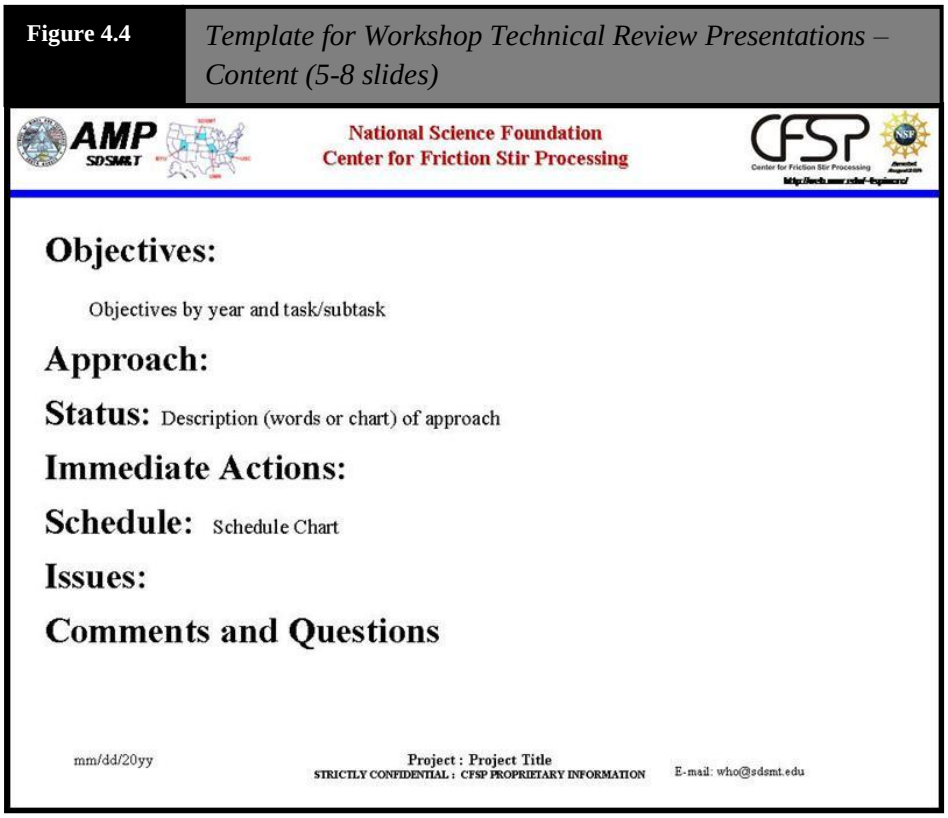
Figure 4.3 *Template for Workshop Technical Review Presentations – Title Page*



As indicated, industry partners also make presentations during the IAB workshop. The content of the presentation varies based on individual sponsor needs. For example, a new industry sponsor will generally present an overview of the company and of the friction stir processing activities in which it is engaged. This introduction to personnel and projects provides a starting point for collaboration discussions and networking opportunities with the other members.

A sponsor who has made previous presentations will generally shorten the overview portion and concentrate on how current or future center activities integrate with their efforts. The presentation may also define how the center can meet a current or anticipated need. All industry sponsors are invited to make presentations, but generally only a few sponsors volunteer at each meeting. New members and members with significant developments to report are encouraged to place themselves on the agenda. Often, an IAB Sponsor will present an overview of a recommended research project that it wishes the CFSP to initiate.

Figure 4.4 *Template for Workshop Technical Review Presentations – Content (5-8 slides)*



4.2 PRESENTATIONS AT IAB MANAGEMENT REVIEW MEETINGS

As noted above, several types of presentations are made during the IAB Management Review Meeting. The following sections describe the content of these presentations in greater detail.

4.2.1 Management-Review Presentations

At this meeting, a management summary is presented for each continuing and proposed project. This is a very brief overview of the project presented immediately prior to the completion of LIFE forms. (Note: technical discussions of these projects were completed at the workshop and social events). These presentations are made by the Site Directors or Project Principal Investigators with student presentations not allowed.

The management summary starts by listing the students and faculty working on the project. Next, it gives a description of the objectives of the project, typically broken down into several tasks. Past progress on these objectives has already been presented and is not repeated here. Instead, the next year's activities are laid out in a brief, bulleted format. This includes a project timeline, typically a chart that shows which tasks are planned to be done in each of the four quarters of the following year.

Figure 4.5 *Time Line Chart*

Activity	Q4 2006	Q1 2007	Q2 2007	Q3 2007
Determine the best evaluation algorithm				
Test & improve the evaluation algorithm				
Design a control model				
Implement control algorithm & hardware				
Run real-time experiments				
Optimize & improve the controller				

Finally, the management summary gives the proposed budget for the project – including any support from REU or RET supplement funding (Section 3.6) allocated to the project. The budget is often just a total dollar figure and is likely to be a fraction or multiple of sponsor fees since sponsors are directly tied to projects.

Figure 4.6 *Executive Summary Presentation Templates – Title Page*

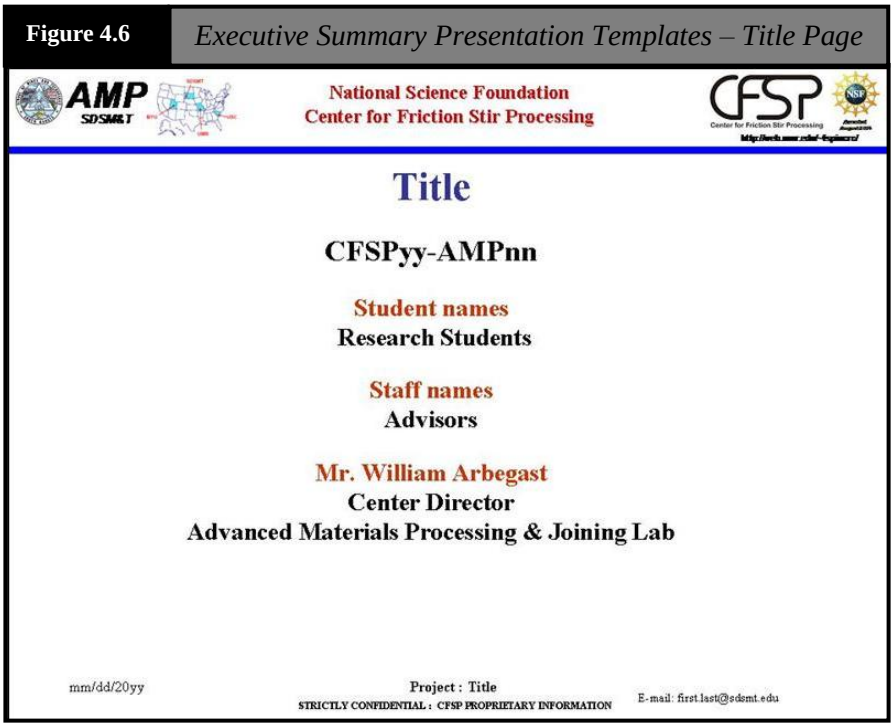
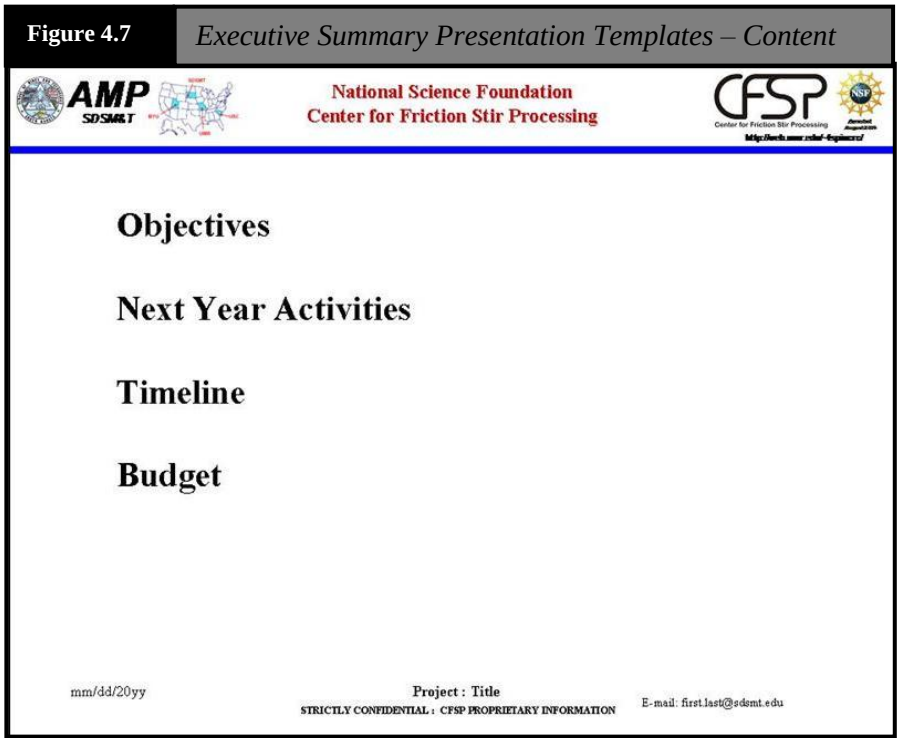


Figure 4.7 *Executive Summary Presentation Templates – Content*



4.2.2 Management Review Meeting—Project LIFE Form Evaluations

The CFSP has defined a process for LIFE form evaluation of projects which has proven effective for timely feedback between sponsors and projects. As noted earlier, the technical-interchange workshop presented the day before the official IAB meeting is convened provides an opportunity for discussion of the technical details of current projects. However, sponsor feedback on the projects is not solicited until the official meeting begins.

An executive summary of each current, continuing, or new project is presented during the meeting with a focus on evaluating the sustainability and progress made during the last period. All presentations make use of a standard presentation template which gives the student guidance in the preparation of the presentation and creates a consistent look for the compiled presentations made available to the IAB Members at the meeting and on the web. The summaries are typically 15 minutes and include the objectives of the project, the approach taken, and a summary of the current

year's progress. A detailed description of the Executive Summary format is contained in Section 4.2.

IAB Members complete a LIFE form after each Executive Summary presentation. Prior to the IAB meeting, the projects to be evaluated are entered into the LIFE form web site at the University of Central Florida (www.isl.ucf.edu/LIFE/). This site provides IAB participants with an excellent electronic tool for recording their evaluation of each project. A sample LIFE form is shown below. Note that new proposals are reviewed using the same LIFE form evaluation procedure used for current and continuing projects. The University of Central Florida web site given above also provides a summary of all LIFE form evaluations, which quickly identifies the level of interest of the members as a group.

While this is quite useful, the CFSP has added an additional step to the LIFE form evaluation process. IAB input on each project is collected and compiled between the first and second days of the meetings. The CFSP has developed a form into which all comments for a single project, as well as the project leader's response to each comment, are entered. A sample LIFE form Response template is shown below. At present, the compilation is done by hand, but automation would be possible.

This process allows Site Directors to meet privately with sponsors to discuss their LIFE form evaluations and the Site Director's response at the beginning of the second day of the meeting. Subsequently, the evaluations and responses are shared with the full IAB. The full board discusses the level of interest and the suggestions for changes, as well as the comments and responses for each project.

A summary of the process is:

<u>IAB Review Meeting Day 1</u>

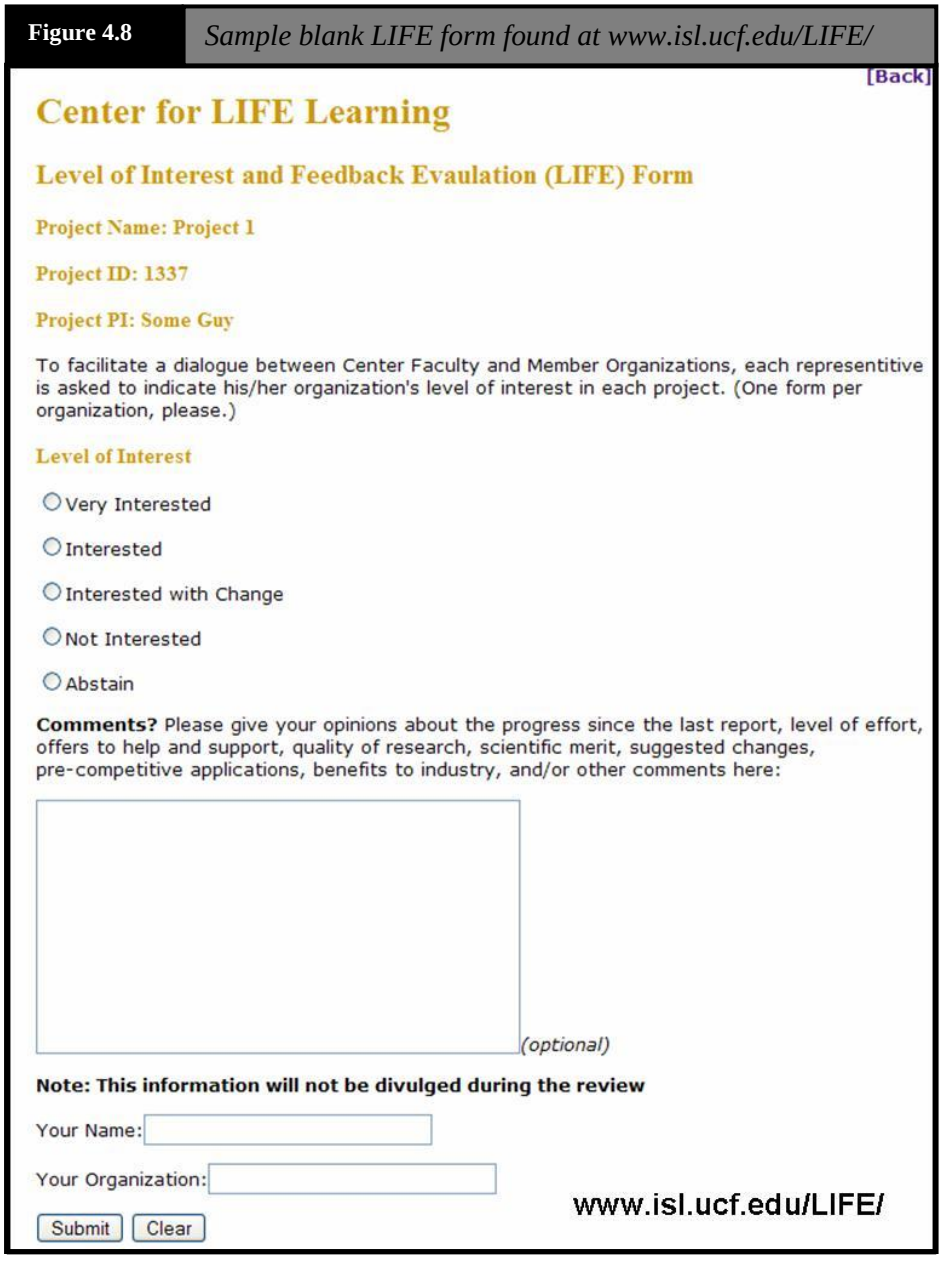
- Management summaries of each continuing and proposed project are presented using a standard template. Student presentations are not allowed.
- Electronic LIFE form evaluations are completed on the web after each presentation. Note that laptop power and net connections are required for each IAB member attending.

- Electronic LIFE form Evaluations are downloaded and sent to each of the Site Directors to prepare responses.
- LIFE form responses are prepared by Site Director and principle investigator for each project using the CFSP Life Form Response template.
- Discussions on projects continue at evening social events.

IAB Review Meeting Day 2

- Site-affiliated sponsors meet with the Site Director and project leaders to discuss responses to LIFE forms and adjust research plans as required. Sponsors with memberships at multiple sites attend the meeting of both. The outcome of this meeting is the site continuing and proposed project recommendations to be presented to the full board.
- Summary of evaluation statistics and LIFE form responses are presented to the full board for discussion.
- Thus, closure on potential changes, additions, and deletions can be made before the end of the meeting.

Figure 4.8 *Sample blank LIFE form found at www.isl.ucf.edu/LIFE/*



[Back]

Center for LIFE Learning

Level of Interest and Feedback Evaulation (LIFE) Form

Project Name: Project 1

Project ID: 1337

Project PI: Some Guy

To facilitate a dialogue between Center Faculty and Member Organizations, each representitive is asked to indicate his/her organization's level of interest in each project. (One form per organization, please.)

Level of Interest

- ○ Very Interested
- ○ Interested
- ○ Interested with Change
- ○ Not Interested
- ○ Abstain

Comments? Please give your opinions about the progress since the last report, level of effort, offers to help and support, quality of research, scientific merit, suggested changes, pre-competitive applications, benefits to industry, and/or other comments here:

(optional)

Note: This information will not be divulged during the review

Your Name:

Your Organization:

Submit Clear

www.isl.ucf.edu/LIFE/

Figure 4.9 *Sample summary of LIFE form evaluations found at www.isl.ucf.edu/LIFE/. The form provides a summary of each interest level and the comments associated with each level of*

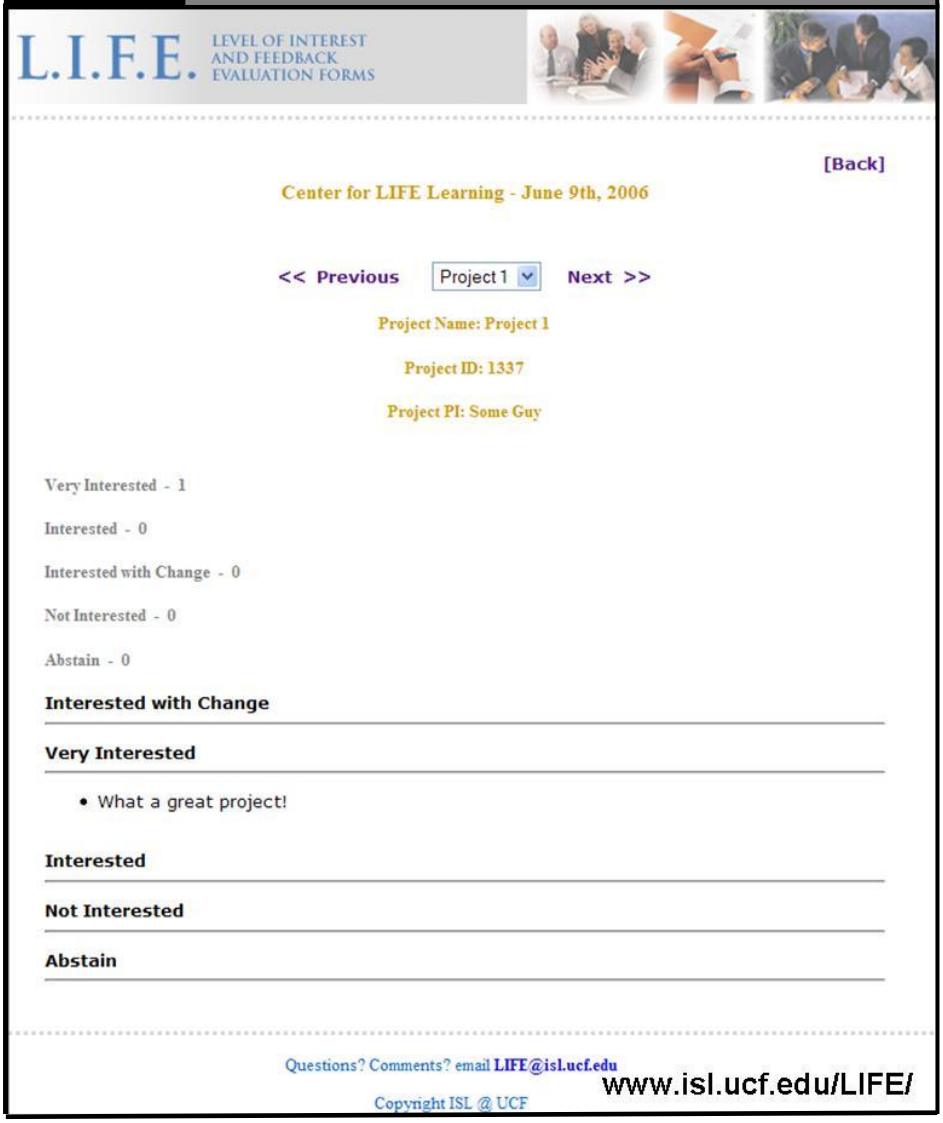


Figure 4.10 *Sample LIFE Form Response. A response is generated for each project reviewed. The Site Director summarizes all comments in the left boxes and provides a response to each in the boxes on the right. The columns on the left indicate if a comment is a suggestion (comment) or an official change request. If a change has been requested, the Site Director indicates if the change is within the scope of the project (in-scope) or not (out-of-scope).*

LIFE Form Response **Oct. 26, 2006**

CFSP04-AMP-03: Development of CFSP Website and Database

Center for Friction Stir Processing

This form is used to track the response to the comments and change requests noted on the LIFE forms. Site directors are responsible for ensuring the form is completed and submitted to the Center Director.

Classification					
Comment	Change Request	In-Scope	Out-of-Scope	Comment/Request/Question	Site Response
CFSP04-AMP-03: Development of CFSP Website and Database					
IC				None	
VI		X		It would be useful to have query return two to three lines of abstract with the title.	Good idea. Will consider implementation.
VI				Excellent progress much needed task.	thanks
VI			X	Think about other applications/usages of this database far down the road, such as FSW standards/specifications, and design software.	Data mining is under development at SDSMT site. Specific sponsor suggestions are encouraged.
I		X		Tool design information (geometry) on the database would also be useful for each weld. This would enable the users to order/build (?) the tools.	Already implemented but tool design fields are not required for every record.
I		X		This project should be funded by all equally.	To be implemented -
I			X	Standardization of the parameters reported for FSW should be set up as required fields when inputting data as discussed. Aim should also be to develop absolute minimum population sizes for evaluations, keeping in mind that MMPDS requirements are prohibitive.	The proposed procedure to develop design allowables for FSW joints is addressed in Project 1 Task 0. This should address this item.

4.2.3 State of the Center Presentation

A unique feature of the CFSP IAB meetings is the opening of the session with a State of the Center report presented by the Center Director. The State of the Center presents an overview of center activities including:

- Reports on Site Directors' meetings held since the last IAB meeting
- The status of the action item list generated at the previous IAB meeting as well as those action items remaining from meetings prior to the last one
- Center funding details
- A summary of CFSP personnel demographics
- A summary of center activity relative to select goals defined by the center and the NSF including:
    - The number of degrees awarded to students in the center
    - The number of students hired by industry from the center
    - The number and types of publications produced by center personnel
    - The number of intellectual property events generated at the center

Three assessment tools provided within the State of the Center Report that have proven useful are the Review of Site Focus Research Areas (Section 2.1.3), the Technology Roadmap (Section 2.1.2), and the assessment of Center performance (Chapter 5) against NSF best practices for an I/UCRC.

As described in the Section 2.1.3 on establishing the center, one of the unique aspects of the CFSP is the structure agreed upon by the participating universities relative to division of focus areas. Once the mission of the center was established and the needs of industry were defined, the participating universities agreed upon specializations, or technological priorities, each would assume in furtherance of the center's mission.

These technological priorities are re-examined at each IAB meeting in light of the changes that have occurred within the industry and the center. While the mission may remain constant, the means to achieve it evolve and adapt as new members are added to the center. The priorities overlap between sites in some cases, but every effort is made to prevent duplication of effort.

The Technology Roadmap is a tool developed by the CFSP to provide members with a visual representation of the center's strategic plan. The items in the assessment rubric were selected from Ron Beck's summary of best practices as identified by

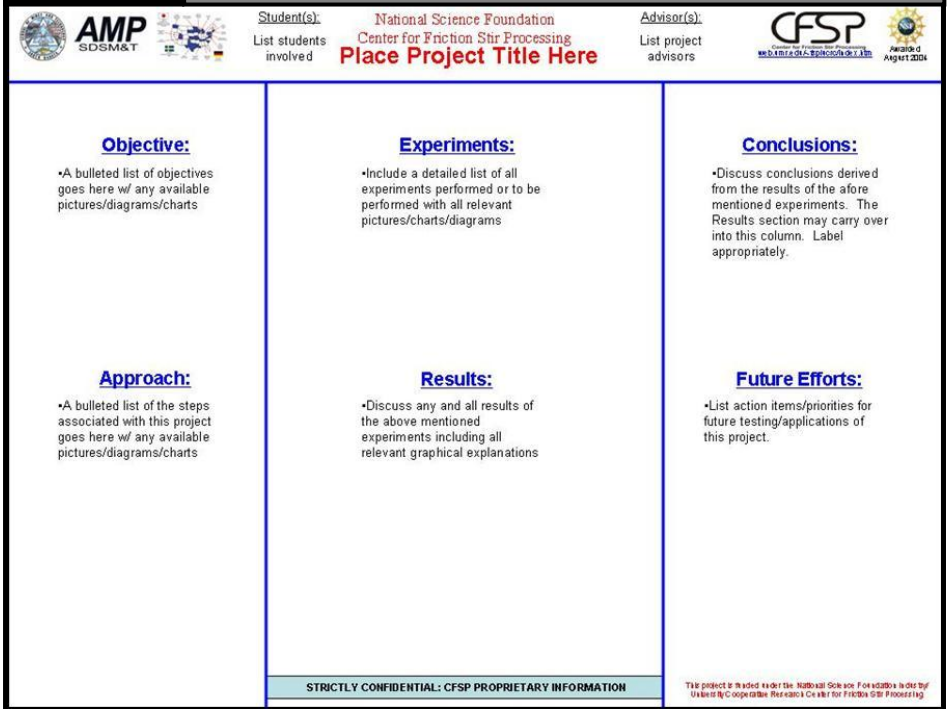
Center Directors in a 2004 survey. Both the roadmap and the assessment rubric are described in Chapter 5, Center Assessments.

4.2.4 Posters

Students and faculty who have technical information in addition to that shared in formal presentations present posters on their work. The students are aided by the deployment of a standard poster template which has the additional benefit of providing a consistent look to the compilation of poster presentations made available to the IAB. A sample of the poster template is shown below. Printed copies are made available to the IAB Members at the meetings and are also uploaded to the center web site for easy reference. The center bylaws require all presentations and posters to be uploaded 30 days prior to the meeting to give participants adequate time to study them.

Posters are displayed on walls and easels and are available for viewing before and after the formal sessions as well as during breaks. During scheduled breaks, students and faculty are available to discuss their work with center members. Students are encouraged to bring laptops to run demonstration programs at this time as well. IAB member feedback indicates a high level of satisfaction with the poster sessions.

Figure 4.11 *IAB Meeting Standardized Poster Template*



4.3 FOLLOW-UP FROM THE IAB MEETINGS

4.3.1 Action Items

The action-item discussion held at each IAB meeting includes a summary of items to be added to the list, items completed since the last meeting, and items which require additional information or input from the board to facilitate resolution. The list and the current status of each item are maintained on the web site and available for all IAB Members to view. The ability to edit and update the action-item list is limited to the Center Director to ensure consistency. A sample of the action-item list from original Salt Lake City Planning Grant Interim IAB meeting is shown below.

Figure 4.12 *Action-item list arising from the initial "Salt Lake City" Interim IAB meeting showing action items related to Center Business*

No.	Description	Responsibility	Date Assigned	Scheduled Complete	Actual Complete	Comments
1	Voting method on research project to be developed by IAB Membership	IAB	04/06/05	10/11/05		Approve at next IAB Meeting
2	Center Technology Development Roadmap to be developed by the industrial sponsors.	IAB Chair	04/06/05	10/11/05		Approve at next IAB Meeting
3	Executive Summary of the proposed Iowa State CNDE TIE program to be by made available to each industrial partners point of contact within a week - 2/3 approval from group required to proceed.	Center Director	04/06/05	04/30/05	04/30/05	IAB Approved and proposal submitted to NSF
4	Project Plan Summaries including: project description, milestones and deliverables for each of the funded projects should be completed	Site Directors	04/06/05	06/11/05		
5	Prepare Project Plan Summaries location on website for each university and upload	UMR	04/06/05	06/11/05	06/6/05	Plans need to be updated and sent to UMR for incorporation monthly
6	Project Plan Summaries Requirements should be defined and incorporated into the by-laws	Center Director	04/06/05	06/11/05		To be approved at next IAB meeting

4.3.2 Annual IAB Members' Report

The Annual IAB Members' report is described in detail in Chapter 5. It contains a summary of center activity for the year including:

- Program Overview
- FSW Technology Development Roadmap (Section 2.1.2)
- Project Master Schedule (Section 5.3.3)
- Project Executive Summaries (Appendix L)
- Current Project Annual Technical Reports (Appendix M)

The Program Overview is prepared by the Center Director and provides the membership with information similar to that submitted to the NSF in the NSF Annual Report (Appendix O). MS-Word document templates are used for the Executive

Summaries and the Project Annual Technical Reports to provide a consistent look across project reports and to reduce search time within a document. The Executive Summary gives an overview of the project including objectives and past year's accomplishments. The template is set up to make the main points stand out, and the details are easy to fill in for the writer and easy to find for the interested reader. Members of the IAB will be scanning all of these executive summaries and want to be able to skim over projects that are not of immediate interest while being able to get detailed information on some projects. The template makes this a fairly painless process both for the writers and the readers of the document. A sample Executive Summary is found in Appendix L.

A hard-bound copy of the Annual Members' Report is provided to each sponsor and to each site, and an electronic copy is posted on the secured portions of the CFSP web site under the Annual Meetings Section.

4.4 QUARTERLY MEETINGS

The IAB meeting is the primary mechanism for soliciting sponsor feedback, but additional meetings are scheduled between the university site and its affiliated IAB sponsors to ensure timely communication of current research progress and development of new research programs. The frequency of these meetings varies with the level of involvement and geographic proximity of the sponsor. Some sites are able to include sponsors in regular meetings while others are not.

At a minimum, Project Principal Investigators and/or the Site Director arrange for a meeting with each sponsor between the semi-annual IAB meetings. These quarterly meetings may be held at the university or the industry sponsor's facilities. As noted in Chapter 3, students and faculty working on a project complete Quarterly Reports which are uploaded to the CFSP database for access by the industry sponsor.

These reports, plus accompanying presentations using the standardized presentation templates, provide a framework for the quarterly meetings. These meetings provide detailed informal feedback on how the project's direction can be fine-tuned to meet the evolving needs of the sponsor. Requests for significant changes in direction, however, may be identified but approval is reserved for the regular IAB meetings.

4.5 WEEKLY MEETINGS

Weekly meetings (See also Section 3.10) are held at each site as part of the internal project management structure. The students and faculty working on a project prepare PowerPoint presentations to explain their objectives and results to date to the entire group. The Site Director and, in the case of the AMP Center, the Center Director, provide feedback as do other students and faculty members of the overall research team. The presentations are modified to reflect the comments and suggestions arising from the team meeting and uploaded to the CFSP database under University Supplemental Documents (Section 3.5) where they can be viewed by the industrial sponsors and other university sites.

The students may be asked to present either an executive summary or a technical review of their project at these weekly meetings following the templates established for the IAB meetings.

The weekly meetings also provide a forum for practicing conference presentations and for discussing research articles as well as for conducting center business. As noted in Chapter 3, in preparation for the weekly meeting, each student is required to read an article related to his or her research, enter the summary information into the on-line resource library found at the CFSP web site (Section 3.4), and present the article and summary to the Site Director. Students must be prepared to discuss the research article at the weekly meeting if requested to do so.

4.6 SUMMARY OF STANDARDIZED MANAGEMENT TOOLS AND PROGRAMS

A number of standardized tools have been discussed to facilitate the CFSP IAB meetings. These include:

- Standardized IAB Meeting Workshop and Management Review Agenda (Section 4.1.2)

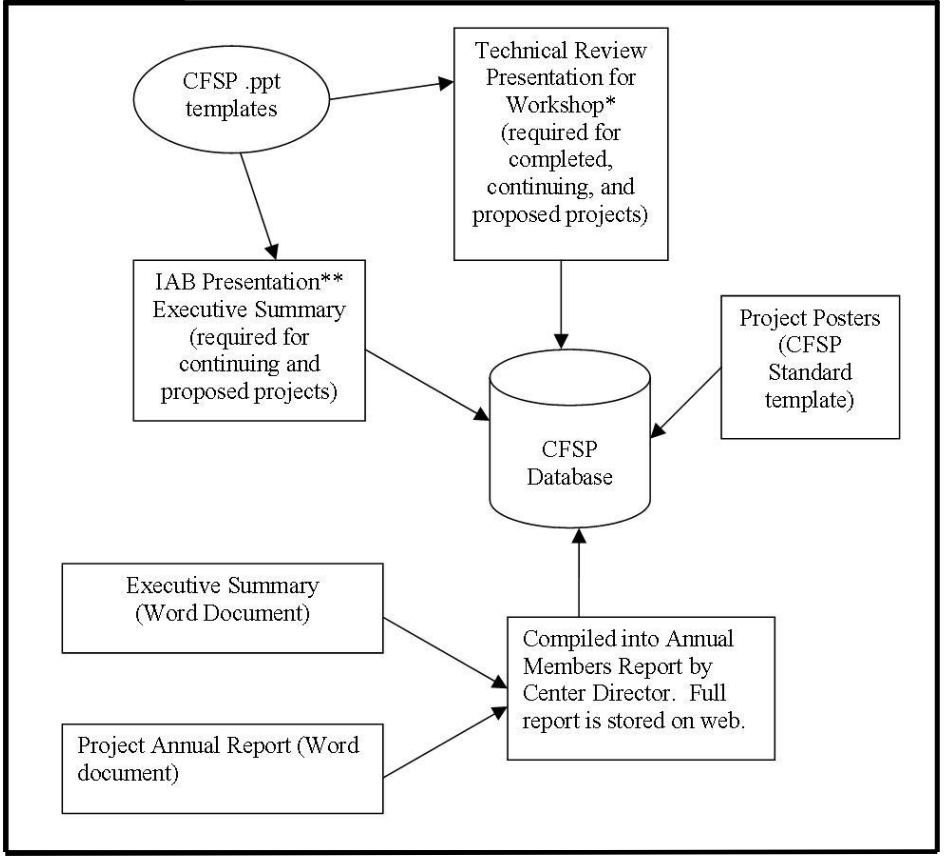
- Off-Site Web meeting software (Section 4.1.1)

- IAB Workshop Technical Presentations (Section 3.3.6)
- IAB Meeting Management Review Presentations (Section 3.3.7)
- Electronic LIFE forms and the LIFE form summaries (Section 5.3.2.3)
- LIFE form response Reports (Section 3.3.5)
- Poster Templates (Section 3.3.11)
- State of the Center Presentation (Section 3.3.10)
- Executive summary template for Annual Members' Report (Appendix L)
- Project Technical Report template for Annual Members' Report (Appendix M)
- Technology Development Roadmap (Section 2.1.2)
- University Site Focused Technology Areas (Section 2.1.3)
- IAB Meeting Action Item list (Section 3.3.9)
- NSF Best Practices rubric (Section 5.2)
- Annual IAB Members' Report (Section 5.3)

Most of these items are made available to members 30 days prior to the meeting through the web site. From publishing the agenda and presentations prior to the meeting, to providing a convenient location for action item management and publication of the final work products of the year, the CFSP web site is an integral part of center management.

The CFSP web site provides a database to manage these documents generated for the meetings and is critical to efficient dissemination of information between the IAB Members and University Partners.

Figure 4.13 *The CFSP web site provides a centralized database where all IAB Meeting information is stored and retrieved by IAB Members and University Partners*



CENTER ASSESSMENTS

Chapter 5

5.0 INTRODUCTION

Monitoring performance is a critical part of center performance. In particular, it is important to collect feedback from constituents to improve the management of the center activities and to report progress to all funding entities. Four tools are of primary importance for center assessment: the NSF Annual report, the best practices rubric, the Annual Members' Report, and the external evaluator's report.

5.1 NSF ANNUAL REPORT

The NSF Annual Report is submitted with a required content to the NSF I/UCRC Program Office using Fastlane (http://www.nsf.gov/eng/iip/iucrc/iucrcannualreport.jsp). The report is compiled by the CFSP Center Director with input from each of the CFSP Site Directors. Annual reports are due 90 days before the anniversary of the center's inception. At the CFSP, one (1) NSF Annual Report is prepared for the entire center with each site uploading to Fastlane a copy of the report under their separate NSF award requirements. Each site submits the NSF Annual

Report on the original award date of the CFSP regardless of the actual award date when new sites are admitted (Appendix O).

The format for the report is somewhat flexible, but the data must include:

1. Participants
   - What people have worked on your project?
   - What other organizations have been involved as partners?
   - Have you had other collaborators or contacts?
2. Activities and Findings (Keep this short).
   - Describe the major research and education activities of the project.
   - Describe the major findings resulting from these activities.
   - Describe the opportunities for training and development provided by the project.
   - Describe outreach activities your project has undertaken.
3. Publications and Products
   - What have you published as a result of this work?
     - Journal Publications
     - Books or other non-periodical one-time publications
   - What web site or other internet site have you created?
   - What other specific products (databases, physical collections, educational aids, software, instruments, or the like) have you developed?
4. Contributions
   - To the principal discipline(s) of the project?
   - To other disciplines of science or engineering?
   - To the development of human resources?
   - To the physical, institutional, or information resources that form the infrastructure for research and education?
   - To other aspects of public welfare beyond science and engineering such as commercial technology, the economy, cost-efficient environmental protection, or solutions to social problems.
5. Special Requirements
   - A brief summary of the work to be performed during the next year of support if changed from the original proposal.

Since the CFSP is a multi-university center, each Site Director collects information about local activities and sends it to the Center Director. The Center Director is responsible for compiling the information from each site. The CFSP NSF Annual Report is organized as follows. Note that data provided in the report is separated by partner university sites where possible.

1. Major Accomplishments for this period
2. Research Goals
3. Short Description of Communication with Center Members
4. Project Selection Process used by the Center
5. Quantitative Information
    a. Number and diversity of students
    b. Number and diversity of faculty and senior personnel
    c. Industrial members
    d. Degrees granted to students involved in center activities
    e. Amounts and sources of income, patents, licenses, and papers created
6. General Center Identification Number
    a. Year of initial funding
    b. Center Director
    c. Partner University Site Directors
7. Operating Budget and total funding
8. Capital and in-kind support
9. Industry Membership Descriptors for the current award
10. Directors Descriptors
    a. Center Director
    b. Site Directors
11. Center Outcomes
    a. Students receiving degrees and type of degree earned
    b. Students hired by industry by type of degree
    c. Publications with research center
    d. Publications with IAB Members
    e. Number of presentations

12. Intellectual property events
    a. Invention disclosures
    b. Patent applications
    c. Software copyrights
    d. Patents granted/derived
    e. Licensing agreements
    f. Royalties realized

A relatively recent addition to the I/UCRC toolkit is a spreadsheet created by North Carolina State University (NCSU). The spreadsheet provides an alternate data collection mechanism for compiling the information needed for the NSF Annual Report. Use of this spreadsheet is not mandated, but it provides numerous pre-defined summations and calculations to reduce the burden on collection of the required data from multi-university centers. However, the most effective use of this tool requires significant advanced planning. If each Site Director can fill out the relevant section and forward the form to the next director, the Center Director's job is noticeably easier. If all Site Directors fill out their portion and individually send them to the Center Director, the same level of effort is required to provide a complete summary of the data. The size of the worksheet also makes it difficult to view and print.

At the present time, no mechanism exists for automatically compiling the NSF report from the site university reports or for combining the individual spreadsheets into a single report. Such a management tool would remove the need for tedious and error-prone cut and paste operations. Examples of the type of summary data available from the NCSU spreadsheet are shown in Appendix Q.

5.2 BEST PRACTICES RUBRIC

The Independent I/UCRC evaluator has surveyed the Center and Site Directors and compiled and published a list of "best practices" from the responses. The CFSP has taken those best practices and created a visual tool for displaying center progress toward implementing those practices. A sample is presented below. A simple color-coding scheme quickly identifies best

practices which are in place and working effectively (green), have not been implemented or are not fully implemented (yellow), or have not yet been addressed (red). This rubric is incorporated into the semi-annual State of the Center document prepared by the Center Director.

Figure 5.1 *Best Practices Rubric*

NSF IUCRC BEST PRACTICES	Red	Yellow	Green	Comments
Implements NSF I/UCRC structure and protocols				Member Agreement, Bylaws, and Center Structure
Critical mass of members/support and fees as recommended by the I/UCRC program				$150K min at each site
Intellectual property (patent) protocols in place				Has not been tested yet
Publication review policies and delays in place				Has not been tested yet
Clearly defined research scope and execution strategy				Agreed to at IAB Meetings
IAB members co-design research goals and program				Agreed to at IAB Meetings
Clearly defined program deliverables and milestones with technology transfer mechanisms in place				Needs better definition of deliverables
Create and quantify value and formally evaluate the impact of center research				CFSP Center Evaluator Survey and Annual Report
Communicate success stories regularly to point out concrete examples of industry implementing and benefiting from center research projects/products				Needs to be addressed
Conduct semi-annual technical review, research planning and IAB meetings				Spring and Fall IAB Meetings
Create center developed business, operations and marketing plans in place and in-sink with industry needs (this is in addition to mission and vision				Workshop and IAB Presentations
Develop an organizational structure				Center Director, Site Director, Project Investigator, Students
Have a center developed strategy for recruiting members in place				Site Directors Meeting Held at TMS
Center have guests sign confidentially statements				Planned for 2006 Spring Meeting, Provo
Make provisions for center research staff and students to work at member company sites				DOE Interns - Needs to be addressed
Student involvement and poster sessions during each IAB meeting				Maximum use of posters at host site-increased offsite posters
LIFE forms used appropriately and feedback discussed during the IAB meeting				Electronic LIFE forms to be evaluated at 2006 Spring IAB
University supports faculty and student recruitment and capital funding				Equipment, Space, and Infrastructure available, New equipment has been

5.3 ANNUAL MEMBERS' REPORT

As noted in Chapter 4, two major reports are prepared during the year. One is the NSF Annual Report described above and the other is the Annual Members' Report. The NSF report is prepared

for the Spring IAB meeting and includes the External Evaluator's report prepared at the end of the previous year. Thus, the 2008 NSF report details center activities for 2007 and includes the evaluator's assessment of the center through 2007. The Annual Members' Report is not required by the NSF but has proven to be an effective tool for communicating center progress to all members, particularly to industry partners. The Annual Members' Report is prepared for the Fall IAB meeting, distributed to the attendees, and posted on the web site for all members to access. The report is several hundred pages and is bound into a book for ease of use and archival purposes.

A standard format for the report is used which contains the following:

- Program Overview (Section 5.3.1)
- FSW Technology Development Roadmap (Section 5.3.2)
- Project Master Schedule (Section 5.3.3)
- Project Executive Summaries (Section 5.3.4)
- Current Project Annual Reports (Section 5.3.5)

5.3.1 Program Overview

The program overview summarizes the objectives of the CFSP, lists the current year's projects, and includes Sections 5 – 12 from the NSF Annual Report. This includes center demographics, a description of industry members and center personnel, budget and funding information, center outcomes, and intellectual property events.

5.3.2 Technology Development Roadmap

The Technology Development Roadmap Section contains three planning tools: the graphical representation of the Technology Development Roadmap, technology development needs chart, and LIFE form summaries.

5.3.2.1 *The Technology Development Roadmap*

The Technology Development Roadmap is used to discuss the direction the center is taking. The roadmap was developed at the creation of the center and provided a multi-year plan of attack for addressing the issues known at the time in friction stir processing and friction stir welding. The document must, of necessity, be dynamic and reviewed on a regular basis. The discussion of the Technology Roadmap is part of the State of the Center presentation and the revised version becomes part of the Annual Members' Report.

A sample of the roadmap graphic is given in Section 2.1.2. Note that it defines a matrix which grids basic research, applied research, manufacturing technology, and industrial implementation on one axis against a timeline for developing specifications and standards, design guidelines, an educated workforce, and low-cost equipment and tooling.

5.3.2.2 *Initial Technology Developments Needs List*

The initial technology developments needs list was developed at the inaugural IAB meeting for the center during the planning grant phase. This is a list of development areas deemed critical to accelerating the integration of friction stir welding and friction stir processing into industrial environments. At the same time, the university or universities which would take the lead in each area were selected. Each year, progress in each area is assessed and assigned a color code to visually display the level of achievement.

The areas identified as "green" are considered to be adequately addressed under the current and proposed projects. Those areas identified as "yellow" are being addressed – but additional efforts are desired. Those identified as "red" are not being adequately addressed under the current program planning. In addition to revising the assessment of the areas each year, the document must be updated as new members join the center. This is accomplished at the fall IAB meetings.

Figure 5.2 *Technology Development List showing status of progress toward objectives which is included in the Annual Members' Report*

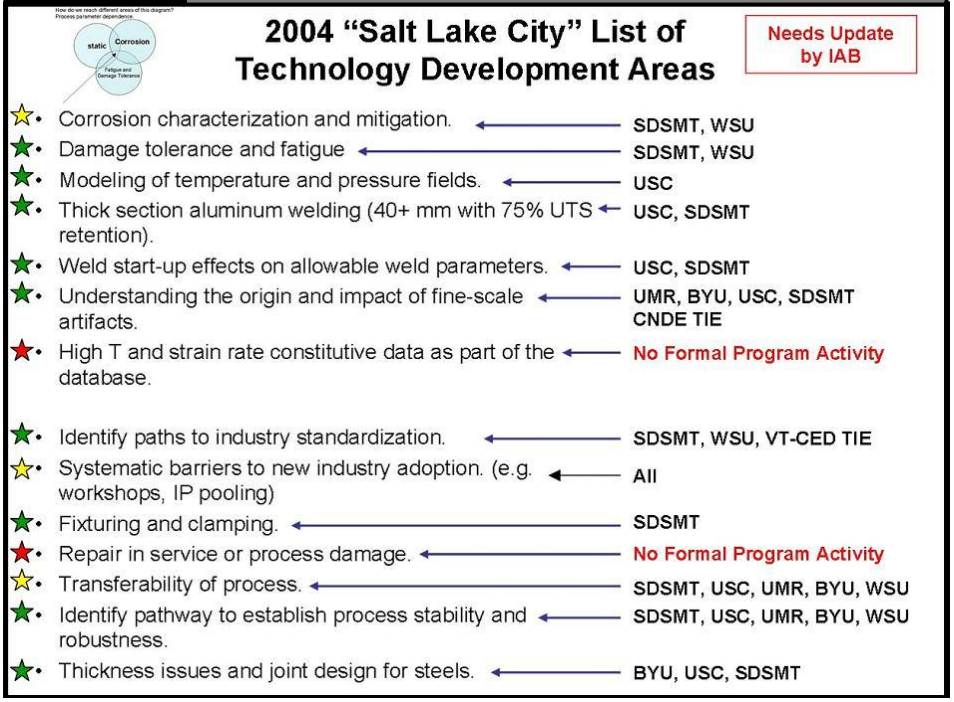


Figure 5.3 *Alternative format for Technology Development List showing status of progress toward objectives which is included in the Annual Members' Report*

Technology Development Areas	Red	Yellow	Green	University Responsible
Corrosion characterization and mitigation				SDSMT, WSU
Damage tolerance and fatigue				SDSMT, WSU
Modeling of temperature and pressure fields				USC
Thick section aluminum welding (40+ mm with 75% UTS retention)				USC, SDSMT
Weld start-up effects on allowable parameters				USC, SDSMT
Understanding the origin and impact of fine-scale artifacts				UMR, BYU, USC, SDSMT, CNDE TIE
High T and strain rate constitutive data as part of the database				No formal program activity
Identify paths to industry standardization				SDSMT, WSU, VT-CED TIE
Systematic barriers to new industry adoption (e.g. workshops, IP pooling)				All
Fixturing and clamping				SDSMT
Repair in service or process damage				No formal program activity
Transferability of process				SDSMT, USC, UMR, BYU, WSU
Identify pathways to establish process stability and robustness				SDSMT, USC, UMR, BYU, WSU
Thickness issues and joint design for steels				BYU, USC. SDSMT

5.3.2.3 *LIFE Form Summary Lists*

The LIFE form summary lists each project and the level of interest indicated by center members at the last IAB meeting. As noted in Chapter 4, the CFSP generates a summary of LIFE form ratings for each project, provides the opportunity for each project lead to respond to the LIFE form comments during the IAB meeting, and reserves time during the meeting for each sponsor to meet with the project leads to discuss the LIFE forms and the responses.

Industry partners have also asked for a summary of the small group discussions to be presented to the entire group. This will be incorporated into the next IAB agenda. The Annual Members' report contained the LIFE form summaries. A complete set of LIFE form ratings/comments and project lead responses are given to the center members at the IAB meeting.

The extent to which the current and proposed programs meet the needs of the IAB Membership is reflected in the interest level of the LIFE FORM analysis from the Spring IAB meeting. VI = Very Interested; I = Interested; IWC = Interested with change; NI = Not Interested; A = Abstain. A Section of the Annual Members' Report summary is presented below.

Figure 5.4 *LIFE Form Summary Statistics Chart included in Annual Members' Report*

		Level of Interest				
Project Title	Project Leaders	VI	I	IWC	NI	A
CFSP04-BYU-01: FSW of Ferritic Steels (BYU)	Carl Sorensen	5	10	2	1	1
CFSP04-BYU-02: FSW of Austenitic Alloys (BYU)	Carl Sorensen	4	15	1	1	0
CFSP04-AMP-01: Design and Analysis of FSW Built-Up Structures (SDSMT)	Bill Arbegast	9	9	3	0	0
CFSP04-AMP-02: Intelligent Process Control Algorithms (SDSMT)	Bill Arbegast	6	9	0	2	2
CFSP04-AMP-03: Development of CFSP Website and Database (SDSMT/UMR)	Bill Arbegast	7	12	0	0	1
CFSP05-AMP-01: CFSP/CNDE TIE- Effects of Defects in FSW (SDSMT)	Bill Arbegast	3	12	5	0	0
CFSP06-AMP-01: Acoustic Emissions Control of FSW (SDSMT)	Bill Arbegast	1	12	1	4	2
CFSP06-AMP-02: Friction Stir - Weld Bond Process Assessment (SDSMT)	Bill Arbegast	2	1	0	0	0
CFSP06-AMP-03: FSJ of Fiber Reinforced Thermoplastics (SDSMT)	Bill Arbegast	6	5	0	5	3
CFSP06-AMP-04: Liquid Metal Embrittlement of MP159 Pin Tools (SDSMT)	Bill Arbegast	2	8	1	4	1
CFSP06-AMP-05: Thick Plate 7XXX and 6XXX Aluminum FSW (SDSMT)	Bill Arbegast	2	10	1	3	0
CFSP04-USC-01: Thermal Management of Aluminum FSW (USC)	Tony Reynolds	5	11	2	0	1
CFSP04-USC-02: Improved Weldability of Titanium Alloys (USC)	Tony Reynolds	12	6	0	0	1
CFSP05-UMR-01: Friction Stir Microstructural Modification (UMR)	Rajiv Mishra	9	7	1	0	2
CFSP05-UMR-02: Robotic Friction Stir Welding of Thin Sheets (UMR)	Rajiv Mishra	10	7	1	1	0
CFSP06-UMR-01: E- Design and the FSW Process (UMR/ VPI TIE)	Rajiv Mishra	6	9	0	1	3
CFSP06-UMR-02: Friction Stir Spot Welding (UMR)	Rajiv Mishra	8	8	0	2	1

5.3.3 Project Master Schedule

The Project Master Schedule conveys several pieces of information about projects in a concise graphical format. Not only are project initiation dates and duration mapped to the timeline, but the status of each project is also indicated by color-coding. A sample timeline is presented below. Note that completed projects

are easily identified as green, current projects are in gray, proposed projects are designated as pink, and canceled projects are coded as yellow. A timeline is prepared for each university site in the center.

Note that TIE projects with non-center members are also indicated on the timeline. The timeline also indicates projects funded entirely by the NSF such as REU, RET and Supplemental Awards (Section 3.6).

The timeline is reviewed at each IAB meeting and updated as needed. The typical project duration is three years, but as indicated in the example, some projects are completed in a shorter time, and some are extended. However, the center members maintain a three year horizon when planning projects and timelines.

Figure 5.5 *Project Master Schedule – SDSMT CFSP Site*

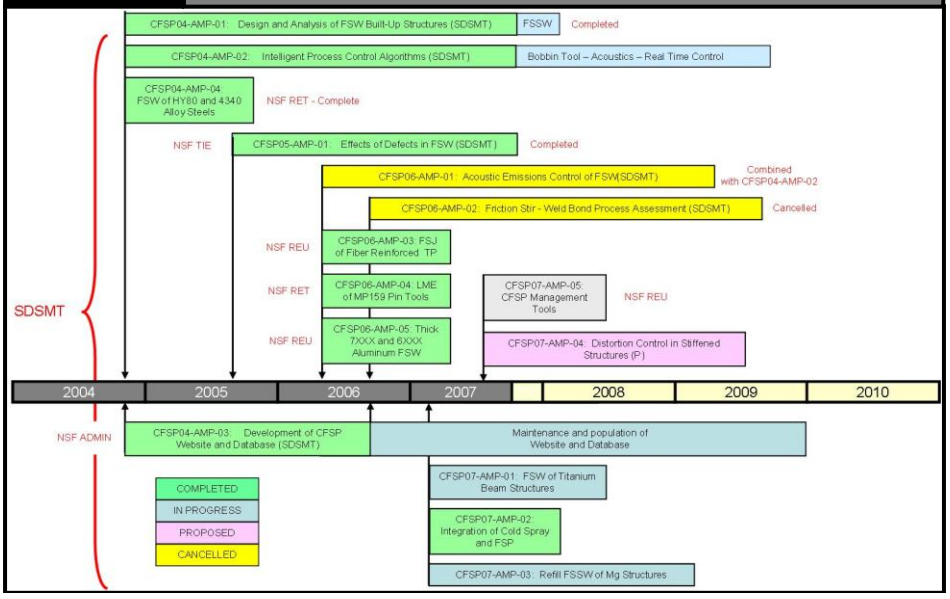


Figure 5.6 *Project Master Schedule – BYU CFSP Site*

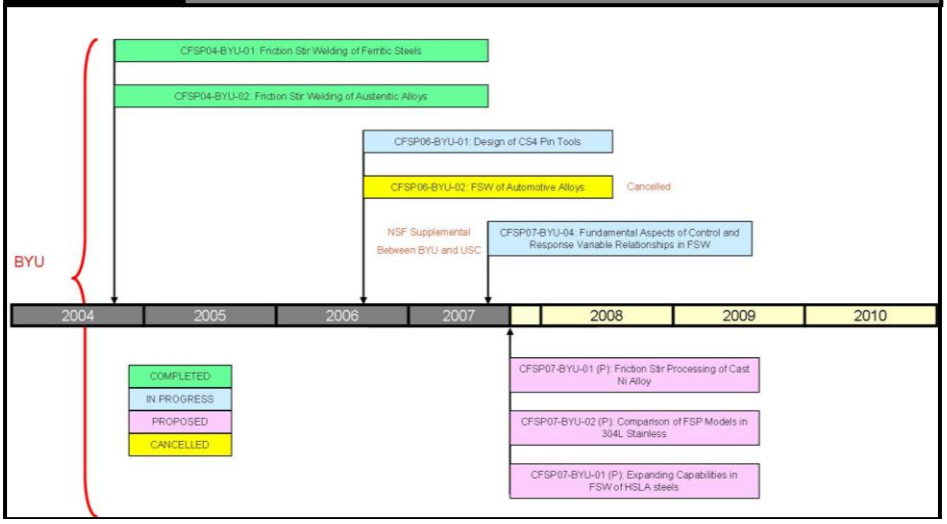
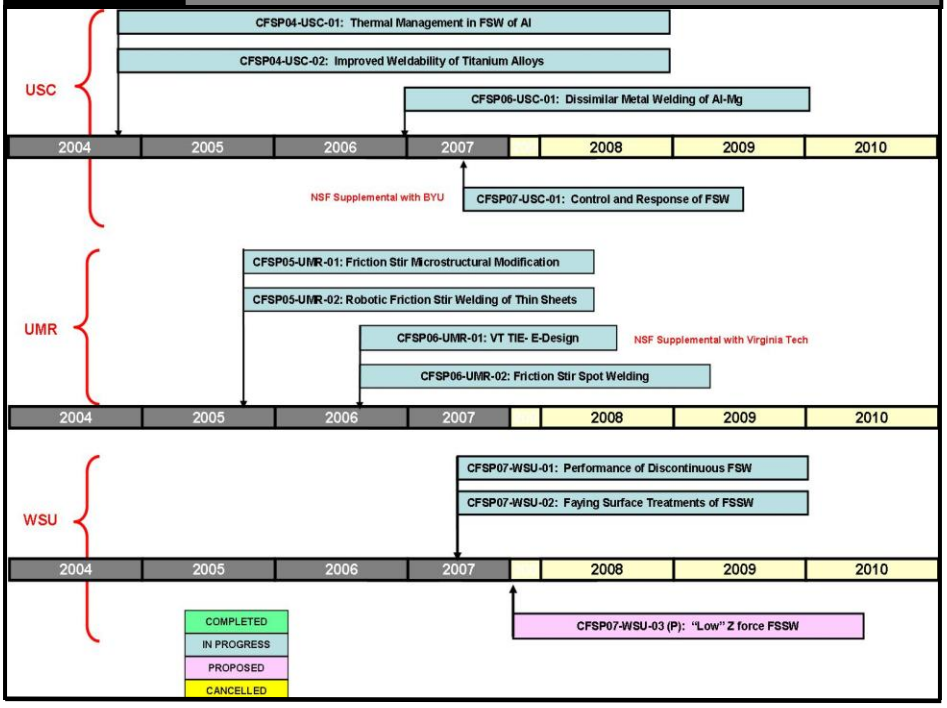


Figure 5.7 *Project Master Schedule – USC, UMR, and WSU CFSP Sites*



5.3.4 Project Executive Summaries

The format and contents of individual Project Executive Summaries were described in detail in Chapter 4, and an example template is shown in Appendix L. The Annual Members' Report contains a compilation of all Executive Summaries of current and proposed CFSP projects. The Executive Summary is a brief description of the objective of the project, the approach taken, and the progress made in the past year. LIFE form evaluations (Section 4.2.2) are completed as part of the Executive Summary presentations.

5.3.5 Current Project Annual Reports

The annual report for a project follows the same format as the quarterly report described in Chapter 4, but, as the name implies, it covers progress made on the project for the entire year. It is an extensive technical discussion of the work completed in the previous year and planned for the next year if the project is continuing. The template for the annual report (Appendix M) is somewhat flexible but should, at a minimum, include:

- an introduction to the project
- the objective of the research
- a description of the methodology/approach used
- experimental data
- analysis of the data, including graphical representation of results
- a summary and conclusion
- description of future work

Annual reports are generated for every on-going project and every project completed during the past year.

5.4 EXTERNAL EVALUATOR'S REPORT

The NSF requires a formal evaluation of the center to be conducted by an independent evaluator. The duties of the evaluator are defined by the NSF I/UCRC Program Office: There

must be an independent evaluator who cannot be from the department within the institution receiving funds for the I/UCRC award. The Center evaluator is responsible for[2]:

- Preparing an annual review of Center activities with respect to industrial collaboration during the previous year (which is appended to the Center's annual report to the NSF);
- Conducting a survey (using an instrument that will be provided by the NSF to all Centers) of all Center participants to probe the participant satisfaction with Center activities;
- Compiling a set of quantitative indicators determined by the NSF to analyze the management and operation of the Center;
- Participating in the IAB and any other relevant meetings;
- Performing exit interviews to determine why members chose to withdraw from the Center; and
- Feeding information on the quality of the industry/university partnership to the NSF and back to the Center for continuous improvement.

The external evaluator attends the IAB meetings and prepares a report after the fall meeting. The fall meeting concludes center business for that year. The evaluator also surveys industry members and includes their feedback in the evaluation. A blank example survey is included in Appendix P. The evaluator's report is included with the NSF Annual Report described above, is discussed at the Spring IAB meeting, and is available on the web site as a part of the documentation for the spring meeting.

The required contents of the report can be found at http://www.ncsu.edu/iucrc/EvalReport.htm. In summary, the report must include an overview of the center, its goals and objectives, changes at the institution or in the industrial environment which impact the center, center organization, the

[2] National Science Foundation Evaluation Project (1997) Evaluator's handbook: National Science Foundation Industry-University Cooperative Research Centers Program (Rev. ed.). Raleigh, NC: North Carolina State University.

research program, center accomplishments, analysis of center progress, and a timeline for events that have occurred at the center.

DOWNLOADABLE WEB-BASED I/UCRC MANAGEMENT TOOLS

Chapter 6

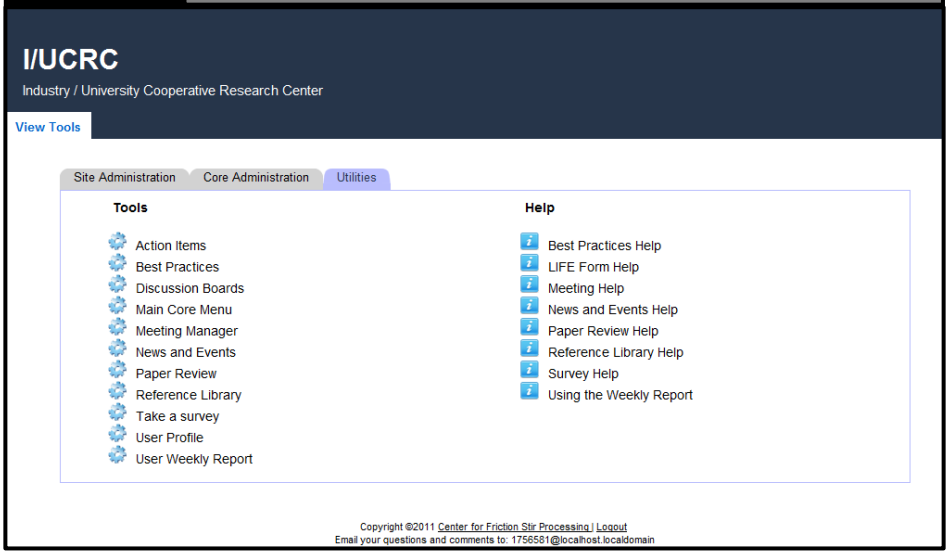
6.1 INTRODUCTION

A set of web tools was designed and implemented to facilitate more efficient management practices for the CFSP. Although aspects of the system are discussed in various chapters of this book, this chapter details the design decisions and specific pieces of the CFSP management system.

Like many software projects, this system began with a small team of developers and many possible directions. As a result, different pieces have been scrapped or rewritten as the needs of the CFSP were better understood. This chapter will focus on the final product which reflects three major design requirements. The released version of this toolset is manageable, redistributable, and modular.

This software will continue to be updated as center needs change or are better defined. Because of this fact, this chapter should not be viewed as the most current description of the software but as a description of the design decisions behind the software and the state of the software at the time of the writing of this document. More current information is available at http://cfsptools.sdsmt.edu/.

Figure 6.1 *I/UCRC Tools Management Screen*



6.2 Design Requirements

6.2.1 Manageable

The main vision behind this project has always been to ease the burden of managing a multi-site I/UCRC. As such, the system takes into account the view of the center director. Each tool has a management side that a center director can access to change privileged options not available to lower-level users. Because this is essentially the oldest requirement, it exists as one of the core modules in the software.

The software is also manageable from an install/update perspective. The team made the installer as user-friendly as possible allowing most of the installation from a web browser. Some technical knowledge is required for different aspects of the software, but the development team attempted to remove as much of the technical knowledge from the requirements as it could. As such, the system is lightweight even though it has the power to manage many important aspects of center life.

6.2.2 Redistributable

During the life of the CFSP, center members as well as NSF evaluators have reported to the NSF on the positive impact these tools have on center operations. This spurred the development team to send student researchers to the NSF I/UCRC Annual Directors' meetings to make presentations on the toolset. The team was given positive feedback, and the NSF funded the proposal "Collaborative Research: Supplement – Dynamic Web Based Methods and Tools for Multi-University I/UCRC Management, Data Integration and Decision Support" to continue tool development. One part of this development was to turn the tools into a package which could be distributed to other centers.

Packaging the toolset included three parts. First, the team had to outline a standard set of requirements which must be met before installing the toolset. The first step in choosing the requirements was to choose a platform from which to host the tools. Because of its popularity in the web space, the team chose to develop on the LAMP stack, which consists of a Linux operating system, Apache software package to host the site, MySQL for data storage, and PHP for delivering web pages. LAMP is known to be a secure, powerful, and free platform.

The second part was to choose a delivery method. The team chose to write a custom installer because it was simpler and cheaper than licensing boxed software installers. The toolkit installer is written in PHP and uses the PHP SVN modules to deliver the latest version of the software directly from development servers.

The third part was modularity and is covered in the next section.

6.2.3 Modular

The third requirement was for the system to be modular. The system is designed to be broken into separate modules called tools. Several reasons supported the team's choice to do this.

First of all, the team wanted the system to be a simple add-in into an existing website. Many I/UCRCs have their own websites, so designing the toolset as its own website would not cater to these centers' needs. Thus, the tools can be added into an existing website as long as it is on the required platform. To satisfy this

requirement, the tools had to be decoupled from the CFSP's existing website which made generating an installer much easier.

Another reason for modularity is the need for updating. Initially, developers worked on the program while it was running and servicing users. This is dangerous, and the team decided that they wanted other I/UCRCs to be able to update when it was convenient for them. Now, each tool can be updated individually as an update is released, giving users the ability to update when they choose.

6.2.4 Further information

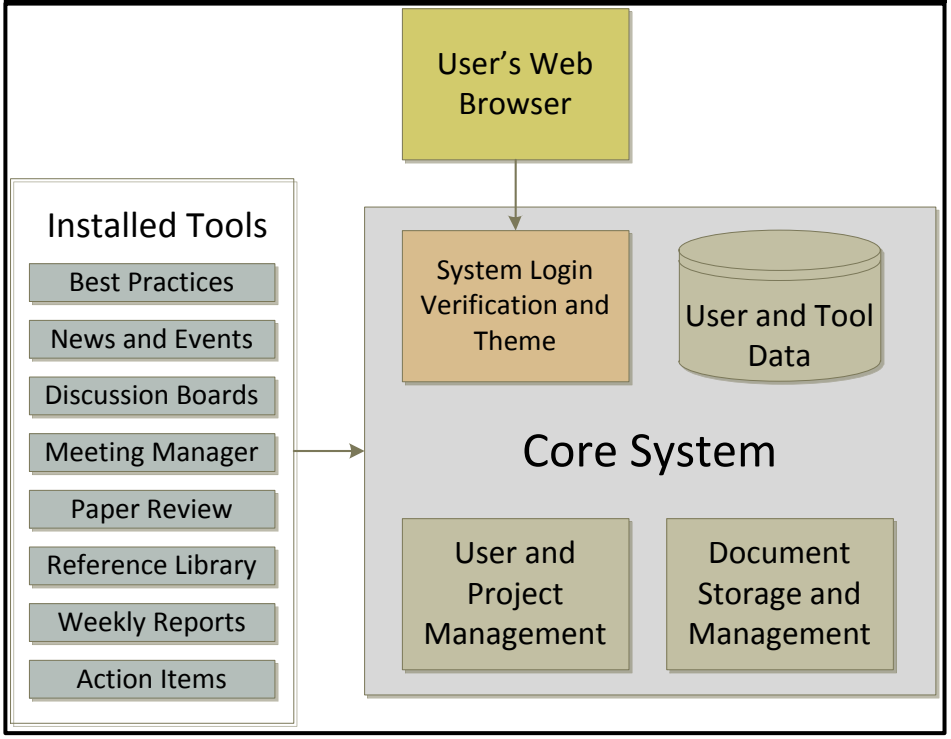
To assist in the deployment of these tools to the NSF, the development team hosts an informative website located at http://cfsptools.sdsmt.edu. At this site, you can download the toolset, see information about the tools, view the presentations given at NSF meetings, and find contact information for the development team. Also on this site is a link to the Bug tracker. The bug tracker is a place for other centers who are using the toolset to submit bugs they find. In this way, users can report bugs in the software, and developers can assign and prioritize bugs that are found.

6.3 Web-Based Management Tools

6.3.1 Base System

The toolset is designed around a core set of tools which provide personnel, project, and document management capabilities. These three pieces comprise the most important aspects of an I/UCRC-centered toolset.

Figure 6.2 *I/UCRC Core Set of Tools*



6.3.1.1 *Personnel*

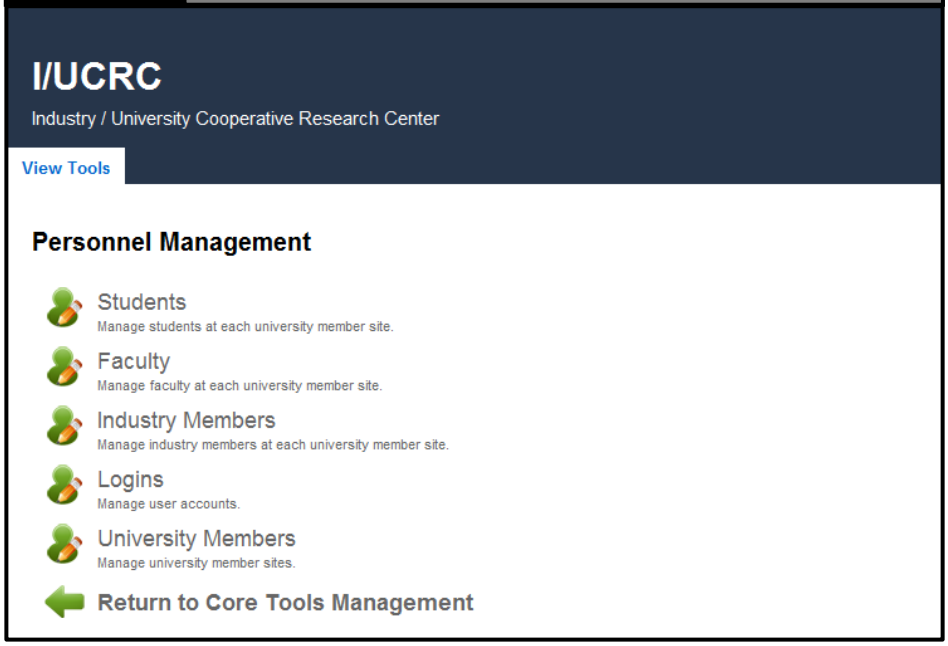
This is one of the basic systems upon which many of the other tools in the package depend. The primary purpose of this system is to track all center personnel. Center participants can be divided into categories which define their access rights to information and sections of the web site. For the CFSP, the categories are:

- Students
- Faculty
- Site directors
- Center director / administrator
- NSF evaluator
- Industry partner

The Personnel Manger provides an interface for creating a new entry, deleting an existing entry, or modifying an existing entry. Only a

person with appropriate rights, a site or center director, can perform these operations.

Figure 6.3 *Personnel Management Tool*



A person is associated with one or many projects. This can be entered at creation of the personnel record or during editing.

Entering a new center participant creates an entry in a database. These entries can be used by other tools, such as project management, and also provide a single location for all information about center participants that can be searched, sorted, and processed to extract statistics for reporting purposes.

An additional feature of the Personnel Manager is the ability to create contact lists. A contact list is similar to an email list, which is one of the ways they are used by other tools, but also provides a more generic feature of defining membership in groups for managing access rights and dynamically generating web pages. Based on rights, different users will see different sections of the tools. For example, a person reviewing papers in the Paper Review System will only see the papers for which he or she is designated as a reviewer since the page is dynamically generated for that user, based on group membership, when it is accessed.

6.3.1.2 *Projects*

The Project Manager is another fundamental tool which is utilized by other tools. Its purpose is to track current projects for the center as well as archive past projects for future data analysis and data mining. Again, these actions are restricted to authorized personnel with sufficient access rights.

Projects are associated with a lead site, so projects can be listed by which site they are associated with. In the case of TIE projects, the Project Manager allows multiple sites to be listed, but only the lead site will show the project.

A new project is created by filling in a form with information such as project title, ID number, originating center, collaborating sites, staff, budget, start and end dates, and abstract. Once the Project Manager verifies that all of the required data fields have been filled in, the project can be added to the system.

Once a project is in the system, a user will be able to view information about it. Users with sufficient access rights will be able to edit information and even deactivate a project when it is no longer active. If deactivated, the project is stored solely for reporting purposes.

6.3.1.3 *Documents*

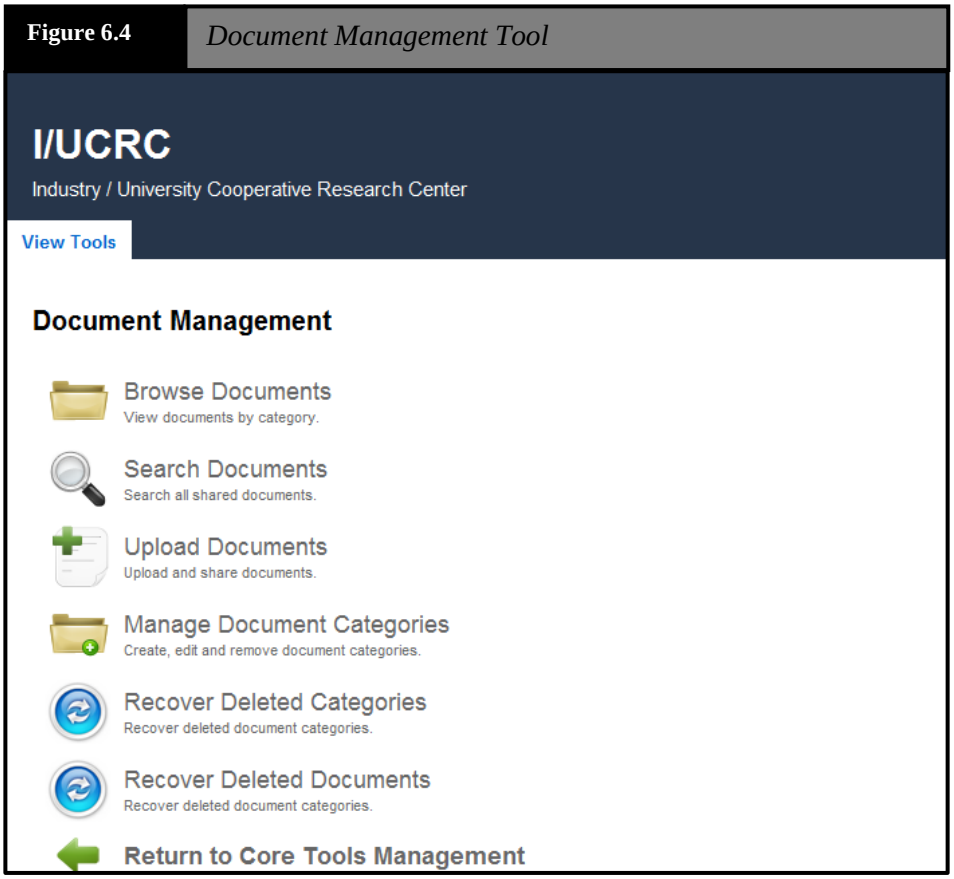
Document management is vital for a center. The Document Manger provides a central place for participants to access and upload documents. It can store all types of documents from membership agreements to theses, papers, and research files. It supplements the functionality of a website by allowing a common place for file storage.

The document management tool facilitates the uploading of documents to other web pages on the site. At present, the document manager allows files to be added to the pages created for By-Laws, Member Agreements, Templates, Proposals, and Annual Reports which were described in previous chapters. The tool creates a database entry for the file with the information necessary for the dynamically-generated page to be automatically updated.

The tool can be customized to allow uploads to any page on the web site with dynamically-generated content. To facilitate this customization, the document manager displays a list of pages

currently on the site to which documents can be added. The file name and location of the document to be uploaded are entered from a standard browse-and-upload box. Note that only a link to the document is placed on the selected page, the document itself is stored on the server and linked through the database entry.

Figure 6.4 *Document Management Tool*



The Document Manager becomes important as many types of files may need to be uploaded based on a center's needs. Weekly reports, presentations, and even research data files are important documents which could be uploaded and stored for center participants to access. To facilitate this possibility, the Document Manager should allow for the creation of custom document-upload categories which work much like folders on a Personal Computer. These categories will limit upload and access capabilities based on the access level of the user logged in.

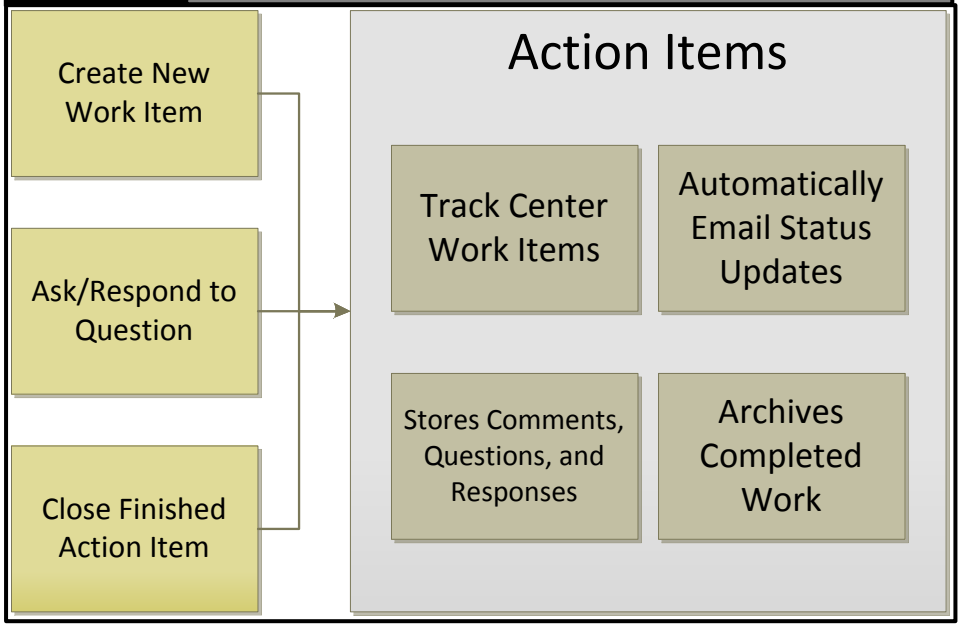
It is important also to provide basic searching of documents within the manager. In this way, a user can see a set of possible matches to their search terms and find a specific document faster. An easy way to implement this feature is by providing a simple sort-and-filter interface.

6.3.2 Additional Tools

6.3.2.1 *Action Items*

In order to track work assignments, the system should implement a tool capable of assigning tasks and tracking them to completion. The Action Item tool will act as a hub for center members wishing to track work items which are assigned to other members. The idea behind this tool is to allow the users stored in the Core system to assign action items to other members. The system then keeps track of progress on the item and stores the record associated with the item when it has been completed.

Figure 6.5 *Additional Tools—Action Items*



The Action Items tool provides an electronic "to do" list to center members viewable by everyone with a login. In addition, the action item list reduces unnecessary email traffic, serves as a

mechanism for people with similar issues to participate in a single solution to the problem that satisfies all needs, and allows everyone to check the progress of open items for planning purposes. The basic operations of the Action Items system are:

- creating an action item
- editing an existing item
- viewing the action item list
- responding to an action item
- closing an action item

When creating an action item, the user provides information including:

- Description – A brief description of the task being assigned
- Responsibility – Whom the item is assigned to. All registered users are in a drop-down list. This information is automatically included in the list from the personnel information stored in the database and managed by the Personnel Manager described above.
- Date assigned – Auto-filled with the current day, it can be changed if the action item was assigned on another day.
- Scheduled Complete – Automatically set for 1 month in the future. The person making the assignment can change that date manually.
- Completed – When the status is set to "closed" by the person assigning the action item or by a person with system administrator rights, the date the item was completed can be selected and will be saved in the database.
- Priority – High, medium, or low.
- Status – Open, closed, or withdrawn.

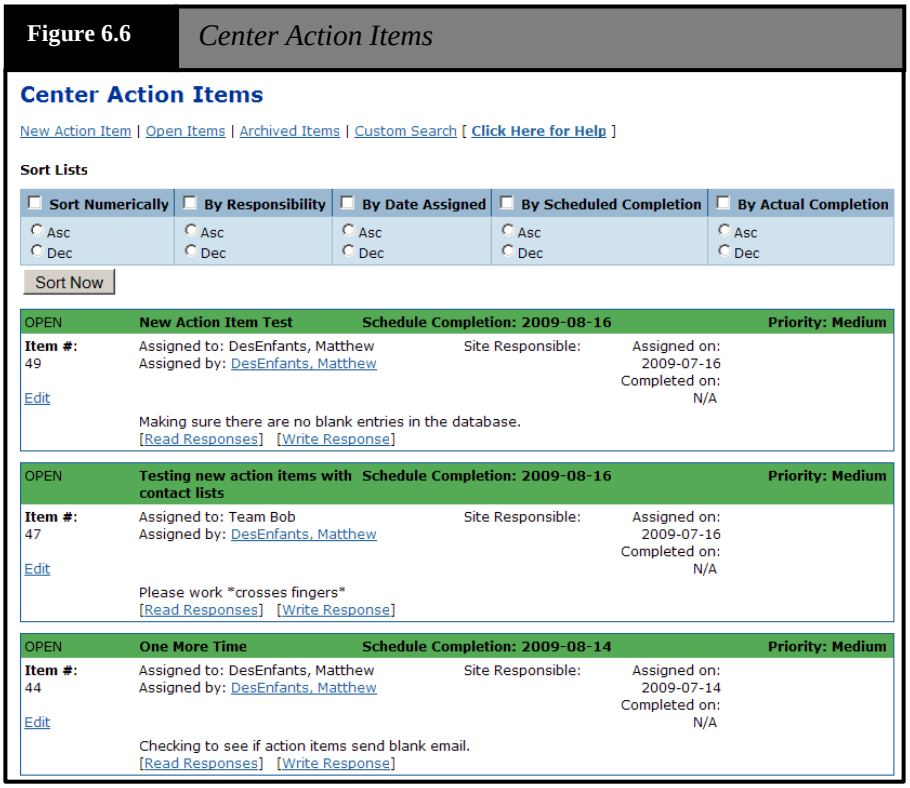
Action items stored in the system are separated in to two categories, active and archived. Active items have not yet been completed while archived items are those that have been

completed (closed) or were withdrawn. Both the active and archived action items can be sorted and filtered by predefined attributes or by using a custom search. All sorts provide ascending and descending options and filter by the following fields:

- action item number
- person responsible
- date assigned
- scheduled completion date
- actual completion date
- priority
- status
- person assigning the action item

In addition, the user can filter the action item list to search for items with characteristics not covered by the predefined sort criteria.

Figure 6.6 *Center Action Items*



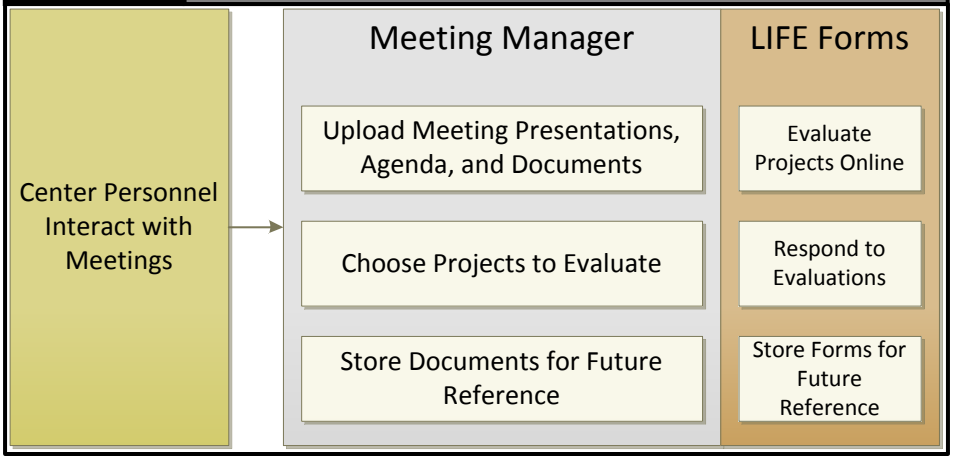
When an action item is generated, the person responsible is notified and can enter a response. In this way, a user can keep the action item up-to-date by simply entering a response. The assigner can be notified of this response and respond in kind if desired. Only the person who originally assigned the action item can designate it as closed. This provides a mechanism for ensuring that the action addresses the problem identified by the person posting it. Once closed, the item is automatically moved to the Archived list.

6.3.2.2 *Meeting Manager*

A common administrative task which can consume a large amount of time is scheduling and managing meetings. As noted in previous chapters, the CFSP has two Industrial Advisory Board Meetings per year with smaller interim meetings scheduled throughout the year. A tool to manage scheduled meetings, meeting documents, and LIFE forms for the meeting becomes a worthwhile addition to the system.

A user schedules a date for a meeting, generally including a year and a season. This information is used to identify the meeting, and is the starting point for creating a meeting in the Meeting Manager.

Figure 6.7 *Meeting Manager*



If this meeting will have documents associated with it, the document categories should be chosen when the meeting is created. This subsystem calls the document manager to automatically create categories of documents to be uploaded for the meeting. For the CFSP, this includes workshop presentations, proposals for new projects, technical reports, poster presentations, executive summaries of projects, and management review presentations. The content of these documents is described in previous chapters. Document categories are like folders on a Personal Computer and described further in section 6.3.1.3. It should be possible for a user to select several categories of documents for a meeting, making the system more flexible.

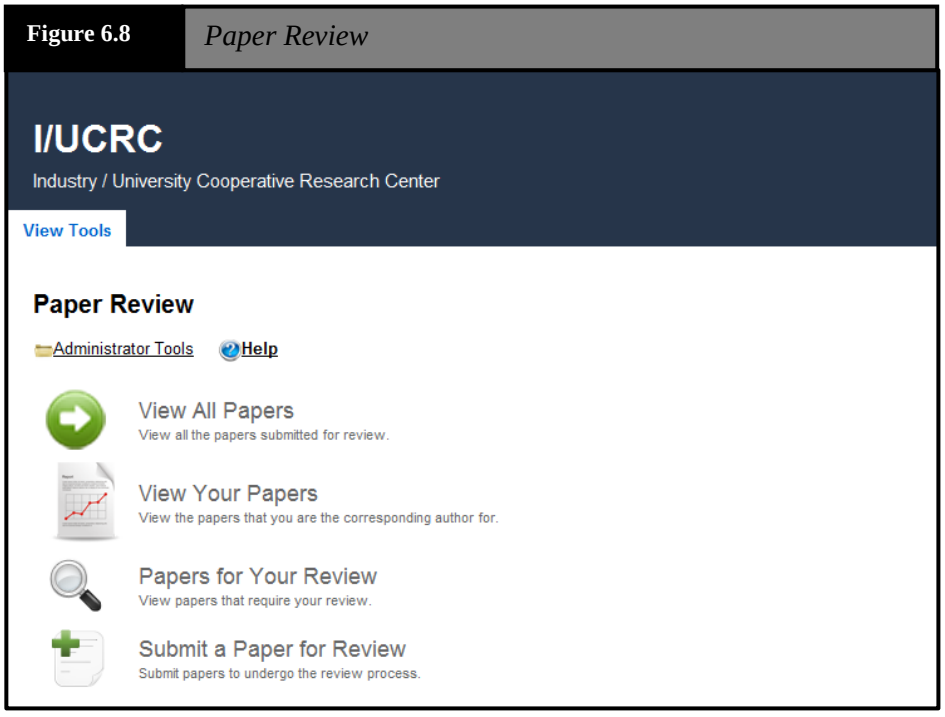
The meeting manager now contains information associated with the new meeting. Center members can access the meeting to upload documents or view information before the meeting and complete LIFE forms during the meeting. After the meeting has completed, the tool holds this information for future events and historical value.

6.3.2.3 *LIFE Form Manager*

A LIFE-forms system is tied into the Meeting Manager since project review is a central part of Center meetings. LIFE forms are used to facilitate these reviews as described in Section 4.2.2. The advantages of completing these forms online include ease of use, central storage of past project reviews, and providing an interface for users to respond to reviewers in a timely manner. It is not uncommon for members of the CFSP to discuss the reviews of a project directly after the forms have been completed, and this tool makes it possible.

6.3.2.3 Paper Review

Figure 6.8 *Paper Review*



A likely product of center's activities is research articles and other documents for publication. Since proprietary information may be involved, it may be necessary to have the approval of the center members prior to publishing.

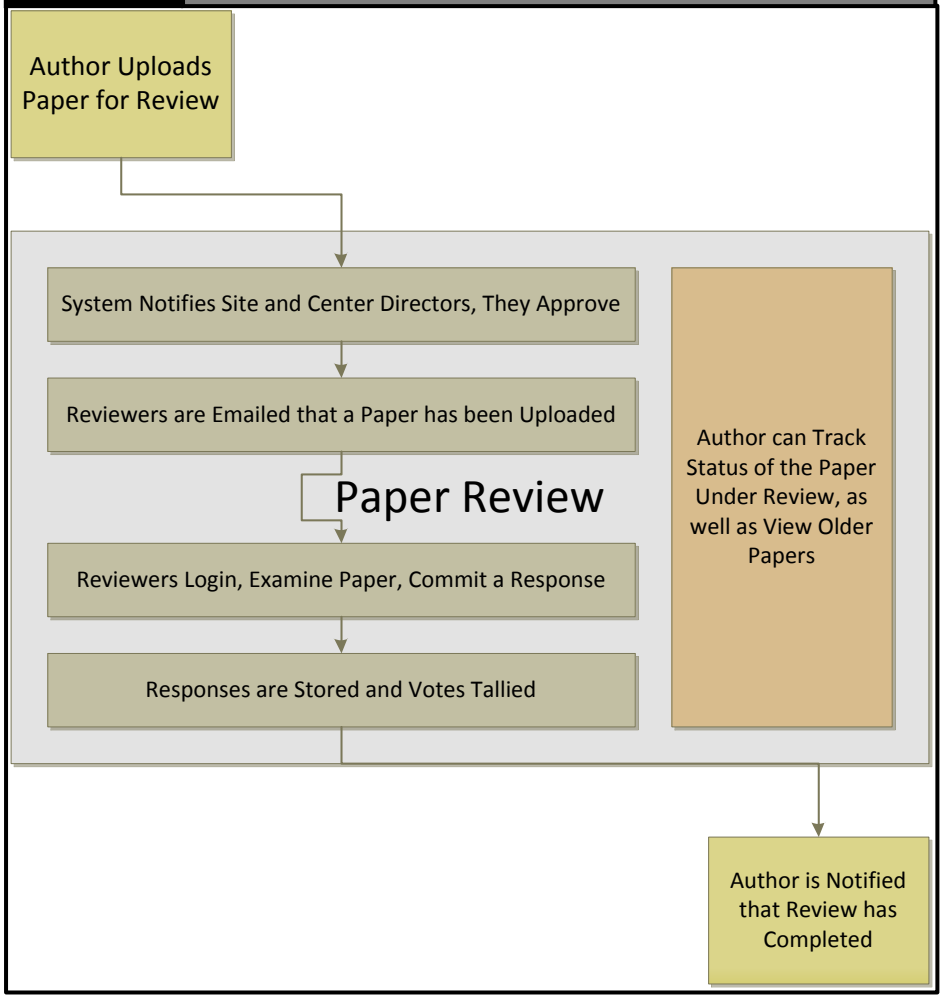
The paper review system provides a web page where the author can upload the paper using the standard browse/upload

interface. The corresponding author supplies the title, other author information, the type of publication (abstract, article etc.), the journal or conference to which it will be submitted, and the CFSP project under which the work was done. If a previously-approved abstract is already in the system, the author can tie the two documents together at this point.

The system should also include a list of reviewers who can be selected individually or as a group, such as "all center members". The reviewers are automatically notified via email that a paper has been submitted which requires review. A reviewer is allowed to accept, reject, or request changes. A list of reviewers, their votes, and comments will be available to the author. A user can specify a due date for reviews after which acceptance is assumed to prevent unnecessary delays in publication.

After the author submits the paper, the site director has the responsibility to approve its posting on the paper review system. This provides an additional safeguard for proprietary information, particularly since many sites perform both center-sponsored work and direct-contract work which cannot be released to the center members. The author can follow the progress of the paper through the review paper and respond to comments as they appear. The author can also upload revisions at any time and the reviewers are automatically notified. Previous versions remain available for comparison. Email notification is sent to the author when comments have been entered for the paper and when the final status of the paper has been determined. The site director makes the final determination of the paper's status when the review period has closed: approved, withdrawn, or delayed. If the paper is withdrawn, it remains in the database for reporting purposes.

Figure 6.9 *Paper Review System*



6.3.2.4 *Reference Library*

The reference library is a database of research articles, related to center projects, that is only available to center personnel. A user can upload a paper, search the database, and read any papers contained in the public collection. The web interface for uploading papers provides a standard browse/upload box and will accept documents in doc/docx and pdf formats as well as jpeg images. Information about the paper, including title, author(s), where it was published, the full citation, keywords, and the date published, is provided by the person uploading the paper. In

addition, this interface provides the user with a list of all papers he or she has uploaded and the ability to edit the information stored about the papers. The site director also has access to change any of the data stored in the library database.

A paper that is uploaded can be for the public archive or for a user's private library. If it is intended for public use, the site director must mark it as approved for posting. This gives the site director the ability to enforce copyright laws. Papers that are uploaded as part of a private library cannot be viewed by anyone but the person who uploaded it and site director. A third option allows the site director to make a paper viewable and searchable by only a defined set of users. This is relevant when proprietary information from one project is not available to the group as a whole.

The library tool provides the standard sort, filter, and search options, including a keyword search and the ability to see all papers in the library. If access to a paper is restricted, either because it is part of someone's private library or is restricted to a group set by the site director, the paper is not included in the search unless the user is authorized to read the paper.

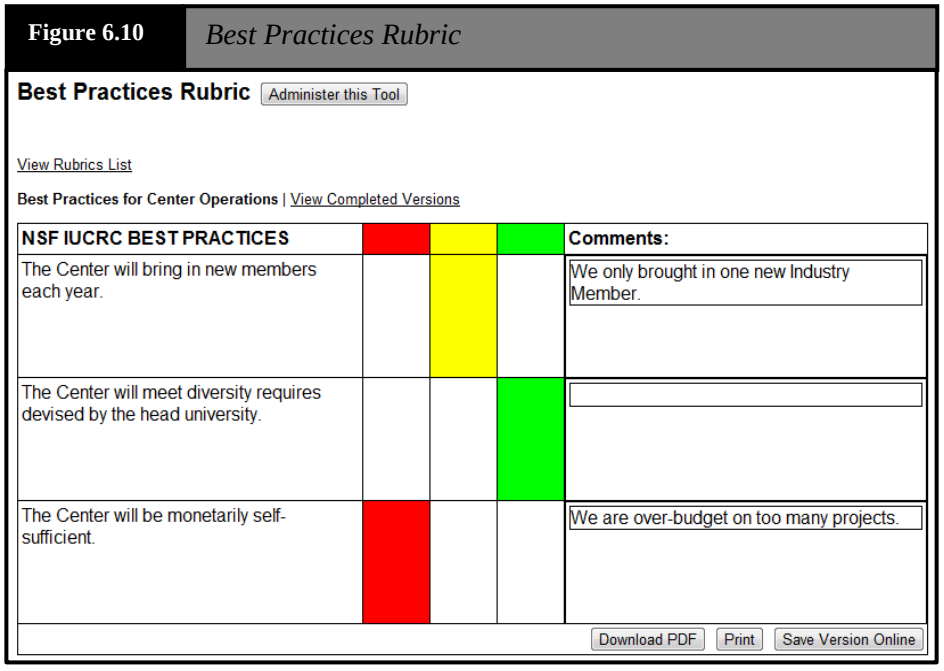
The administrative backend allows the site director to manage all documents in the library. This includes the ability to view recent uploads, sort papers, view un-approved papers, edit paper information stored in the database, and approve papers for posting with appropriate access restrictions, if any.

Although the original purpose of the library was to store research articles, it can also be used to store and retrieve experimental results and other center work products.

6.3.2.5 *Best Practice Rubric*

The NSF has created a Best Practices Rubric for running an I/UCRC (Section 5.2). This rubric is provided as a tool that allows an administrator to fill in the rubric to reflect the current status of the center and also change the list of best practices to better suit a particular I/UCRC. All users will be able to see the current status and download the rubric as a PDF file.

Figure 6.10 *Best Practices Rubric*



Best Practices Rubric Administer this Tool

View Rubrics List

Best Practices for Center Operations | View Completed Versions

NSF IUCRC BEST PRACTICES				Comments:
The Center will bring in new members each year.				We only brought in one new Industry Member.
The Center will meet diversity requires devised by the head university.				
The Center will be monetarily self-sufficient.				We are over-budget on too many projects.

Download PDF Print Save Version Online

A Best Practices tool will provide a place for users to create, fill out, and store rubrics. Once a rubric has been created for use, a user can access it. After reviewing a question, a user can enter a value giving depicting his/her feelings on this area. The user will also be able to explain his/her thoughts in a text field next to the value. This rubric can then be stored for future viewing.

Because best practices can be applied in many areas, the tool should allow the capability of tracking multiple rubrics. A user may enter the system to create new and edit existing rubrics to make changes as necessary.

6.3.2.6 *Surveys*

The survey tool can be used as a stand-alone tool for an arbitrary survey or can be tied to the personnel manager and contact list systems. In the latter case, email lists can be created, or pre-built lists selected, for notification that a new survey has been created. The survey tool also allows access to responses and creates a summary of the responses.

After logging in and selecting the survey tool, the administrator has the option of creating a new survey or accessing an existing survey. When adding or editing a survey, the user can

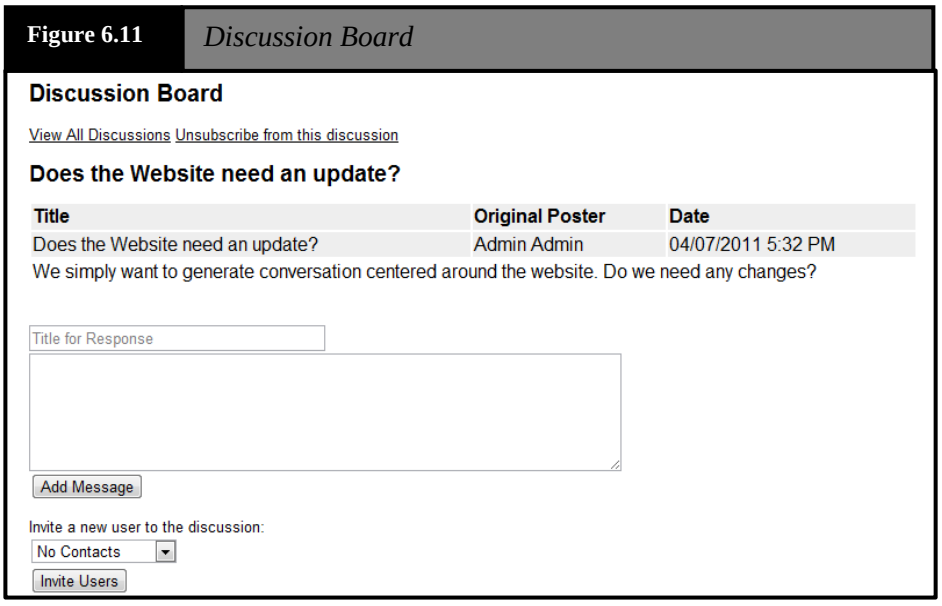
add a question and select the format of the answer such as a drop down, text field, checkbox, or radio button. Questions can also be deleted or reordered.

The survey tool also contains an option to view results. This can be done either as a detailed list of individual responses or as an aggregated report.

6.3.2.7 *Discussion Boards*

The discussion board tool is a private bulletin board for center members. A member can initiate a discussion and invite others to participate in the discussion. Only the person who initiated the discussion can add users to the board. A list of discussion topics is available for all center members to view, but only invited members can see the posting or add a posting. When initiating a thread, a drop-down menu provides easy access to all potential participants, both as individuals and as groups from the Contact List tool embedded in the Personnel Manager. A person can also unsubscribe from a discussion. All subscribers to a discussion board have the option of receiving email notification when a new post is created.

Figure 6.11 *Discussion Board*



6.4 Decision Support Tool Overview

The Decision Support Tool is designed to help research centers and industrial partners select a project to implement from several alternatives based upon benefit and cost analysis. This tool utilizes the multiple attributes of a project in the decision making process. There are three alternative methods available for use and these are briefly described below.

6.4.1 Monetary

This method uses the monetary values of the attributes of a project for comparison. Since benefits and costs are not measured in the same units, in this method the user converts the benefits to US dollars, the same units used for cost. (For example, while costs are measured in US dollars, the attribute "publications" is measured by the number of papers, and these must be converted to a US dollar equivalent in order to make a comparison between attributes.) This method is applicable for projects where all of the attributes can be represented by monetary values.

Key Equation Utilized: Profit Monetary Values = Benefit – Cost

6.4.2 Rank and Order

The Rank and Order Method is a simple and straightforward approach to multi-criteria decision making. The user ranks the project attributes from the most important to the least important, and then the tool evaluates each project to be evaluated according to the ranked order of the attributes. (Projects are evaluated on the most important attribute first, and, if there are ties between projects on that attribute, the second attribute is then considered, and so on.) If the user does not specify an order for the projects, a default order is used based on the previous user's rank order entries.

6.4.3 Utility Method

The Utility Method is a way to evaluate the projects based upon the values of a utility function. The utility function allows comparison of all projects in common units and also is a reflection of the user's attitude towards risk. The range of a utility function is 0 to 1.

There are two utility functions available

Exponential utility function: $U(x) = 1 - e^{-ax}$

This is a one-parameter utility function where the parameter a is specified by the user. The equations used are presented below:

For increasing exponential function, $a = -\ln(1 - u) / x$
For decreasing exponential function, $a = -\ln(u) / x$

where a is calculated by having the user provide two values for x, specifying the satisfaction level for each value from very bad (0.1) to very good (0.9). The values of a for each value are calculated and then averaged to obtain the a used as a parameter value.

Linear utility function: $U(x) = a + bx$

This is a two-parameter function. The methods to determine a and b are similar to that found in the exponential function. Two values are given and evaluated.

$$b = (u_1 - u_2) / (x_1 - x_2)$$
$$a = (u_2 x_1 - u_1 x_2) / (x_1 - x_2)$$

The tool is designed with a number of "Explanation Text" paragraphs throughout to aid the user when needed during the analysis (see Figure 6.10 below).

Figure 6.12 *Example of "Explanation Text" provided in the Decision Tool*

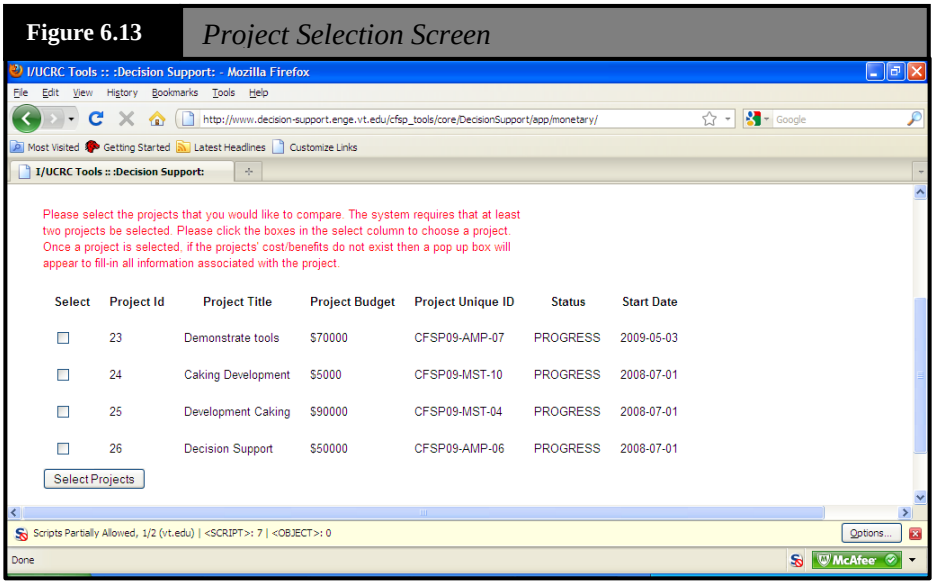
In the Rank & Order the user ranks the project attributes from the most important to the least important and then the tool evaluates each project to be evaluated according to the ranked order of the attributes. (Projects are evaluated on the first attribute, first , and if there are equivalent values between projects on that attribute, the second attribute is then considered.) If the user does not specify an order for the projects, a default order is used based on the previous user's rank order entries.

6.5 Using the Decision Tools

6.5.1 Project Selection

The procedure for selecting projects is common to all of the tool options. Upon selection of "Decision Support" from the main menu and selection of an appropriate analysis method (monetary, rank & order, or utility), the user is presented with a list of projects that have been loaded into the system (see Figure 6.11 below).

Figure 6.13 *Project Selection Screen*

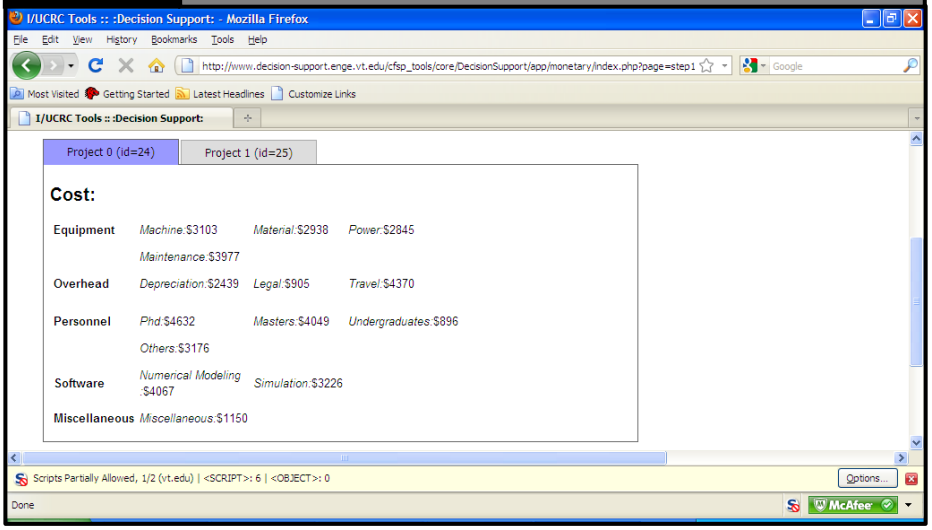


The user must select at least two projects for comparison. The program then confirms these selections and provides general

information about the projects such as the project title, budget, status, and start date.

Upon completion of this step, for all analysis methods, the user is presented with the cost data that already exists in the database for each project under consideration (see figure below). The user may examine the project cost values under the general headings of equipment, overhead, personnel, software, and miscellaneous. The screens following the review of the cost data are unique to each of the different analysis methods and are discussed in the sections that follow.

Figure 6.14 *Project Cost Data Screen*

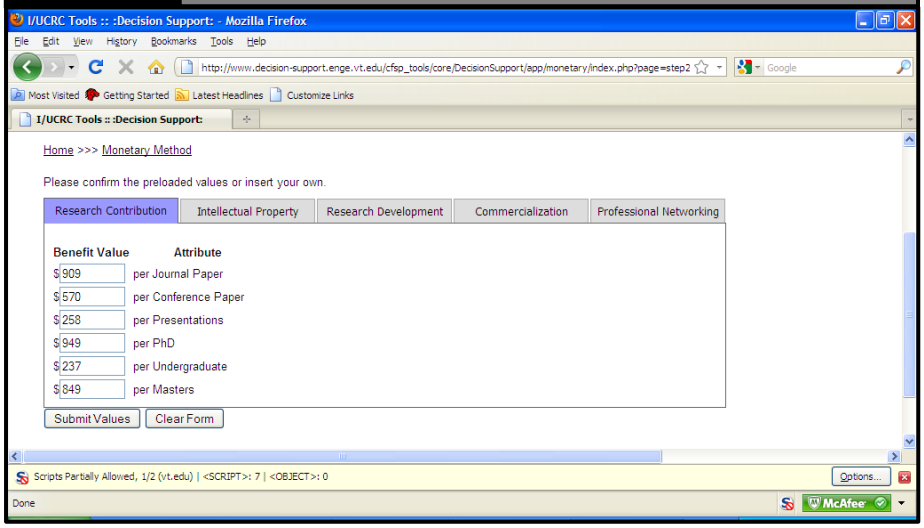


6.5.2 Using the Monetary Method

In the monetary method, the user converts the attributes of a project into a common monetary value (US Dollars) in order to allow a common basis for comparison between projects. After the projects have been selected and the cost information already available in the database for each project is presented (see section 6.5.1), the user is prompted to enter monetary values for all of the benefit areas associated with the projects under consideration. The benefit areas under consideration are Research Contributions, Intellectual Property, Research & Development, Commercialization, and Professional Networking. In each of

these top level headings, the user enters values (in US dollars) for particular attributes. For example under Research Contributions, we may value a Journal Paper at $909 per paper for this analysis (see Figure 6.13 below). The user enters monetary values for each of the attributes under the principal headings prior to advancing to the next stage of analysis.

Figure 6.15 *Monetary Method Screen*

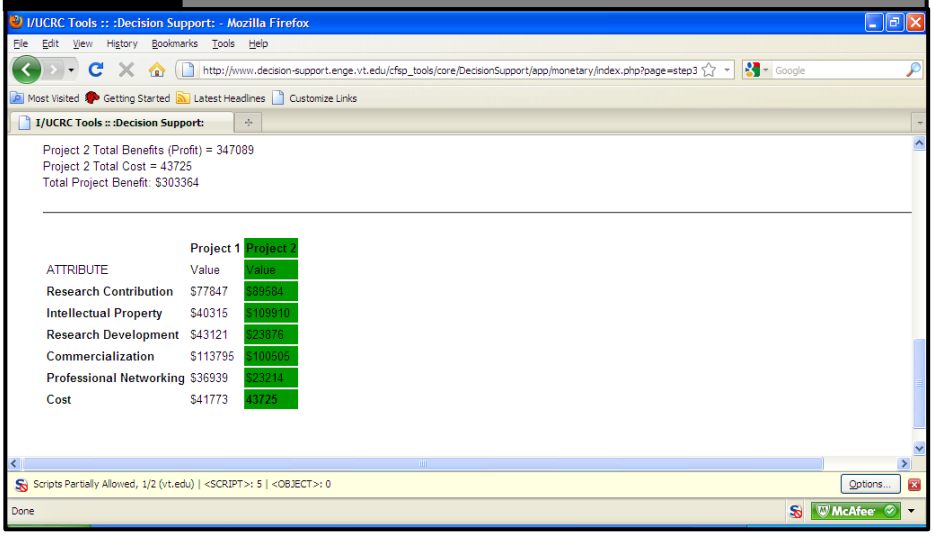


Following the input of all of the equivalent monetary values for benefits, the user is presented with a screen that provides a sum-total of the entered monetary values for the five principal benefit categories. The user can elect to continue with the already entered values or modify these inputs if necessary.

The last screen of this analysis option presents the final monetary results of the overall analysis. The user is presented with a summary table illustrating the total costs, total benefits (profit) and total project benefit for each project. The summary table provides the total of monetary values for all of the key attributes for each project under consideration. The project with the highest net value (benefits – cost) is highlighted in green (see figure below).

Upon completion of the monetary analysis, the user may click HOME to clear all selections and start a new analysis.

Figure 6.16 *Final Monetary Method Screen—with most beneficial project highlighted in green*



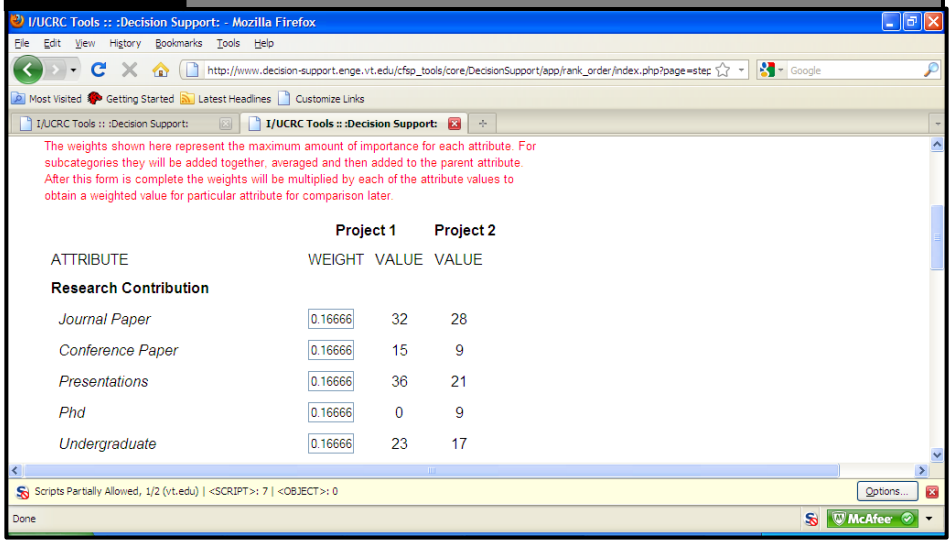
6.5.3 Using the Rank and Order Method

In the rank and order method, the user applies weighting values to various project attributes in order to rank the attributes from the most important to the least important and thus create a ranked order. Projects are compared and a project is recommended based on these rankings.

After the projects have been selected and the cost information already available in the database for each project is presented (see section 6.5.1), the user is prompted to enter weighting values for all of the benefit areas associated with the projects under consideration. The weightings represent the maximum amount of importance for each attribute. The greatest weighting value that can be given to an attribute is 1.0 and the lowest weighting value that can be assigned is 0. These values are stored in the first column while the other columns store the actual values for each attribute (see figure below). In this method, cost is locked in with a weighting of 1.0. As an example, as seen in the figure below, under Project 1, subheading Research Contribution, the Journal Paper attribute has a value of 32 (i.e. thirty-two journal papers were produced on this project) and this attribute also has a weighting of .166666 or 16.6666%. The subcategories such as

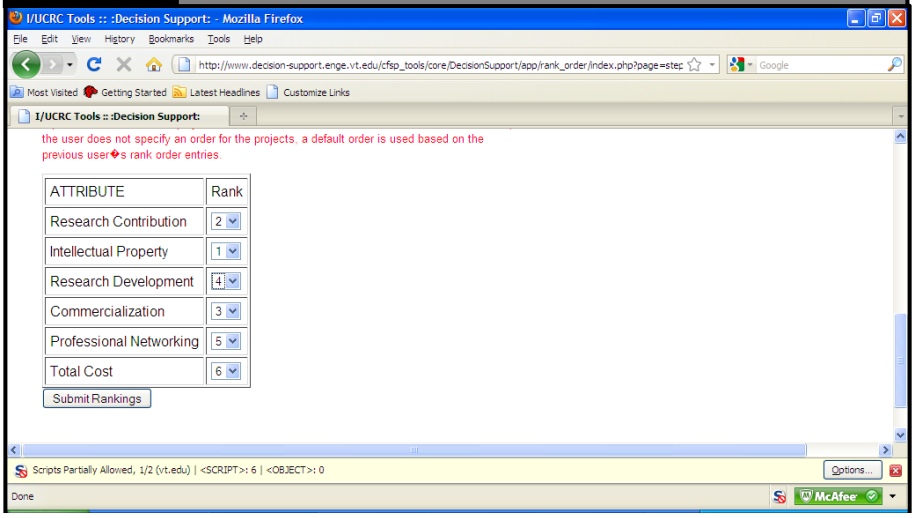
Journal Paper will be added together, averaged and then added to the parent attribute (Research Contribution in this example). After this form is complete, the weights will be multiplied by each of the attribute values to obtain a weighted value for particular attribute.

Figure 6.17 *Attribute Weighting Input Screen*



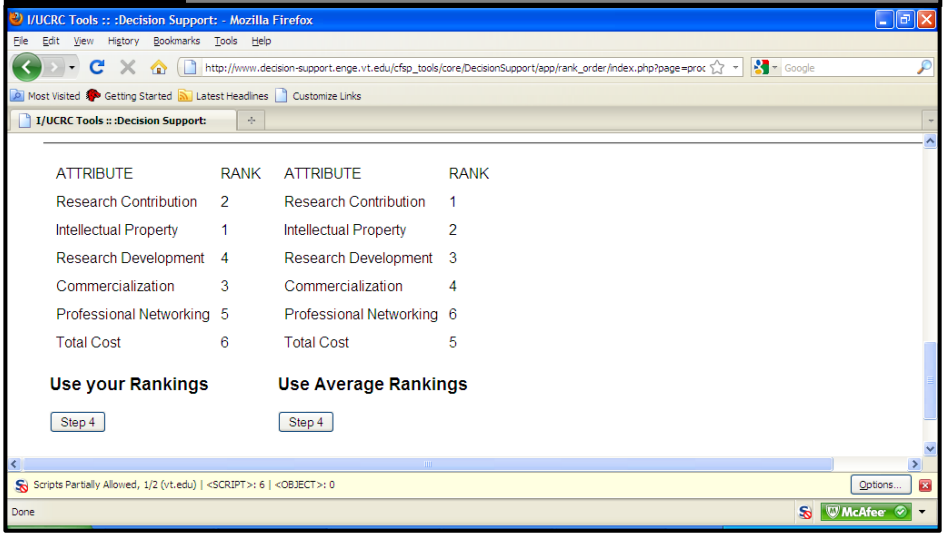
Following the input of the weightings, the entered values are processed and a listing of attribute weightings multiplied by the attribute value and totals of those products for each of the major benefit areas is presented. Continuing with the inputs, the user is then prompted to provide a rank to the five major attribute categories (Research Contributions, Intellectual Property, Research & Development, Commercialization, and Professional Networking) plus cost.

Figure 6.18 *Attribute Ranking Screen*



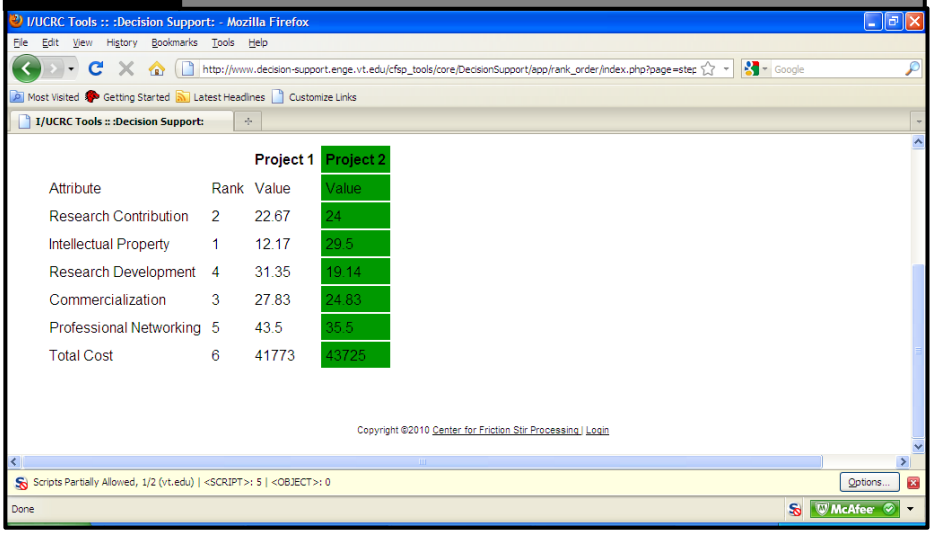
The next page presents the user with a confirmation screen of the previously entered rankings along with the option to select default rankings that are an average of the previously entered rankings (see figure below). The ranking option chosen will used for the final analysis.

Figure 6.19 *Ranking Confirmation & Selection Screen*



The final screen presents the user with a matrix listing all of the project's previously calculated five major attribute category values and cost values along with the chosen ranking order for each of the attributes and cost. The project with the highest total ranking value is highlighted in green (see figure below). Note that projects are evaluated on the first attribute, and, if there are equal values for several projects for that attribute, the second attribute is then considered, and so on. For example, attribute Intellectual Property has the highest rank. Therefore, Project 1 and Project 2 are compared upon Intellectual Property, and Project 2 wins since it has a bigger value for this attribute (29.5 versus 12.17).

Figure 6.20 *Final Rank & Order Analysis Screen—highest ranked project highlighted in green*



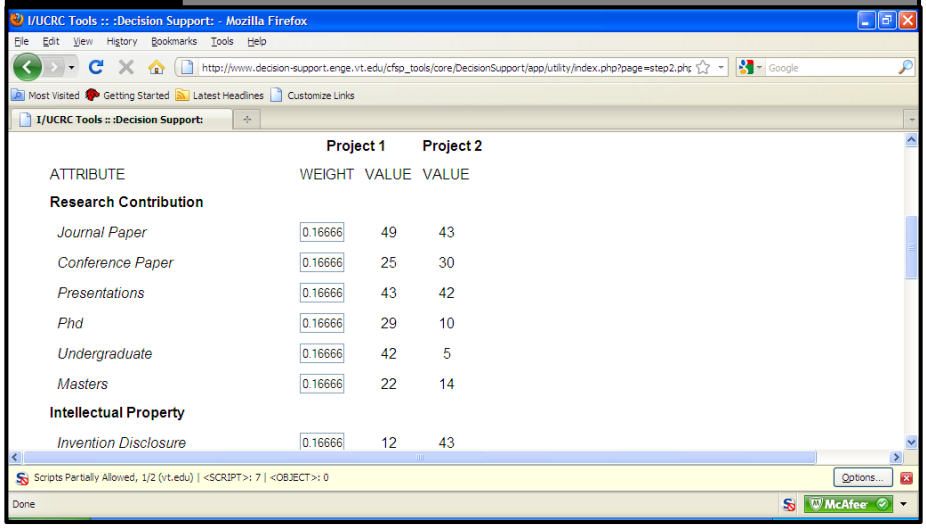
Upon completion of the rank & order analysis, the user may click HOME to clear all selections and start a new analysis.

6.5.4 Using the Utility Method

In the utility method, utility functions are used to compare and select a project. After the projects have been selected and the cost information already available in the database for each project is presented (see section 6.5.1), the user is prompted to enter weighting values for all of the benefit areas associated with the

projects under consideration. This portion of the method is the same as that used in the Rank and Order method. The weightings represent the maximum amount of importance for each attribute. The greatest weighting value that can be given to an attribute is 1.0, and the lowest weighting value that can be assigned is 0. In this method, cost is locked in with a weighting of 1.0. The weighting values are stored in the first column, while the other columns store the actual values for each attribute. For example, in the figure below, under Project 1, subheading Research Contribution, the Journal Paper attribute has a value of 49 (i.e. forty-nine journal papers were produced on this project) and this attribute has a weighting of .166666 or 16.6666%. The subcategories such as Journal Paper will be added together, averaged and then added to the parent attribute (Research Contribution in this example). After this form is complete, the weightings will be multiplied by each of the attribute values to obtain a weighted value for a particular attribute that will be used later in the comparison.

Figure 6.21 *Attribute Weighting Input Screen*

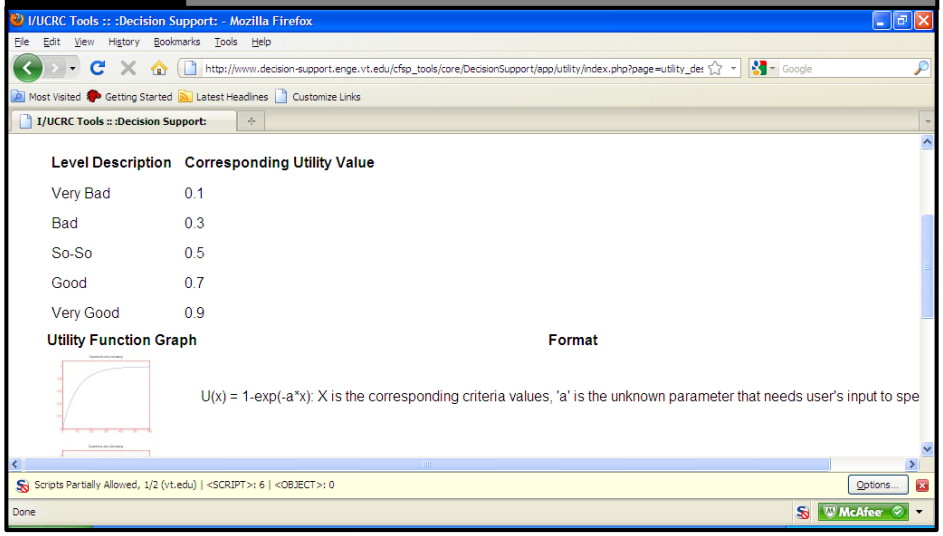


Following the input of the weightings, the entered values are processed and a listing of attribute weightings multiplied by the attribute value and totals of those products for each of the major benefit areas is presented. The user has the option to either accept

the presented values and proceed with the analysis or go back and modify the weighting inputs.

The next screen provides the user with background on the utility function equations. Linear and exponential utility functions are defined, and the values that the user will need to specify for each attribute are given.

Figure 6.22 *Screen capture of the Utility Function description*



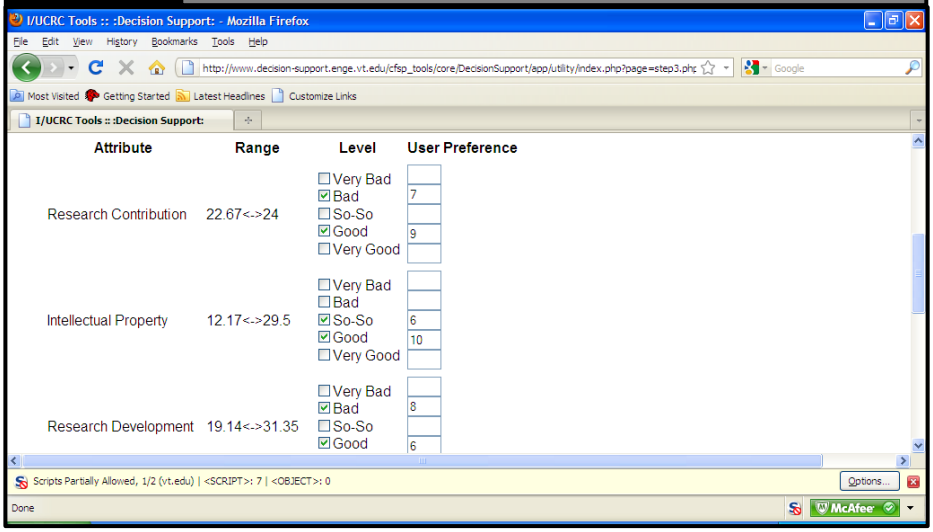
The next screen allows the user to select the actual utility preferences to associate with each attribute. The value range of corresponding attribute is listed in the column entitled Range for user's reference. For each attribute, the user can select a satisfaction level and enter a value that corresponds to it. The user specifies a satisfaction level for each of these values, such as very bad (0.1), bad (0.2), so-so (0.5), good (0.7), very good (0.9). The *a* value in the utility function equation is specified by two *x* values for a criteria, and the calculation is conducted on the background.

The values from this utility preference screen are then used to calculate the utility functions, and these are presented to the user prior to the final presentation of analysis results.

The final screen presents the results of the comparison between projects using the utility function determined previously and highlights the project with the highest utility function value in green. The data is presented in matrix format with the value of the

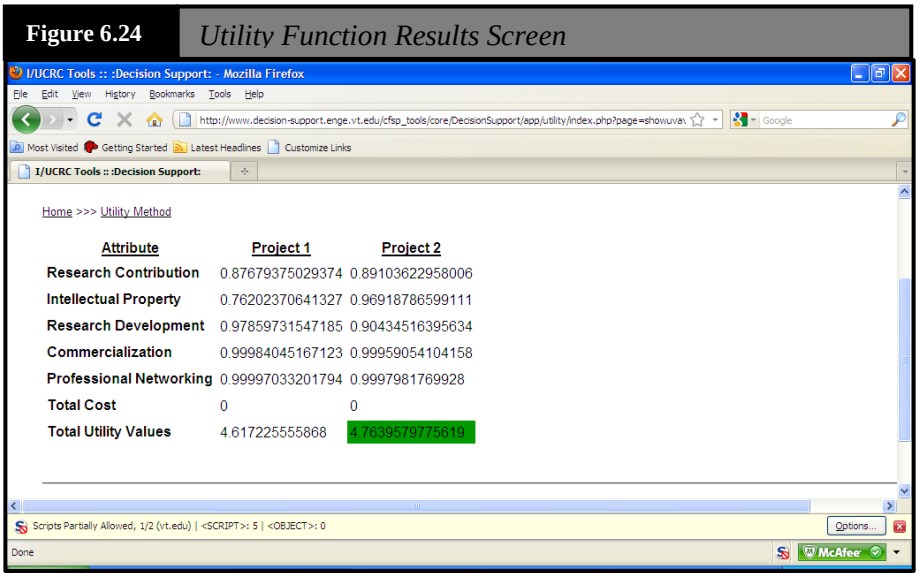
utility function for each of the five major attribute categories plus cost.

Figure 6.23 *Utility Preference Input Screen*



Upon completion of the utility analysis, the user may click HOME to clear all selections and start a new analysis.

Figure 6.24 *Utility Function Results Screen*



Appendix A – CFSP MEMBERSHIP AGREEMENT

Center for Friction Stir Processing

NSF Industry/University Cooperative Research Center

This Agreement is made this ____ day of _____, 20__ by and between the University Consortium (hereinafter referred to as CONSORTIUM) comprising and acting through the following UNIVERSITY AFFILIATES:

- South Dakota School of Mines and Technology, Rapid City SD
- Brigham Young University, Provo UT
- University of South Carolina Research Foundation, Columbia SC
- Missouri University of Science and Technology, Rolla MO, and
- Wichita State University, Wichita, KS

And _____ (hereinafter called "COMPANY").

WHEREAS, the parties to this Agreement intend to join together in a cooperative effort to support an Industry/University Cooperative Research Center for Friction Stir Processing (hereinafter called "CENTER") by the CONSORTIUM to maintain a mechanism whereby the university environment can be used to perform research to advance, develop and promote research into the principles and technology of Friction Stir Processing science and engineering through research, development, education, and technology exchange among academic, industry, and government entities.

The parties hereby agree to the following terms and conditions:

A. CENTER will be operated by certain faculty, staff and students at the UNIVERSITY AFFILIATE level. For the first five years, the CENTER will be supported jointly by industrial firms, Federal laboratories, the National Science Foundation (NSF), and the UNIVERSITY AFFILIATES.
The Center Director will be:
Mr. William Arbegast, South Dakota School of Mines and Technology
The CONSORTIUM AFFILIATE Directors and Principal Investigators will be:
Dr. Tracy W. Nelson, Brigham Young University
Dr. Anthony Reynolds, University of South Carolina Research Foundation
Dr. Rajiv Mishra, Missouri University of Science and Technology
Dr. Michael West, South Dakota School of Mines and Technology
Dr. Dwight Buford, Wichita State University

B. Any COMPANY, Federal Research and Development organization, or any Government-owned Contractor Operated laboratory may become a sponsor of the CENTER, consistent with applicable state and federal laws and statutes. Federal Research and Development organizations and Government-owned Contractor Operated laboratories may become sponsors of the CENTER with greater rights than those specified in this agreement only upon unanimous approval by the CONSORTIUM and

upon approval of two-thirds of the Industrial Advisory Board (as defined in Section E. below). The COMPANY shall designate a UNIVERSITY AFFILIATE as its principal point of contact.

C. COMPANY agrees to contribute the annual membership fee in support of the CENTER as described in Article III of the Center bylaws, and thereby becomes a member. Payment of these membership fees shall be made as a lump sum of $_____ effective _____; or in four equal quarterly installments of $_____ on _____, _____, _____ and _____ of each year of sponsorship. Checks from COMPANY should be mailed to the UNIVERSITY AFFILIATE Site Director and made payable to the UNIVERSITY AFFILIATE. Arrangements for providing approved In-kind fees should be made between COMPANY and UNIVERSITY AFFILIATE. Because research of the type to be done by the CENTER takes time and research results may not be obvious immediately, COMPANY should join CENTER with the intention of remaining a fee-paying member for at least three years. However, COMPANY may terminate this Agreement by giving the UNIVERSITY AFFILIATE 90 day written notice prior to the termination date.

The results of CENTER research will be made equally available to all sponsoring COMPANIES. Ownership of patents and copyrights that result from CENTER research will remain with the UNIVERSITY AFFILIATE that generated the patent or copyright rights, as per the terms of this Agreement.

D. The organization and operation of the CENTER will be specified by CENTER bylaws that will be adopted at the first Industrial Advisory Board meeting. The bylaws, when adopted, will become part of this Agreement.

E. There will be an Industrial Advisory Board composed of one representative from each COMPANY member. The Advisory Board will meet twice annually and the CONSORTIUM will report its research results and make recommendations for future work. This board will make recommendations on (a) the research projects to be carried out by the CENTER (b) the apportionment of resources to these research projects, and (c) changes in the bylaws. The operation of this board is specified in the bylaws.

F. The CONSORTIUM reserves the right to publish in scientific or engineering journals and/or present in professional meetings the results of any research performed by CENTER. The UNIVERSITY AFFILIATE will submit any proposed publication or presentation to each COMPANY, containing results of the research program of the CENTER. COMPANY shall have the right to request a delay in publication for a period not exceeding ninety (90) days from the date of submission to COMPANY, for proprietary reasons, provided that COMPANY makes a written request and justification for such delay within thirty (30) days from the date the proposed publication or presentation is submitted by certified mail to COMPANY.

G. All patents derived from inventions conceived or first actually reduced to practice in the course of research conducted by a UNIVERSITY AFFILIATE shall belong to the UNIVERSITY AFFILIATE that generated the invention(s). Said UNIVERSITY AFFILIATE pursuant to chapter 18 of title 35 of the United States Code, commonly called the Bayh-Dole Act, will have ownership of all patents developed from this work, subject to "march-in" rights as set forth in this Act. COMPANIES that wish to exercise rights to a royalty-free nonexclusive license agree to pay their respective portion of the

costs associated with application for and maintenance of the patent. CONSORTIUM agrees that all such CENTER sponsors in good standing at the time of disclosure are entitled to said nonexclusive royalty-free license. COMPANY will have the right to sublicense the intellectual property of the patents to its subsidiaries and affiliates but will not have the right to sublicense other entities. If only one COMPANY seeks a license, that COMPANY may obtain an exclusive, fee-bearing license from the UNIVERSITY AFFILIATE that owns the patent rights.

H. Copyright registration and ownership shall be obtained by the UNIVERSITY AFFILIATES having ownership of software developed through the CENTER. The UNIVERSITY AFFILIATE will grant COMPANIES that are CENTER sponsors in good standing at the time of disclosure and request a license, a royalty-free nonexclusive license. COMPANY will have the right to sublicense its subsidiaries and affiliates for internal use of the software, but will not have the right to sublicense other entities. COMPANY will have the right to enhance and to re-market enhanced or un-enhanced software provided the COMPANY negotiates in good faith a royalty-bearing license agreement with the UNIVERISTY AFFILIATE, which royalty shall be based on the worth of the initial software and a fair sale price of the enhanced or un-enhanced software product sold or licensed by COMPANY. If only one COMPANY seeks a license, that COMPANY may negotiate an exclusive, royalty-bearing license from the UNIVERSITY AFFILIATE that owns the copyright rights.

I. If no COMPANY desires a license to CENTER patents or software, the UNIVERSITY AFFILIATE that generated the patents or software shall be free to grant fee-bearing licenses to said patents or software to third parties any time after six (6) months following notice to CENTER COMPANIES that the patents or software were available for licensing.

J. If CENTER COMPANIES elect to take nonexclusive licenses to patents or software under Paragraphs G or H, the UNIVERSITY AFFILIATE that generated the patents or software shall be free to grant royalty-bearing, nonexclusive licenses to third parties any time after twelve (12) months following notice to CENTER COMPANIES that the patents or software are available for licensing.

K. Any revenues received by a UNIVERSITY AFFILIATE shall be distributed according to the policy of said UNIVERSITY AFFILIATE.

L. No party is assuming any liability for the actions or omissions of any other party as a result of this Agreement. COMPANY will indemnify and hold UNIVERSITY AFFILIATES harmless against all claims, liability, injury, damages or costs, including reasonable attorney fees, based upon injury or death to persons, or loss of, damage to, or loss of use or property that arises out of the performance of this Agreement to the extent that such claims, liability, damage, cost or expense results from the negligence of the COMPANY's agents or employees.

UNIVERSITY AFFILIATE		COMPANY	
Name	_____	Name	_____
Title	_____	Title	_____
Signature	_____	Signature	_____
Date	_____	Date	_____
For	_____	For	_____
	UNIVERSITY AFFILIATE		COMPANY

Appendix B – CFSP CENTER BYLAWS

National Science Foundation
Industry/University Cooperative Research Center

Center for Friction Stir Processing (CFSP)
South Dakota School of Mines and Technology, Lead University

ARTICLE I – INTRODUCTION

1.1 The following Bylaws will be used to govern the Friction Stir Processing Industry/University Cooperative Research Center (FSP I/UCRC).

1.2 The Bylaws can be amended at any time by an affirmative vote of two thirds of the members of the Industrial Advisory Board (IAB).

1.3 The FSP I/UCRC are a university consortium comprised of the following affiliated sites/participating universities:

South Dakota School of Mines and Technology, Rapid City SD (Lead University)
Brigham Young University, Provo UT (Affiliate University)
University of South Carolina, Columbia SC (Affiliate University)
Missouri University of Science and Technology, Rolla MO (Affiliate University)
Wichita State University, Wichita KS (Affiliate University)

1.4 These Bylaws form a part of the Membership Agreement with participating Sponsors. If there are any inconsistencies between the Bylaws and the Membership Agreement, the terms and conditions outlined in the Membership Agreement takes precedence over the Bylaws provided the inconsistent terms of the Membership Agreement have been approved by the Center Director, the Site Directors, and two thirds of the IAB representatives.

ARTICLE II – PURPOSE

Vision Statement

2.1 The FSP I/UCRC is designed to provide a forum for industry/university cooperative research on the development and validation of emerging technologies involving solid-state materials joining and processing known as Friction Stir Processing.

Mission Statement

2.2 The mission of the FSP I/UCRC is:

To advance, develop and promote research into the principles and technology of friction stir processing science and engineering through research, development, education, and technology exchange among academic, industry, and government entities;

To increase the quantity and quality of professionals prepared to work in this area;

To involve the faculty of the Consortium University(s) in research in areas of

common interest to Sponsors and the University(s);

To perform research that will promote the global competitiveness of Sponsor friction stir processing facilities.

Research Focus

2.3 FSP I/UCRC research topics will be focused on the needs of the Sponsors and the capabilities of the university(s). Areas of research will include:

- Friction Stir Joining
- Friction Stir Microstructural Modification
- Friction Stir Post-Processing
- Friction Stir Structural Designs and Applications
- Friction Stir Intelligent Controllers and Efficient Tooling
- Friction Stir Cost Benefits Analysis

ARTICLE III – SPONSORSHIP

3.1 The FSP I/UCRC sponsorship (membership) fees are $35,000 per year for the first five years and will be used to support Center research.

3.2 A Company, Corporation, or Organization may support the Center with two or more sponsorships at $30,000 for each additional sponsorship.

3.3 A participating university that receives and uses sponsorship (membership) fees will provide a 25% cost share match in connection with the sponsor's cash fees to support Center research in accordance with the requirements of the National Science Foundation I/UCRC Program Solicitation NSF01116.

3.4 An "In-Kind" sponsorship (membership) is possible upon approval by the Center Director, all University Site Directors, and two thirds of the IAB. A member Organization that provides "In-Kind" membership fees in lieu of cash payments will provide a listing of categorized items to be considered as its "In-Kind" support for approval.

3.5 All Sponsors (members) will sign the same Membership Agreement unless otherwise approved by the Center Director, all University Site Directors, and two thirds of the representatives of the IAB.

ARTICLE IV – ORGANIZATION

4.1 Although individual Sponsors of the Center join the Center through one of the University Sites, there is only one IAB for the Center. The IAB will select a Chairperson for a two-year term at the Inaugural IAB meeting on October 6-7, 2004 and no less than every two years thereafter.

4.2 Sponsors paying membership fees and the Sponsors providing "In-Kind" sponsorship will have one representative on the IAB. An Organization may have more than one Center sponsor and will be entitled to have one voting representative on the IAB for every paid up sponsorship.

4.3 All Sponsors will participate in the strategic planning of the Center. The IAB will assist the participating faculty in identifying pre-competitive, generic, industry-related, research problems in friction stir welding and processing; recommend research projects for future work; assist in identifying appropriate industrial internship opportunities for graduate students and postdoctoral students; assist

the Center Director and Site Directors in identifying new sponsors; review the research and educational accomplishments of the Center; and recommend restructuring and/or redirecting of on-going programs to meet IAB needs and concerns..

4.4 The Center Director will be responsible for all Center activities and will report directly to the Vice President for Research at the South Dakota School of Mines and Technology and the IAB. The FSP I/UCRC Center Director will be Mr. William Arbegast, South Dakota School of Mines and Technology. In the event Mr. Arbegast is unable to serve, the Vice President for Research at the South Dakota School of Mines and Technology will appoint a successor FSP I/UCRC Center Director subject to confirmation by the members of the university consortium.

4.5 The Site Directors at the Lead and Affiliated Universities will be responsible for Center activities at their university and will report directly to their respective appropriate university administrators and to the Center Director. The Site Directors will provide liaison between the Center and the appropriate academic departments of the member universities.

4.6 Site Principal Investigators will manage specific research projects funded by the Center and will report directly to the appropriate Site Director, the appropriate university administrators, and to the Sponsors supporting the project.

4.7 The FSP I/UCRC Site Directors and Principal Investigators will be:

Dr. Michael West, South Dakota School of Mines and Technology
Dr. Tracy W. Nelson, Brigham Young University
Dr. Anthony Reynolds, University of South Carolina
Dr. Rajiv Mishra, Missouri University of Science and Technology
Dr. Dwight Burford, Wichita State University

If a Site Director/Principal Investigator is unable to serve, the participating university will appoint a successor director and principal investigator subject to confirmation by the other members of the university consortium.

4.8 A Center External Evaluator, appointed by the National Science Foundation, will assist the Center Director, Site Directors, and the Industrial Advisory Board to organize the Center and provide an independent assessment of the operation. The Center External Evaluator will report directly to the I/UCRC Program Manager at the National Science Foundation. Travel expenses for the Center External Evaluator will be paid by the participating universities from I/UCRC sources and shall be limited to travel to the IAB meetings and one program review trip to each participating university per calendar year. The participating university hosting the IAB meeting will incur the cost of the Center External Evaluator travel expenses for that meeting.

4.9 University Policy Committee: The Center will form a multi-university administrative oversight and policy committee consisting of the Vice President or Provost of Research (or his/her designee) at each university to resolve any and all Center administrative issues, including review of academic standards, recruitment strategies, retention issues, funding issues, space requirements, and equipment requirements related to the Center. This committee will assure faculty recognition for participation in the Center in tenure and promotion decisions, and

to assure that the research is appropriate for graduate education.

4.10 Administrative Support Staff: The Lead University and each Participating University will provide a reasonable level of clerical and accounting support for the operation of the Center.

ARTICLE V – ADMINISTRATION

5.1 The Center Director and Site Directors will work with the Industrial Advisory Board on strategic plans for the Center and on recruiting new Sponsors.

5.2 The Center Director in cooperation with the Site Directors will submit an annual operating and research budget to the IAB for review and recommendations. This will be available for review prior to the Spring IAB Meeting each year.

5.3 The Site Directors, upon recommendation of the Industrial Advisory Board and the Center Director, will authorize the use of membership fees by the Project Principal Investigators in support of Center research.

5.4 The Site Directors will work with the appropriate departments on recruiting graduate students for the Center and will set standards for student participation; monitor student progress towards a degree; set goals for recruiting students (especially minority and women); promote multidisciplinary nature of the research program; and, help students to organize industrial internships. The Site Director will develop a strategy to integrate the technologies of this I/UCRC into the academic curriculum at each participating university to the maximum extent possible.

5.5 Each FSP I/UCRC graduate student will have a Center faculty mentor and, if available, at least one Center industrial advisor. The faculty mentor is responsible for advising the student on university, departmental, and Center policies.

ARTICLE VI – REPORTS

6.1 The Center Director shall provide a semiannual report to the Sponsors and to the National Science Foundation.

6.2 The Site Directors/Principal Investigator shall provide interim reports to the Center Director and to the Sponsors as necessary at the completion of major research tasks. These interim reports will be distributed via the Center web site and email notification to all sponsors once posted.

6.3 All administrative issues, concerns, or conflicts regarding the activities of research and reporting are responsibilities of the Center Director.

ARTICLE VII – MEETINGS

7.1 The Center Director, Site Directors and the IAB Chairperson will establish the schedule of activities and meetings for the Center as well as the agenda for the semiannual research review meetings.

7.2 The participating universities and IAB Members for the FSP I/UCRC will meet twice a year (spring and fall). The participating universities will host the Spring Center meeting on a rotating basis with the date and location determined at the previous IAB meeting.

7.3 The IAB will meet twice a year to review research results, select projects, review budgets, and discuss the strategic plans for the Center. The IAB review meetings

will coincide with the semiannual FSP I/UCRC center meetings. A Sponsor may send more than one representative to the IAB meetings, but may only vote on center matters corresponding to the number of memberships they possess.

7.4 The University Policy Committee will meet as necessary during the annual Center Meeting to discuss and resolve Center program and management issues.

ARTICLE VIII – RESEARCH PROJECT SELECTION PROCEDURE

8.1 An algorithm for selecting projects will be developed and adopted by the members of the Industrial Advisory Board.

8.2 During the start-up period of the Center (September 2004 to August 2005), commitment of membership fees to Project Principal Investigators will be made as first-year membership fee Sponsors join the Center. The Center Director, Site Directors, and the IAB will jointly approve first-year start-up projects in support of the Center mission with special consideration given to first year sponsor research needs. This interim provision will be replaced by a strategy described below as amended and approved by the Industrial Advisory Board.

8.3 An FSP I/UCRC research project will usually require two or more industrial sponsors. Therefore, membership fees from several Sponsors may be used to support individual projects of common interest to the Sponsors. The FSP I/UCRC research projects will be conducted by students (undergraduate, graduate, and/or postdoctoral) at one or more of the Participating Universities.

8.4 All Center Members (Sponsors) may participate in the selection and evaluation of research projects. Individual organizations may acquire multiple memberships, and therefore will have a corresponding number of Center memberships and voting representatives on the IAB.

8.5 Typically, individual Sponsors will propose general industry-oriented research topics of interest to their organization. A portfolio of relevant research topics will be compiled based on the interest of the Sponsors. These research topics will be posted on the Center web site (restricted) and will form the basis for cooperative discussions among the faculty and the industrial members. Each participating university will develop a set of pre-proposals consistent with the goals of their group, the interest of the Sponsors, and the mission of the Center. The pre-proposals will be posted on the Center web site prior to the Fall IAB meeting. At the research review meeting, faculty/student teams will discuss their proposals with IAB Members.

8.6 Sponsors will have an opportunity to fund one or more projects at different universities or at the same university. Members of the IAB will recommend funding of projects and will cooperate with the Center Director to establish an annual budget for each project.

ARTICLE IX – PUBLICITY

9.1 A Sponsor shall not use the name of any University in the Consortium in any publicity, advertising or news release without the prior written approval of an authorized representative of the affected University. Likewise, no Consortium University may use the name of a Sponsor in any publicity without the prior written approval of the Sponsor. Press releases will be coordinated between the

Center Director and participating university press office. Notwithstanding the forgoing the parties may satisfy any reporting requirements of their respective organizations.

9.2 Subject to the recommendations of the IAB, the Center Director shall post the descriptions of all FSP I/UCRC research projects on the Center web site. The descriptions shall not contain confidential or proprietary information and may be published freely.

ARTICLE X – PUBLICATIONS

10.1 Researchers engaged in FSP I/UCRC research shall be permitted to disclose the methods and results of their research after a review by the Sponsors for proprietary materials as outlined in the Membership Agreement.

10.2 At any time a Site Director may request permission to publish Center information presented in summaries, semiannual reports, annual reports, or final reports; or arising out of or resulting from research projects; in the form of abstracts, presentations, or manuscripts. To receive permission, the Site Director shall submit to the Center Director a "Request for Permission to Publish" containing the information to be published in the form in which publication will be sought. The Center Director shall submit the Request to the Sponsors by sending the Request to the primary contact for each Sponsor with read receipt requested, as well as posting the Request to the Center website. Such information may be published in a substantial form (as submitted with the Request) if within thirty (30) days after the receipt of the Request from the Center Director, the Sponsor has not objected in writing to the Center Director to the publication of such information. The Sponsor may object if the publication contains patentable subject matter that requires protection and/or the publication contains Sponsor's confidential information. In such cases, publication will be delayed ninety (90) days to allow for patent applications to be filed or confidential information to be removed. It is understood that in no case can this provision for delay of publication cause an unreasonable delay in the normal academic progress of a graduate student of participating University with respect to preparation and submission of a graduate thesis or dissertation.

10.3 Any confidential information provided by Sponsors to a Project Principal Investigator or other members of the Center shall be provided under the protection of an independent confidentiality agreement between the Sponsor and the appropriate university.

ARTICLE XI – BENEFITS

11.1 All Sponsors will have non-exclusive rights to the entire FSP I/UCRC research portfolio under the conditions outlined in the Membership Agreement.

11.2 All Sponsors will have an opportunity to directly contribute to FSP I/UCRC research and education programs by serving as industrial mentors and/or thesis committee members as appropriate and consistent with the policies and procedures of participating Universities.

11.3 All Sponsors will have an opportunity to propose case study problems, specific research problems, and focus areas for research. The case study problems will be used to train FSP I/UCRC students on the use of current FSP technologies.

11.4 All Sponsors will have an opportunity to host postdoctoral research associates and/or graduate students as industrial interns.

11.5 Technology transfer between the faculty/student research teams and Sponsors will be promoted by:

- Pre-doctoral and post-doctoral industrial internships;
- The direct involvement of the industrial advisor on the research team;
- Web based submission of reports; and,
- Semiannual research retreats.

11.6 Each Sponsor that joins the Center by paying a cash membership fee will vote on the selection of research projects supported by membership fees.

11.7 Each Sponsor that joins the Center on an approved In-Kind basis will vote on the selection of research projects funded by membership fees if approved by two-thirds of the cash paying membership. In-Kind Sponsors will otherwise vote on all other Center matters and will participate in the evaluation and discussion of research projects.

ARTICLE XII – NEW UNIVERSITY AFFILIATES AND INDUSTRIAL SPONSORS

12.1 From time to time, new universities may request membership into the FSP I/UCRC as an affiliated site. Each new university requesting membership shall initially obtain concurrence from the Center Director, Site Directors, the I/UCRC Program Manager at the National Science Foundation prior to submitting a "Letter of Intent" to join to the FSP I/UCRC. These new universities requesting membership as an affiliated site must demonstrate their ability to perform synergistic research within the focused research areas of the Center and their willingness to work within the structure, policies and procedures of the FSP I/UCRC. Upon concurrence by the Center, the new university requesting membership as an affiliated site may continue application per the applicable procedures of the current National Science Foundation I/UCRC program solicitation.

12.2 A new university requesting membership into the FSP I/UCRC shall review their research objectives and program plans, and, obtain and submit within their Planning Grant Proposal a "Letter of Support" from the Site Director at each of the current Center university members.

12.3 From time to time, new Companies, Corporations, or Organizations may request, or be requested, to join a university affiliated site of the FSP I/UCRC as a Sponsor (member). These new Companies, Corporations, or Organizations may join the FSP I/UCRC upon signature of the existing consortium Membership Agreement, acceptance of the current Bylaws, and upon payment of the NON-PRORATED annual membership fee. Application of these new membership fees shall be made to existing research programs at the affiliated site unless a new "interim" research program is otherwise approved by the Center Director, Site Directors, and the Chairman of the IAB. Continued funding of the "interim" research program is subject to IAB approval at the next annual IAB meeting under the terms of these Bylaws.

ARTICLE XIII – OUTREACH AND BROADER IMPACTS

13.1 The Center Director and Site Directors at each university will develop a Broader Impacts Plan to ensure that the I/UCRC promotes collaborations within the community through local, regional, national and international participation in the center activities. Teaming arrangements between the participating universities and minority, Native American, and community technical colleges for the purpose of technology transfer and collaborative educational opportunities are to be encouraged. This plan shall include solicitation of National Science Foundation, Sponsor, university, and state funding in support in these broader impact activities.

13.2 The Center Director and Site Directors at each university will develop within the Broader Impacts Plan a strategy to ensure that the I/UCRC promotes collaborations within the community through extensive K-12 involvement. This plan may take the form of technology demonstrations, tours, and student research projects at the K-12 level. This plan will promote development of collaborative educational opportunities for K-12 faculty and students though establishment of summer internship programs at the I/UCRC. This plan shall include solicitation of National Science Foundation, Sponsor, university, and state funding in support in these broader impact activities.

Appendix C – SDSMT MUTUAL NON-DISCLOSURE AGREEMENT

This non-disclosure agreement ("Agreement") is between the South Dakota School of Mines & Technology, a South Dakota Public University, having an address at 501 East St. Joseph St., Rapid City, SD 57701 ("SDSMT"), and _____ ("Company"), a _____ corporation having a business address at _____

RECITALS

A. SDSMT and Company wish to exchange certain confidential information pertaining to advanced materials processing and joining including all communication of information between the parties in any form whatsoever, including oral, written, and machine readable, pertaining to metals processing and joining ("Confidential Information").

B. SDSMT and Company wish to exchange Confidential Information for the sole purpose of furthering a potential business relationship between them related to the joint development of advanced metals processing and joining technologies and each party desires to protect such Confidential Information from unauthorized disclosure or use.

C. SDSMT and Company are each willing to disclose Confidential Information (as the "Owning Party") and receive Confidential Information (as the "Receiving Party") on the terms and conditions set forth herein.

AGREEMENTS

Therefore, SDSMT and Company in consideration of the mutual promises and covenants contained in this Agreement intending to be legally bound thereby, agree as follows:

1. The Receiving Party shall:

a. (i) Not disclose Confidential Information of the Owning Party to any other person and (ii) use at least the same degree of care to maintain the Confidential Information confidential as the Receiving Party uses in maintaining as confidential its own confidential information, but always with at least a reasonable degree of care.

b. Use the Information only for joint activities in the development of advanced metals processing and joining technologies.

c. Restrict disclosure of the Confidential Information of the Owning Party solely to those employees or students of the Receiving Party having a need to know such Confidential Information in order to accomplish the purpose stated above.

d. Advise each such employee or student, before he or she receives access to the Confidential Information, of the obligations of the Receiving Party under this Agreement, and require each such employee or employee to maintain those obligations.

e. Within fifteen (15) days following a request to return any Confidential Information of the Owning Party, to return to the Owning Party all documentation, copies, notes, diagrams, computer memory media and other materials containing any portion of the Confidential Information, or confirm to the Owning Party, in writing, the destruction of such materials.

2. This Agreement imposes no obligation on the Receiving Party with respect to any portion of the Confidential Information received from the Owning Party which (a) was known to the Receiving Party prior to disclosure by the Owning Party, as demonstrated by files in existence at the time of disclosure, (b) is lawfully obtained by the Receiving Party from a third party under no obligation of confidentiality, (c) is or becomes generally known or publicly available other than by unauthorized disclosure, (d) is independently developed by the Receiving Party or (e) is disclosed by the Owning Party to a third party without a duty of confidentiality on the third party.

3. This Agreement imposes no obligation on the Receiving Party with respect to any portion of the Confidential Information unless such portion is (a) disclosed in a written document or machine readable media marked "CONFIDENTIAL" at the time of disclosure or (b) disclosed in any other manner and summarized in a memorandum mailed to the Receiving Party within thirty (30) days of the disclosure. Confidential Information disclosed by the Owning Party in a written document or machine readable media and marked "CONFIDENTIAL".

4. The Confidential Information shall remain the sole property of the Owning Party.

5. NEITHER OWNING PARTY MAKES ANY REPRESENTATION WITH RESPECT TO AND DOES NOT WARRANT ANY INFORMATION PROVIDED UNDER THIS AGREEMENT, BUT SHALL FURNISH SUCH IN GOOD FAITH. WITHOUT RESTRICTING THE GENERALITY OF THE FOREGOING, NEITHER OWNING PARTY MAKES ANY REPRESENTATIONS OR WARRANTIES, WHETHER WRITTEN NOR ORAL, STATUTORY, EXPRESS OR IMPLIED WITH RESPECT TO THE INFORMATION WHICH MAY BE PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. NEITHER OWNING PARTY SHALL BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY NATURE WHATSOEVER RESULTING FROM RECEIPT OR USE OF THE INFORMATION BY THE RECEIVING PARTY.

6. In the event of a breach or threatened breach or intended breach of this Agreement by either party, the other party, in addition to any other rights and remedies available to it at law or in equity, shall be entitled to preliminary and final injunctions, enjoining and restraining such breach or threatened breach or intended breach.

7. The Receiving Party will not export, directly or indirectly, any technical data acquired from the Owning Party or any product utilizing any such data to any country for which the U.S. Government or any agency thereof at the time of export requires an export license or other governmental approval, without first obtaining such license or approval.

8. The rights and obligations of the parties under this Agreement may not be sold, assigned, or otherwise transferred.

9. The parties under this Agreement are independent contractors, and nothing contained in this Agreement shall be construed to constitute the Owner and Recipient as partners, joint ventures, co-owners or otherwise as participants in a joint or common undertaking.

This Agreement is binding upon both parties and upon the directors, officers, employees, and agents of each. This Agreement is effective as of the later date of execution and will continue for three years, unless terminated on thirty (30) days written notice by either party. However, the Receiving Party's obligations of confidentiality and restrictions on use of the Confidential Information disclosed by the Owning Party shall survive termination of this Agreement for a period ending five years after the later date of execution.

Name: _____

Title: _____

Signature: _____

Date: _____

South Dakota School of Mines & Technology

Name: _____

Title: _____

Signature: _____

Date: _____

(COMPANY) _____

Appendix D – CSFP PERSONAL NONDISCLOSURE AGREEMENT

Center for Friction Stir Processing

The undersigned, in consideration of the opportunity to attend a meeting of the Center for Friction Stir Processing (hereafter referred to as "Center") hereby agrees as follows:

1. I understand that during the meeting of the Center, I will see presentations, handouts, and posters, and hear and participate in discussions concerning research conducted by the Center.

2. I understand that the Center considers this intellectual property confidential. I will not, without the express written consent of the Center: (1) disclose or publish any part of such information to others for a period of five (5) years from receiving the information; or (2) make any use of such information, outside of Center activities, for a period of five (5) years. However, I further understand that I shall not be prevented from disclosing information when I can establish, by competent evidence, that such information:

   a. Was already known to me at the time of this meeting; or

   b. Was available to the public or otherwise was part of the public domain at the time of this meeting, or

   c. Became available to the public or otherwise became part of the public domain after the time of this meeting, but other than through my own acts or omissions in violation of this Agreement; or

   d. Was lawfully disclosed to me by a third party subsequent to the time of this meeting.

3. This Agreement is to be governed by and construed according to the laws of the State of South Dakota. I also agree to be subject to the jurisdiction of South Dakota courts in the enforcement of this Agreement.

DATED this _____ day of _____ , 20_____

Full name of the Participant:

Participant's signature:

Home Address:

Witness:

_____

Signature Printed Name

Appendix E – Standardized IAB INVITATION LETTER Format

Center For Friction Stir Processing
"The Win-Win Solution to FSP Technology Development"

CFSP Center for Friction Stir Processing — NSF Awarded August 2004

Center Director:
Mr. William J. Arbegast
Advanced Materials Processing & Joining Center
South Dakota School of Mines and Technology
Rapid City, SD 57701
605-394-6924

Dr. Anil Patnaik
Department of Civil and Environmental Engineering
South Dakota School of Mines and Technology
Rapid City, SD 57701
605-394-2442

UNIVERSITY OF SOUTH CAROLINA
Dr. Anthony P. Reynolds
Department of Mechanical Engineering
University of South Carolina
Columbia, SC 29208
803-777-9548

BYU
Dr. Tracy W. Nelson
Department of Mechanical Engineering
Brigham Young University
Provo, UT 84602
801-422-6233

Dr. Rajiv S. Mishra
Center for Friction Stir Processing
University of Missouri - Rolla
Rolla, MO 65409
573-341-4351

WICHITA STATE UNIVERSITY
Dr. Dwight Burford
National Institute for Aviation Research
Wichita State University
Wichita, KS 67260
316-978-5204

A Global Research Consortium of University, Government, and Industrial Partners Advancing the Science and Technology of Friction Stir Joining and Processing

Dear Center for Friction Stir Processing members,

As you are aware, the spring meeting of the CFSP is fast approaching. It will be held April 24-26 in Rolla, Missouri at the campus of the University of Missouri – Rolla. You should have already received registration instructions. We look forward to seeing you there.

We have received some important feedback from you in previous meetings that has caused us to make some changes in the meeting format and mechanics. First, we have commitments from all the universities to have their presentations available on the CFSP website at least two weeks before the meeting. Please check the site starting Monday, April 2, to find the presentations.

Next, we have added an additional day to the meeting. This day will be a technical conference, rather than a business meeting of the center. Each university site will be responsible for leading a technical discussion on an open topic in Friction Stir Processing. These discussions will last approximately 60 minutes each, and will hopefully lay a foundation for identifying new research topic in FSP. In addition, we are making the opportunity available for member companies to present brief (about 15 minute) presentations on exciting work going on in their companies.

If you would like to make a presentation during the technical conference portion of the meeting, please let me know by Friday, March 30. This will allow us to finalize the agenda. If time at this meeting does not permit all the presentations to be given, we will be sure to schedule your presentation for the next meeting.

Thank you again for your membership in the Center. We value the contributions, both financial and technical, of each of our member companies.

Sincerely,

William J. Arbegast
Center Director, NSF CFSP
South Dakota School of Mines and Technology

Attachment 1:
Attendance Confirmation Form

Annual Fall IAB Conference 2007
November 6-8, 2007

South Dakota School of Mines & Technology
Rapid City, South Dakota

**There is no fee to attend this conference.

Name:

Company:

University Affiliate:

Attending (Y/N):

Number of Guests:

Names of Guests:

Arrival Date & Time:

Arrival (RAP):

Departure Date & Time:

Depart (RAP):

Hotel: Microtel Inn reservations <605-348-2523>
or Hampton Inn reservations <605-348-1911>

Special Food Requirements (ex. Vegetarian):

Contact Info (for updating purposes):

Phone: Mobile:
Fax:
Email:
Address:

Attachment 2
Hotel Information and Campus Map

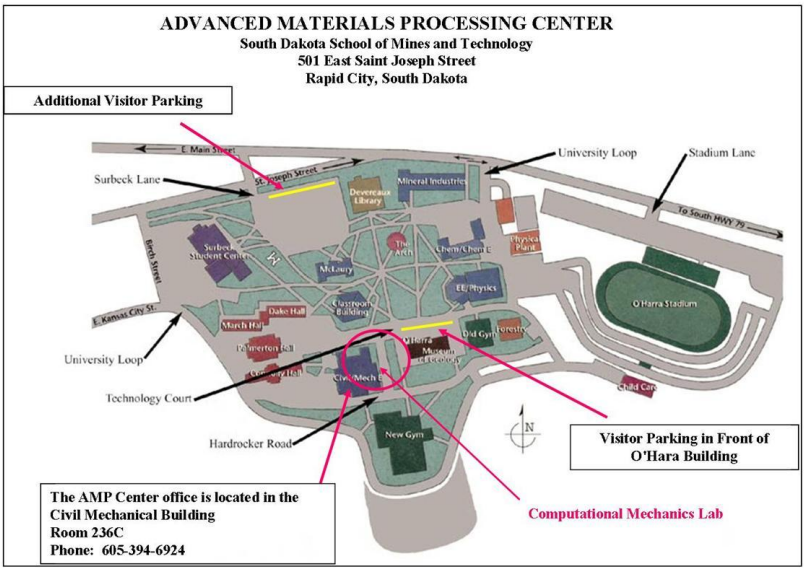
The hotel where the conference is being held is the Grand America. It has a 24-hour shuttle service to and from the airport from 6 AM to 10 PM. If your flights get in later or earlier than that, just call the hotel and let them know when your flight gets in. Taxis are also available to take from the airport. The hotel is only about 10 miles/15 minutes away from the airport.

Grand America 1-800-621-4505 www.grandamerica.com,

Other Available Lodging

Hotel	Address	Phone	Price	Distance from Grand America
Embassy Suites	110 W. 600 S.	801-359-7800	$140	1 block
Hampton Inn	425 S. 300 W.	801-741-1110	$90	5 blocks
Hilton	255 S. West Temple	801-328-2000	$140	?
Holiday Inn	999 S. Main	801-359-8600	$90	4 blocks (complimentary shuttle)
Little America	500 S. Main	801-363-6781	$80	right next door
Marriott Courtyard	130 W. 400 S.	801-531-6000	$120	3 blocks
Monaco	15 W. 200 S.	801-595-0000	$170	?
Sheraton Salt Lake	150 W. 500 S.	801-401-2000	$140	?
West Coast- Red Lion	161 W. 600 S.	801-521-7373	$110	1 block
Wyndham Hotel	215 W. South Temple	801-531-7500	$150	1 mile

ADVANCED MATERIALS PROCESSING CENTER
South Dakota School of Mines and Technology
501 East Saint Joseph Street
Rapid City, South Dakota



Appendix F – CFSP IAB MEMBERSHIP POC List

CFSP IAB MEMBERSHIP PRINCIPLE POINTS OF CONTACT - Revision C- October 2007						
SDSMT						
MTS Systems Corporation	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Mike Skinner		5/8/2007	5/8/2007	(612)-937-4000	Mike.Skinner@mts.com	
Mr. Jim Freeman		5/8/2007			jim.freeman@mts.com	
Pacific Northwest National Laboratory	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Glenn Grant		5/8/2007	5/8/2007	(509)-375-6890	Glenn.Grant@pnl.gov	(509)-375-4448
Dr. Darrell Herling					Darrell.Herling@pnl.gov	
The Boeing Company	Delivered	Read	Approved:	Phone	E-mail	Fax
Dr. John Baumann		N/A	5/8/2007	(314)-232-3764	john.a.baumann@boeing.com	
BAE / United Defense, LP	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Ed Savage		5/8/2007	5/8/2007	(408) 289-4344	Ed.Savage@baesystems.com	(408) 289-4429
Mr. Herb Allshouse					herb.allshouse@baesystems.com	
Mr. Greg Bakke					Greg.Bakke@baesystems.com	
Mr. Michael W. Davis		5/8/2007			michael.w.davis@baesystems.com	
US Army Research Laboratory	Delivered	Read	Approved:	Phone	E-mail	Fax
Victor Champagne		5/8/2007		(410) 306-0822	vchampag@arl.army.mil	
Sikorsky Aircraft	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. William Harris		5/9/2007	5/14/2007	(203)-386-3568 Cell (203)-305-4557	WHarris@SIKORSKY.COM	(860)-998-6224
Mr. Ricardo Flores		5/9/2007	5/8/2007	(203)386-4376	RFlores@sikorsky.com	
USC						
NASA Langley Research Center	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Robert Hafley		5/10/2007	5/9/2007	(757)864-8078	robert.a.hafley@nasa.gov	(757)864-7893
Mr. John Wagner				(757) 864-3132	j.a.wagner@larc.nasa.gov	
Spirit Aerosystems	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Mike Cumming		5/9/2007	5/15/2007		michael.j.cumming@spiritaero.com	
Mr. Gil Sylva				(952)-937-4630	Gil.sylva@mts.com	
Casey Allen		5/9/2007			casey.d.allen@spiritaero.com	
Mr. Robert M. Kay				(316) 523-1557	robert.m.kay@spiritaero.com	
Kaiser Aluminum `	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Roy Nash		5/15/2007	N/A	(509) 927-6092	Roy.Nash@kaisertwd.com	
Mr. Paul Ainsworth					Paul.Ainsworth@Kaisertwd.com	
EADS Airbus	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Marco Pacchione		5/23/2007	5/23/2007	+49 (0) 421 538 4825	Marco.Pacchione@airbus.com	
Lockheed Martin Space Systems	Delivered	Read	Approved:	Phone	E-mail	Fax
Mrs. Jennifer Takeshita			5/14/2007	(504) 257-3161	jennifer.a.takeshita@maf.nasa.gov	504-257-4482
Tim (Zhixian) Li				(504) 257-1061	Zhixian.li@lmco.com	
BYU						
JFE Steel Corporation	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Muneo Matsushita		5/8/2007	5/8/2007	81-43-262-2914	mu-matsushita@jfe-steel.co.jp	81-43-262-2117
Mitsubishi Heavy Industries, Ltd.	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Yasuyuki Fujiya				(0794) 45-6719.	yasuyuki_fujiya@mhi.co.jp	(0794) 45-6948
Mr. Masaru Kodama					masaru_kodama@mhi.co.jp	
Mr. Yujiro Wantanabe					yujiro_watanabe.MHI@notesgw.nqsrdc.mhi.co.jp	
Toshiba Corporation	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Satoru Asai				81-45-510-5381	satoru.asai@toshiba.co.jp	
Hitachi, Ltd.	Delivered	Read	Approved:	Phone	E-mail	Fax
Mr. Kazutaka Okamoto			5/15/2007		kazutaka.Okamoto@hap.com	
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WSU							
Bombardier			Approved:		Phone	E-mail	Fax
	Delivered	Read					
Leo J.J. Kok, Sr.							
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	Delivered	Read					
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FAA			Approved:		Phone	E-mail	Fax
	Delivered	Read					
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Hawker Beechcraft			Approved:		Phone	E-mail	Fax
	Delivered	Read					
Bill Jones		5/8/2007				bill_jones@rac.ray.com	
Bryon Colcher		5/8/2007				byron_colcherjr@hawkerbeechcraft.com	
Phil Douglas						phil_douglas@rac.ray.com	

The CFSP IAB Members Point of Contact list is an Excel document that allows for the monitoring and update of membership information – including names of principle points of contact, phone, email, and fax.

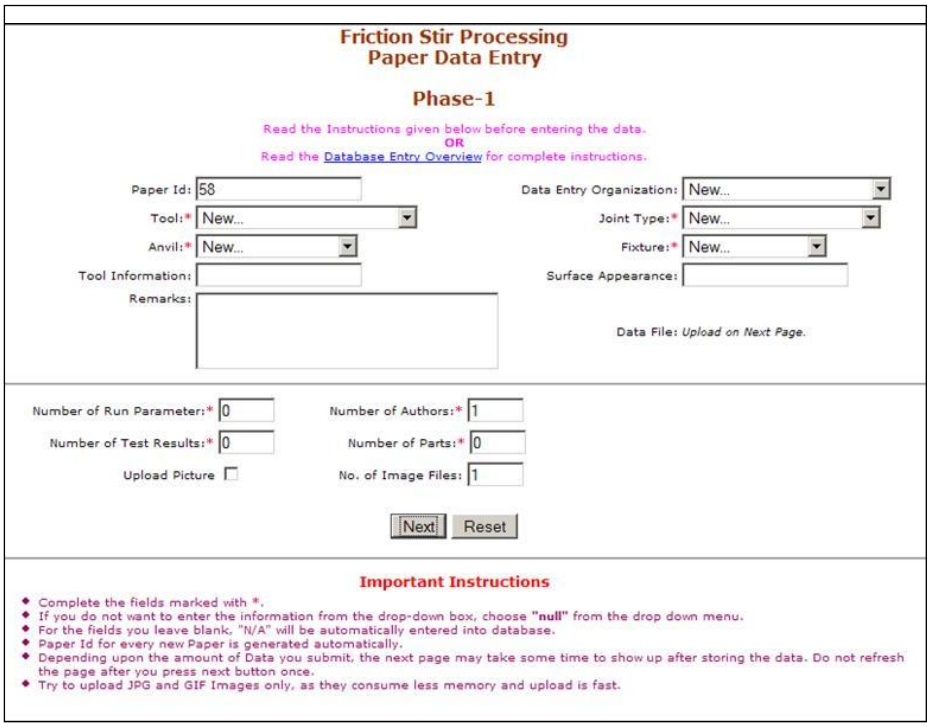
Additionally, the form can be used to track and monitor the status of document and information transmittals to the IAB Membership specifically requiring IAB Members' responses. For example, this form can be used to track the invitation and response to IAB Members Meetings, and, track the submittal, receipt, and approval of Requests for Publication of CFSP papers, articles, and journal publications.

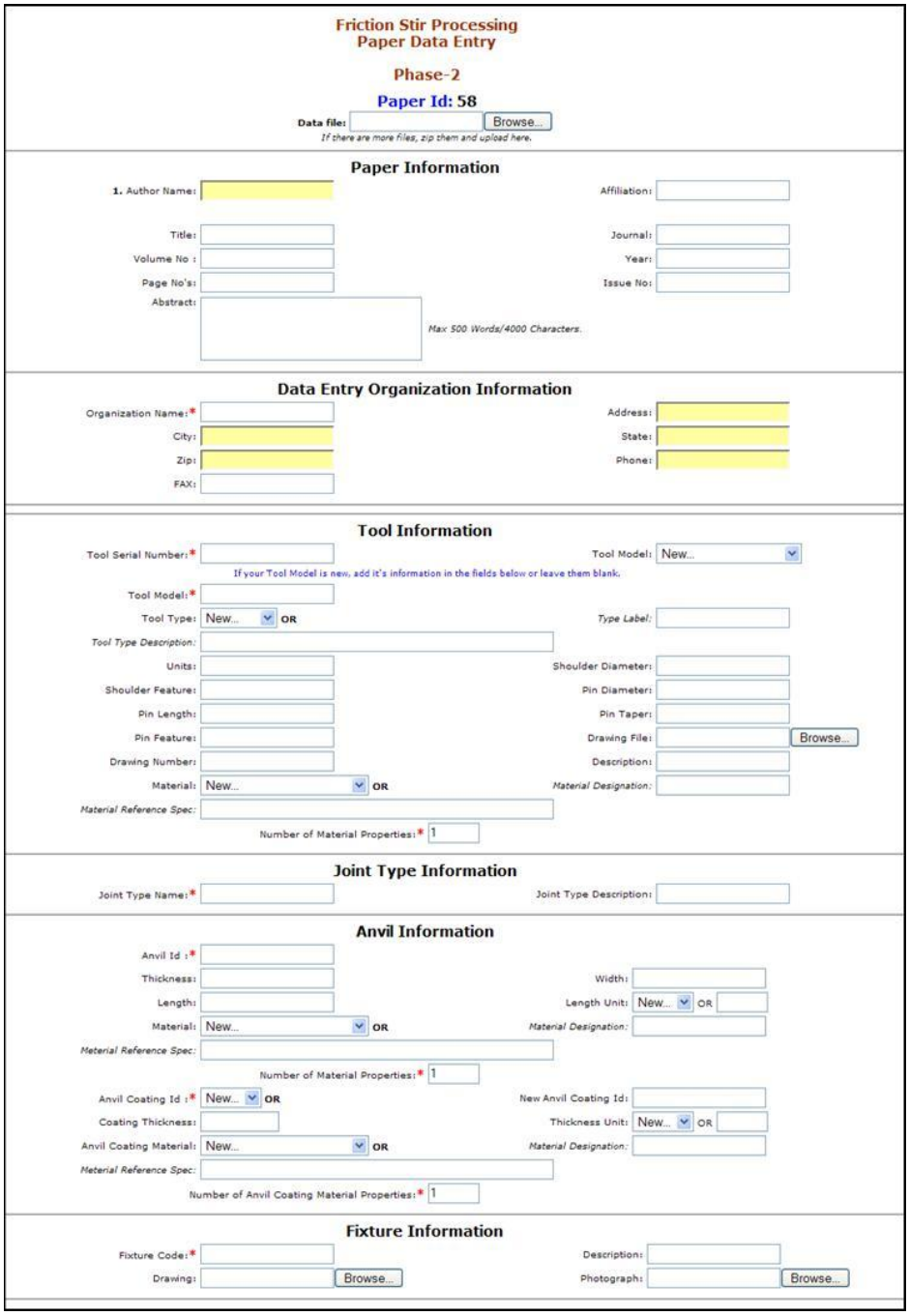
Appendix G – CFSP Website Based Reference Library

The CFSP maintains a secured website for the exchange of information between the university sites and the IAB. One element of the database structure is the Website Based Reference Library.

The students are required to summarize the paper and uploaded a summary to the secured portion of the CFSP Website. In this way, the center develops a centralized location of relevant papers and is a valuable resource for students writing research papers and graduate theses. The IAB Membership has access to this web Based Reference Library. *Care is taken to summarize the papers so as not to violate copyright laws. A complete copy of the paper is not provided, but reference to the source of the paper is provided.*

Example images from the CFSP Website Based Reference Library showing various system functionalities.





Friction Stir Processing
Paper Data Entry

Phase-2

Paper Id: 58

Data file: Browse...
If there are more files, zip them and upload here.

Paper Information

1. Author Name: | Affiliation:
Title: | Journal:
Volume No : | Year:
Page No's: | Issue No:
Abstract: *Max 500 Words/4000 Characters.*

Data Entry Organization Information

Organization Name:* | Address:
City: | State:
Zip: | Phone:
FAX:

Tool Information

Tool Serial Number:* | Tool Model: New...
If your Tool Model is new, add it's information in the fields below or leave them blank.
Tool Model:*
Tool Type: New... OR | *Type Label:*
Tool Type Description:
Units: | Shoulder Diameter:
Shoulder Feature: | Pin Diameter:
Pin Length: | Pin Taper:
Pin Feature: | Drawing File: Browse...
Drawing Number: | Description:
Material: New... OR | *Material Designation:*
Material Reference Spec:
Number of Material Properties:* 1

Joint Type Information

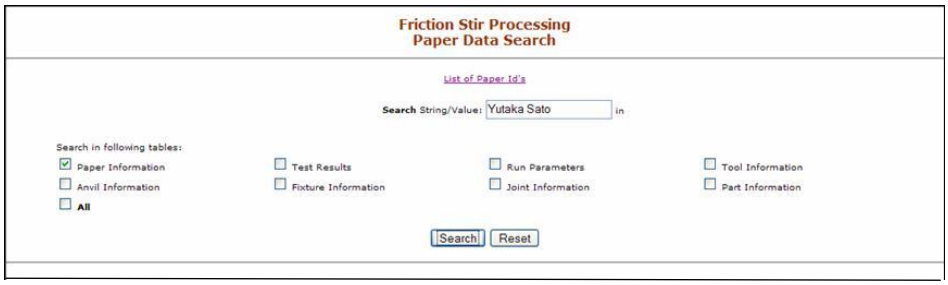
Joint Type Name:* | Joint Type Description:

Anvil Information

Anvil Id :*
Thickness: | Width:
Length: | Length Unit: New... OR
Material: New... OR | *Material Designation:*
Material Reference Spec:
Number of Material Properties:* 1
Anvil Coating Id :* New... OR | New Anvil Coating Id:
Coating Thickness: | Thickness Unit: New... OR
Anvil Coating Material: New... OR | *Material Designation:*
Material Reference Spec:
Number of Anvil Coating Material Properties:* 1

Fixture Information

Fixture Code:* | Description:
Drawing: Browse... | Photograph: Browse...



Friction Stir Processing
Paper Data Search

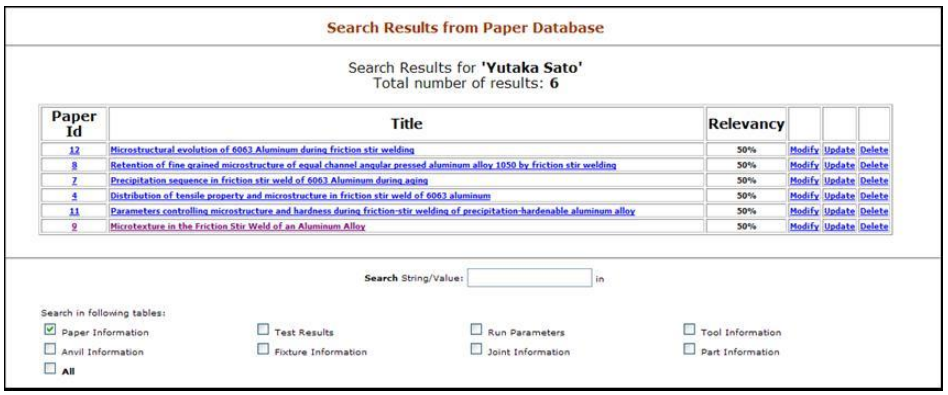
List of Paper Id's

Search String/Value: Yutaka Sato in

Search in following tables:

- [x] Paper Information
- [ ] Test Results
- [ ] Run Parameters
- [ ] Tool Information
- [ ] Anvil Information
- [ ] Fixture Information
- [ ] Joint Information
- [ ] Part Information
- [ ] **All**

Search | Reset



Search Results from Paper Database

Search Results for **'Yutaka Sato'**
Total number of results: **6**

Paper Id	Title	Relevancy			
12	Microstructural evolution of 6063 Aluminum during friction stir welding	50%	Modify	Update	Delete
8	Retention of fine grained microstructure of equal channel angular pressed aluminum alloy 1050 by friction stir welding	50%	Modify	Update	Delete
7	Precipitation sequence in friction stir weld of 6063 Aluminum during aging	50%	Modify	Update	Delete
4	Distribution of tensile property and microstructure in friction stir weld of 6063 aluminum	50%	Modify	Update	Delete
11	Parameters controlling microstructure and hardness during friction-stir welding of precipitation-hardenable aluminum alloy	50%	Modify	Update	Delete
9	Microtexture in the Friction Stir Weld of an Aluminum Alloy	50%	Modify	Update	Delete

Search String/Value: in

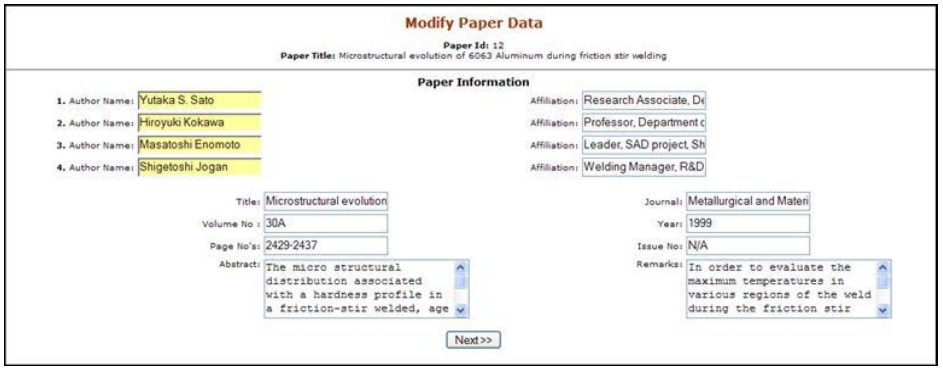
Search in following tables:

- [x] Paper Information
- [ ] Test Results
- [ ] Run Parameters
- [ ] Tool Information
- [ ] Anvil Information
- [ ] Fixture Information
- [ ] Joint Information
- [ ] Part Information
- [ ] **All**

Paper Data

Paper Id: 9
Paper Title: Microtexture in the Friction Stir Weld of an Aluminum Alloy

Paper Information			
Author 1: Yutaka S. Sato		**Affiliation:**Research Associate, Department of Materials Processing, Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan	
Author 2: Hiroyuki Kokawa		**Affiliation:**Professor, Department of Materials Processing, Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan	
Author 3: Keiske Ikeda		**Affiliation:**Professor, Department of Materials Processing, Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan	
Author 4: Masatoshi Enomoto		**Affiliation:**Leader, SAD project, Showa Aluminum Corporation, Tochigi 323-8678, Japan	
Author 5: Shigetoshi Jogan		**Affiliation:**Welding Manager, R&D Department, Showa Aluminum Corporation, Osaka 590-8576, Jap	
Author 6: Takenori Hashimoto		**Affiliation:**Researcher, Research Laboratory, Showa Aluminum Corporation, Tochigi 323-8678, Japan	
Title: Microtexture in the Friction Stir Weld of an Aluminum Alloy		**Journal:** Metallurgical and materials transactions A	
Page No: 941-948	**Year:** 2001	**Volume No.:** 32A	**Issue No.:** N/A
Abstract: In order to characterize plastic flow during friction stir welding, the microtextures in a friction stir weld of the precipitation hardened aluminum alloy 6063 have been analyzed by orientation imaging microscopy. The base-material plate has a Goss orientations. The weld center region, except for the upper surface, takes a typical shear texture component with two types of orientations. the orientations have a pair of common {111} and <110> parallel to the cylindrical pin surface and transverse direction of the plate, respectively. The typical texture component is also observed around the weld center on the midsection, although it rotates about the plate normal direction. A microtexture analysis after postweld heat treatment has suggested that dynamic recrystallization during friction stir welding generates the recrystalised grains at the weld center.			
Remarks: Microstructures in the recrystallized zone of a friction stir welded Al alloy 6063 are analyzed by OIM, and then the plastic-flow behavior during FSW is deduced from the microtextures. Optical microscopic observations show that the fine equiaxed grains occupy the weld center region and deformed grains exist just outside the weld zone. The weld center is characterized by the recrystallized grain structure. Regions apart from the weld center do not take the shear texture componenet detected at the weld center. The weld center is mainly generated by dynamic recrystallization during FSW.			
Surface Appearance: Extruded Al alloy 6063-T5. Thickness: 4mm. Composition: Al-0.43Si-0.13Fe-0.01Cu-0.03Mn-0.50Mg-0.01Cr-0.04Zn-0.01Ti		**Tool Information:** N/A	
Data File: N/A			
Data Entry Organization: U of Missouri-Rolla, 1870 Miner Circle, Rolla, Missouri -65409, Ph:(573)341-6361, Fax:-.			
Test Result Information			
Test Result #: 1			
Property Name: Schematic illustration of effect of shear stress arising from the tool shoulder on the shear plane inclination at the weld center	**Property Unit Id:** N/A	**Test Specification:** N/A	**Value:** N/A	**Datafile:** view
Test Result #: 2			
Property Name: Schematic illustration of shear stresses induced by the forward motion of the rotating pin.	**Property Unit Id:** N/A	**Test Specification:** N/A	**Value:** N/A	**Datafile:** view


Modify Paper Data
Paper Id: 12
Paper Title: Microstructural evolution of 6063 Aluminum during friction stir welding
Paper Information
1. Author Name: Yutaka S. Sato
2. Author Name: Hiroyuki Kokawa
3. Author Name: Masatoshi Enomoto
4. Author Name: Shigetoshi Jogan
Affiliation: Research Associate, De
Affiliation: Professor, Department c
Affiliation: Leader, SAD project, Sh
Affiliation: Welding Manager, R&D
Title: Microstructural evolution
Volume No : 30A
Page No's: 2429-2437
Abstract: The micro structural distribution associated with a hardness profile in a friction-stir welded, age
Journal: Metallurgical and Materi
Year: 1999
Issue No: N/A
Remarks: In order to evaluate the maximum temperatures in various regions of the weld during the friction stir
Next >>

Appendix H – AMP Paperless Data Management System – (PaDMS)

The following shows various input screens for developing project tasks, subtasks and work orders in PaDMS.

Create a New Program – Administrative Access Required:

Project Number	AMPRO06030
Project Title	(AF) Aging Aircraft Structural Repair Facility Study
Project Type	○ CFSP ◉ AMP
Status	◉ Active ○ Closed
Stage	○ Proposal ◉ Project
Access	○ ITAR ◉ Proprietary
Account	Select Add New Remove 440406 Alion DOD EAFB --Aging Aircraft
Period of Performance	07/01/2006 through 03/31/2007 Ext. 1 08/31/2007 Ext. 2
PI	Select Add Remove Gautam Pillay Remove William Arbegast
Students	Select Add Remove Kegan Luick Remove Dustin Blosmo
Abstract Title	
Abstract	TBD
Security	Select Select Select Add Remove Gautam Pillay - Administrator Remove Kegan Luick - Contributor Remove Dustin Blosmo - Contributor Remove William Arbegast - Administrator
	Submit Cancel

Examples of tasks created under a project giving task description and start and end dates:

Tasks: Add Edit

1. Part Preperation/Inspection - Identify Component Materials (**Start:** 05/14/07 **Target:** 05/18/07 **End:** Open)
   Parts will be investigated to evaluate possible solutions.
2. Ruddevator Fittings - Repair Scrapped Parts Using CS and/or FSW (**Start:** 05/30/07 **Target:** 06/30/07 **End:** Open)
   Use the technologies available to the AMP Center and SDSMT Campus to repair the scrapped KC-135 Ruddevator Fittings
3. Bell Crank Housing - Repair Broken Attachment Lugs (**Start:** 05/30/07 **Target:** 06/30/07 **End:** Open)
   2 lugs have broken off of the bracket and need to be re-attached using FSW.
4. B-1 False Axle - Cold Spray False Axle to Re-manufacture (**Start:** 07/04/07 **Target:** 07/20/07 **End:** Open)
   Deposite Nickel-Aluminum blend powder on false axle so that it can be re-machined to tolerance
5. Titanium Tubing - Use Cold Spray to Repair Abrasive Defects on Ti Tubing (**Start:** 07/04/07 **Target:** 07/20/07 **End:** Open)
   Use Cold Spray to re-build abrasive marks on tubing walls
6. Chem-Milled Panels - Repair chem-milled panels (**Start:** 07/10/07 **Target:** 07/14/07 **End:** Open)
   Chem-milled panels that have fatigue crack damage will be reapired using cold spray.

Example of project task description showing subtasks and start and end dates:

Start Date: 05/30/07 **Target End Date:** 06/30/07 **End Date:** Open

Assigned to:
William Arbegast
Kegan Luick

Objective - Repair Scrapped Parts Using CS and/or FSW
Use the technologies available to the AMP Center and SDSMT Campus to repair the scrapped KC-135 Ruddevator Fittings

Deliverables - Repaired Parts
4 parts will be repaired using a combination of cold spray and friction stir welding. An evaluation will be made to determine the best possible repair option for the technologies demonstrated.

Subtasks: Add Edit

1. Cold Spray Repair - Demonstrate Cold Spray as a Repair Technique - (**Start:** 05/30/07 **Target:** 06/30/07 **End:** Open)
   Build up part with cold spray, then machine part to required dimensions.
2. Friction Stir Welding Repair - FSW Repair of Ruddevator Part - (**Start:** 05/30/07 **Target:** 06/30/07 **End:** Open)
   Use FSW to process the fatigue cracks in the Ruddevator Parts

Task Documents: Edit Download

Other Documents: Edit Download

Work Orders: Add Edit
None

Example of project Sub Task description showing Work Orders being conducted

Start Date: 05/14/07 **Target End Date:** 05/18/07 **End Date:** Open

Assigned to:
William Arbegast
Kegan Luick

Objective - Identify Component Materials
Parts will be investigated to evaluate possible solutions.

Deliverables - Identify Part Materials and Determine Scale of Defects
Part materials will be identified. Defect sizes will be quantified to determine acceptable repairs.

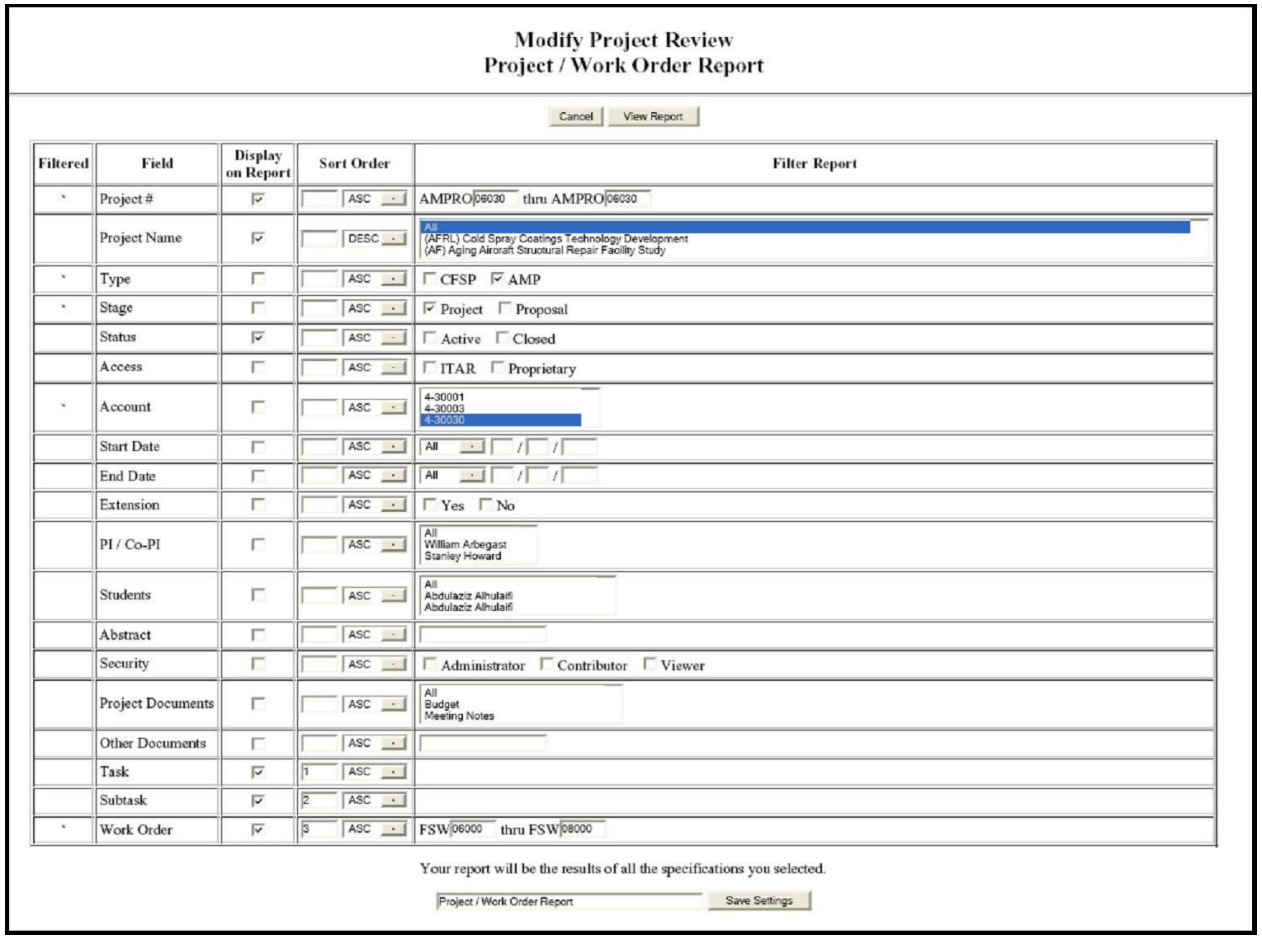
Subtasks: Add Edit
None

Task Documents: Edit Download

Other Documents: Edit Download

Work Orders: Add Edit
FSW07068 - Aircraft Component Material Identification
FSW07075 - Part Cleaning/Paint Removal
FSW07076 - Dye Penetrant Inspection of Aircraft parts
FSW07094 - Metallography
FSW07095 - SEM Brake Duct

Complete sort and retrieval capabilities exist in PaDMS. The following page shows the sort selection features available.



Modify Project Review
Project / Work Order Report

Cancel | View Report

Filtered	Field	Display on Report	Sort Order	Filter Report
`	Project #	☑	ASC	AMPRO 06030 thru AMPRO 06030
	Project Name	☑	DESC	All (AFRL) Cold Spray Coatings Technology Development (AF) Aging Aircraft Structural Repair Facility Study
`	Type	☐	ASC	☐ CFSP ☑ AMP
`	Stage	☐	ASC	☑ Project ☐ Proposal
	Status	☑	ASC	☐ Active ☐ Closed
	Access	☐	ASC	☐ ITAR ☐ Proprietary
`	Account	☐	ASC	4-30001 4-30003 4-30030
	Start Date	☐	ASC	All / /
	End Date	☐	ASC	All / /
	Extension	☐	ASC	☐ Yes ☐ No
	PI / Co-PI	☐	ASC	All William Arbegast Stanley Howard
	Students	☐	ASC	All Abdulaziz Alhulaifi Abdulaziz Alhulaifi
	Abstract	☐	ASC	
	Security	☐	ASC	☐ Administrator ☐ Contributor ☐ Viewer
	Project Documents	☐	ASC	All Budget Meeting Notes
	Other Documents	☐	ASC	
	Task	☑	1 ASC	
	Subtask	☑	2 ASC	
`	Work Order	☑	3 ASC	FSW 06000 thru FSW 08000

Your report will be the results of all the specifications you selected.

Project / Work Order Report | Save Settings

APPENDIX I – AMP Standard test plan format

Advanced Materials Processing Center
South Dakota School of Mines and Technology
501 East Saint Joseph Street
Rapid City, SD 57701

AMP
SDSM&T

Test Plan

AMPTP-Year-next sequential

(TITLE OF PROJECT)

Revision: New
Creation Date:
Revision Date:

Prepared By: _____
(Name and Title of Preparer)
Advanced Materials Processing Center
South Dakota School of Mines and Technology

Approved By: _____
William J. Arbegast
Director
Advanced Materials Processing Center
South Dakota School of Mines and Technology

1.0 SCOPE:

1.1 Application: This test plan defines the work to be performed by the South Dakota School of Mines and Technology Advanced Materials Processing (AMP) Center to (describe the test goals and the program which the tests support).

1.2 Describe the scope of the testing and the limitations on applicability (i.e., what is covered in the testing and what is not covered in the testing).

2.0 APPLICABLE DOCUMENTS: The latest issue of the following documents, unless otherwise noted, forms a part of this test plan to the extent specified

herein. If there is a conflict between documents, the requirements provided in this specification shall take precedence.

2.1 Government Documents: (include as applicable)

Mil-H-81200	Heat Treatment of Titanium Alloys

2.2 Industry Specifications and Standards: (include as applicable)

ASTM E 8	Test Method for Tension Testing of Metallic Materials
QQ-A-250/11	2024-T3 Aluminum Alloy Sheet
QQ-A-250/11	2024-T851 Aluminum Alloy Plates

2.3 Advanced Materials Processing Center Specifications: (include as applicable)

AMP-03-xxx	Operating Procedures for the FSW Equipment
AMP-03-xxx	Operating Procedures for the Interstitial Analyzer
AMP-03-xxx	Preparation of Metallographic Specimens

2.4 Other Documents:

AMP-03-xxx	AMP Center Safety Manual

3.0 REQUIREMENTS: The detailed requirements, as specified herein, shall be followed for all testing and evaluation of the (provide test description).

3.1 Materials: Describe the materials to be tested AND the materials needed to support the test program.

3.2 Equipment: Describe the test equipment to be used.

3.3 Personnel: Describe the personnel and skill level requirements.

3.4 Procedure: Describe in detail the test procedures to be used such that the test can be COMPLETELY reproduced at a future date. Include references to test specimen configurations to be included in APPENDIX A.

4.0 DATA ANALYSIS: The detail requirements and procedures for data collection and data analysis are described here. Include discussion of anticipated results.

5.0 ACCOUNT NUMBER: Provide the contract name and account number here.

6.0 TECHNICAL POINT OF CONTACT: Provide the lead engineer name, phone number and organization here.

APPENDIX A:
Include drawings of test specimens and schematics of test setup when appropriate.

APPENDIX J – AMP Standard laboratory report format

Advanced Materials Processing and Joining Center
South Dakota School of Mines and Technology
501 East Saint Joseph Street
Rapid City, SD 57701

==========

Laboratory Report

==========

Noise Detection of MTS ISTIR-10 FSW Machine

Work Orders: FSW06010, FSW05128, FSW05088 and FSW04005

Prepared For:
CFSP I/UCRC

Prepared by:
Enkhsaikhan Boldsaikhan

Advisors:
William J. Arbegast
Casey D. Allen
Edward M. Corwin
Antonette M. Logar

==========

Approved by:

William J. Arbegast
Director, NSF Center for Friction Stir Processing (CFSP)
Director, SDSMT Advanced Materials Processing and Joining Center (AMP)

==========

November 4, 2006
South Dakota School of Mines and Technology

Abstract

The purpose of the experiment was to investigate the machine dependent noise in the feedback signals. In order to do that, we collected noise signals while the FSW machine was running without actual welding (empty run, the pin tool was in the air, no material was involved), under 28 variation of system parameters values. We created the DFT's of noise signal and compared them with the DFT's of actual welds. It appears that the machine-dependent noise is may be embedded in the feedback signals. A machine-dependent noise is a collection of frequency values that behaves to be independent of the system parameter values and the variation of material and pin tool.

Introduction

The objective was to collect the feedback signals while the machine was performing an empty run (the pin tool was in the air) and compare them with the feedback signals of actual welds. The FSW machine is MTS ISTIR-10. We are investigating the effectiveness of a various methods to removing machine-dependent noise from the distorted feedback signals. We can handle the high frequency noise by using a low-pass filter. The only problem is how to determine and remove the low frequency noise (machine-dependent), whose sources can be any of the moving mechanisms of the FSW machine. We are assuming that the feedback signals with the frequencies of the spindle or less than the spindle frequencies may have important information regarding the weld quality. Consequently, the low frequency noise (machine-dependent noise) may lead us into a wrong conclusion on analyzing those feedback signals. Thus, it is extremely important to determining and removing low frequency (machine-dependent) noise from the distorted feedback signals.

Approach / Procedure

Task1 – Noise Data Collection. Collect the noise signals while the FSW machine is performing an empty run, under various system parameter values. (The traversing speed variation was 2, 4, 6 and 10 [ipm], and the spindle speed variation was 200, 250, 300, 350, 425, 500 and 600 [rpm])

Task2 – Noise Detection (Exhaustive Search). The objective of this task is to determine the machine-dependent noise frequency. In order to do that, create the frequency spectral plots of all the feedback signals using a discrete Fourier transform. It is worth full to create the frequency spectral plots from various welds with different system parameters, material and pin tool. Compare all these plots and search for machine-dependent noise frequencies among the dominant frequency peaks in the frequency spectral plot. *If a collection of frequency peaks that behaves to be independent of the system parameter values and the variation of material and pin tool design, then it means a machine-dependent noise is present in the feedback signals.*

Results

In order to compare the noise signals with the actual weld signals, we used data from FSW04005, FSW05088 and FSW05128 (The materials, which were involved in these experiments, are 0.25" Al 7075-T73 and 0.25" Al2024-T3). We created several frequency spectral plots. By examining them, we discovered that a same dominant peak is located at ~14Hz in the frequency spectrum of all the feedback signals (especially, X

feedback force) independent of traversing speed and material variations. The corresponding spindle speed was 600 rpm. This dominant peak represents the machine-dependent noise frequency. (Figures 1 & 2).

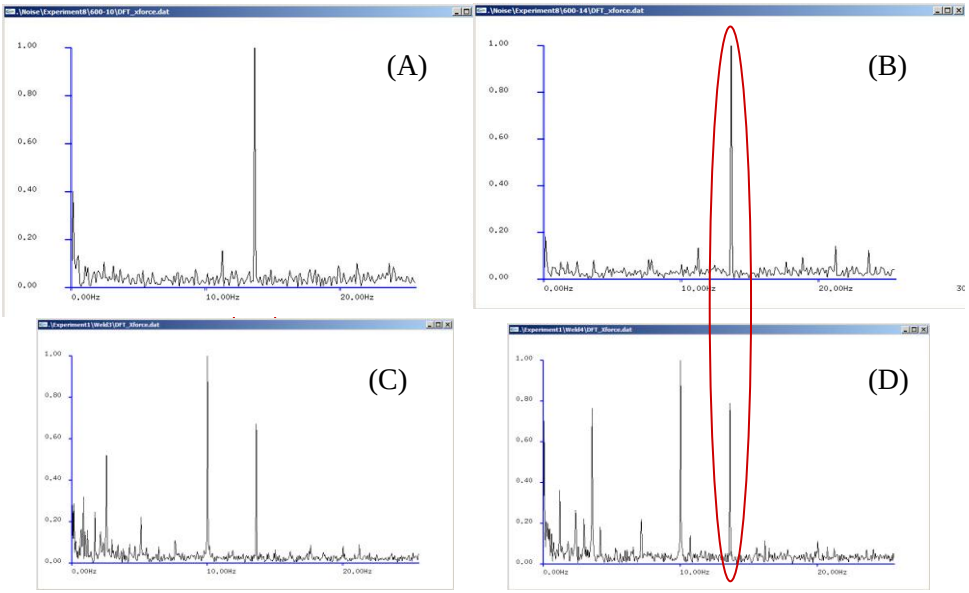


Figure 1. X force DFTs. Spindle speed is 600RPM. Noise frequency is in a red circle. (A) & (B) are from empty run and corresponding (C) & (D) are from actual welds.

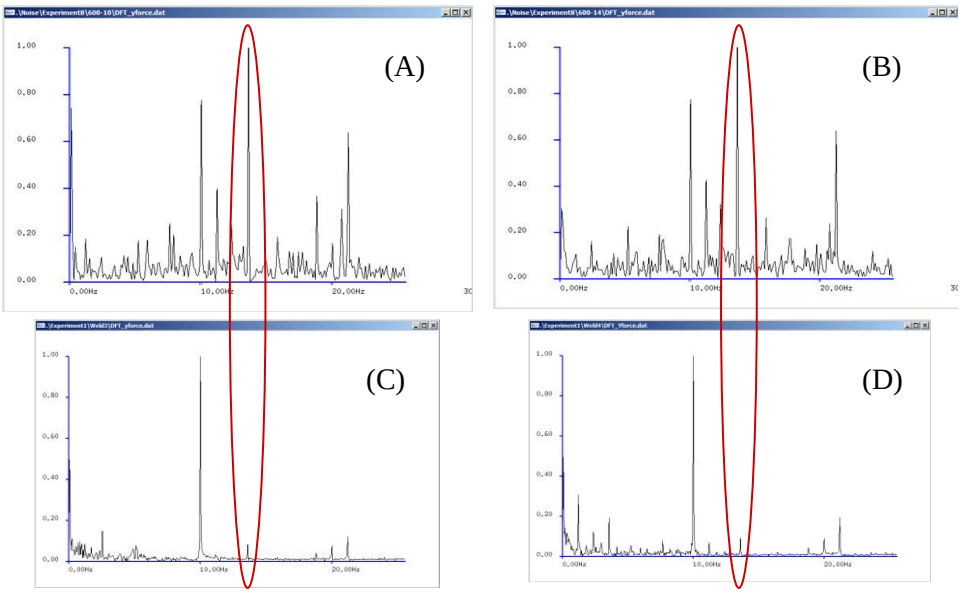


Figure 2. Y force DFTs. Spindle speed is 600RPM. Noise frequency is in a red circle. (A) & (B) are from empty run and corresponding (C) & (D) are from actual welds.

Discussion

According to the experiment, the machine-dependent noise starts occurring from 600 rpm, it means that the machine-dependent noise may occur at the higher spindle speed (greater than 600 rpm). We need to verify it!

For the sake of determining the machine-dependent noise frequencies, we applied an exhaustive search method (Approach\Task2) which requires a large amount of data and time. The advantage is, once the noise frequencies were determined, it will be easy to remove these noise frequencies from the feedback signals using a forward and inverse Fourier transform. Additional noise filtering techniques (including an adaptive filter) are currently being studied.

Conclusion

MTS ISTIR-10 FSW machine has some machine-dependent noise at the spindle speed of 600 rpm or higher. The exhaustive search method (Approach\Task2) may help us to determine the machine-dependent noise frequencies of any FSW machine.

APPENDIX K – CFSP IAB Meeting Agenda

Tuesday, 6 November 2007 CFSP I/UCRC TECHNICAL WORKSHOP

7:45- 8:00 Registrations
8:00- 8:15 Welcome
8:15- 9:15 Review of South Dakota School of Mines & Technology projects (Arbegast)

CFSP04-AMP-01: Design Analysis of FSW Built-Up Structures (Completed)
CFSP04-AMP-02: Intelligent Process Control Algorithms (Current)
CFSP05-AMP-01: CFSP/CNDE TIE- Effects of Defects in FSW (Completed))
CFSP07-AMP-01: FSW of Titanium Beam Structures (Current)
CFSP07-AMP-02: Integration of Cold Spray and FSP Technologies (Completed)
CFSP07-AMP-03: Refill FSSW of Magnesium Structures (Current)
CFSP07-AMP-04 (P): Distortion Control in Stiffened Structures (Proposed)

9:15- 10:15 Reviews of Missouri University of Science and Technology projects (Mishra)

CFSP05-UMR-01: Friction Stir Microstructural Modification (Current)
CFSP05-UMR-02: Robotic Friction Stir Welding of Thin Sheets (Current)
CFSP06-UMR-01: E-Design and the FSW Process (VPI TIE) (Current)
CFSP06-UMR-02: Friction Stir Spot Welding (Current)

10:15- 10:30 Break
10:30- 11:00 IAB Presentations
11:00- 12:00 Reviews of Brigham Young University Projects (Nelson et al)

CFSP04-BYU-01: FSW of X-65 Steels (Current)
CFSP04-BYU-02: FSW of Austenitic Alloys (Current)
CFSP06-BYU-01: FSW Tool design study (Current)
CFSP07-BYU-01 (P): FSW&P of Nickel Base Superalloy (Proposed)
CFSP07-BYU-02 (P): FSW Higher strength HSLA steels (Proposed)
CFSP07-BYU-03 (P): Comparisons of FSP Models in 304L (Proposed)

12:00- 1:00 Lunch
1:00- 2:00 Reviews of Wichita State University Projects (Burford)

CFSP07-WSU-01: Performance of Discontinuous FSW (Current)
CFSP07-WSU-02: Faying Surface Treatments of FSSW (Current)
CFSP07-WSU-03 (P): “Low” Z force FSSW (Proposed)

2:00- 2:30 IAB Presentations
2:30- 2:45 Break

2:45- 3:45 Reviews of University of South Carolina Projects (Reynolds)

CFSP04-USC-01: Thermal Management of Aluminum FSW (Current)

CFSP04-USC-02: Improved Weldability of Titanium Alloys (Current)

CFSP06-USC-01: Dissimilar Metal FSW of Aluminum to Magnesium (Current)

3:45- 4:15 CFSP07-AMP-05 NSF REU Supplemental – I/UCRC Management Tools *(Current)*

4:15- 4:45 CFSP07-USC-01/CFSP07-BYU-04 – NSF Supplemental – Control and Response Variable Relationships in FSW (*Current)*

4:45- 4:55 Wrap-up and review of second day activities

6:00 - Dinner

Wednesday, 7 November 2007 CFSP I/UCRC Annual IAB Review Meeting

7:45- 8:00 Registrations
8:00- 8:10 Welcome (Dr. Gautam Pillay – VP Research, SDSMT)
8:10- 8:20 Introductions of Participants (Arbegast)
8:20- 8:40 Dr. Ed Clancy (NSF) and Dr. Ron Beck (Center Evaluator)
8:40- 9:00 State-of-the-Centers (Arbegast)

Management Review and Life Forms for Current and Continuing Projects

9:00- 9:10 CFSP04-AMP-02: Intelligent Process Control Algorithms
9:10- 9:20 CFSP07-AMP-01: FSW of Titanium Beam Structures
9:20- 9:30 CFSP07-AMP-03: Refill FSSW of Magnesium Structures
9:30- 9:40 CFSP05-UMR-01: Friction Stir Microstructural Modification
9:40- 9:50 CFSP05-UMR-02: Robotic Friction Stir Welding of Thin Sheets
9:50- 10:00 CFSP06-UMR-01: E-Design and the FSW Process
10:00- 10:10 CFSP06-UMR-02: Friction Stir Spot Welding

10:10- 10:40 Break and Poster Session

10:40- 10:50 CFSP06-BYU-01: FSW CS4 Tool design study
10:50- 11:00 CFSP07-WSU-01: Performance of Discontinuous FSW
11:00- 11:10 CFSP07-WSU-02: Faying Surface Treatments of FSSW
11:10- 11:20 CFSP04-USC-01: Thermal Management of Aluminum FSW
11:20- 11:30 CFSP04-USC-02: Improved Weldability of Titanium Alloys
11:30- 11:40 CFSP06-USC-03: Dissimilar Metal FSW of Aluminum to Magnesium

11:45 1:00 Lunch

1:00- 1:30 Center Business (Baumann & Sorensen)
1:30- 2:15 IAB Closed Meeting / Site Director Offsite Meeting
2:15- 2:30 Technology Road Map Discussion

New Project Proposals

2:30- 2:40 CFSP07-BYU-03 (P): Comparison of FSP Models in 304L
2:40- 2:50 CFSP07-BYU-01 (P): FSW&P of Nickel Base Superalloy
2:50- 3:00 CFSP07-BYU-02 (P): FSW Higher strength HSLA steels
3:00- 3:10 CFSP07-AMP-04 (P): Distortion Control in Stiffened Structures
3:10- 3:20 CFSP07-WSU-03 (P): “Low” Z force FSSW

3:20 - 3:30 Discussions and Wrap-up
5:00 - 9:00 Dinner at Crazy Horse Memorial

Thursday, 8 November 2007 CFSP I/UCRC Annual IAB Review Meeting

8:00- 8: 05 Handout Life Form Summaries to IAB
8:05- 9:00 Site/Sponsor Meetings to discuss life forms
9:00- 10:00 Life form review with entire IAB

10:10- 10:15 Break

10:15- 11:30 IAB Meeting (closed)
11:30- 12:00 IAB feedback – All

12:00- 1:00 Lunch

1:00 Adjourn

OPTIONAL – Tour of the SDSMT Advanced Materials Processing Laboratory (Friction Stir Welding, Ultrasonic Spot Welding, Thermoplastic Friction Stir Joining, Structures Testing) and the Advanced Materials Joining Laboratory (Cold Spray, Virtual Reality Welder Training, Pulsed MIG) after the meeting

APPENDIX L – IAB Annual Members' Report – Executive Template

CFSP Site: SDSM&T

Number	Project Title			Budget
CFSP04-AMP-01	Design, Analysis and Performance of "Built-Up" Aluminum Friction Stir Welded (FSW) and Friction Stir Spot Welded (FSSW) Structures			$150,000 (Year 2)
Report Date	**Start Date**	**End Date**	**PI and Senior Personnel**	**Students**
October 01, 2006	October 01, 2005	September 30, 2006	Bill Arbegast Anil K. Patnaik Casey Allen	Travis Reidy (MS) Barney Frankl (Sr) Matthew Herringer (Sr) Cassandra Degan (Jr) Neelima Nagotu (MS) Karl Koch (Sr)

EXECUTIVE SUMMARY

CFSP04-AMP-01: Design, Analysis and Performance of "Built-Up" Aluminum Friction Stir Welded (FSW) – Arial Font size 14

OBJECTIVE (Arial 12 – All Caps)

(Arial 11 – justified) The objectives of this program are to expand the understanding and knowledge of the design and analysis methodologies for friction stir welded aluminum structures. The technology readiness level for aluminum FSW is high with current industrial implementations in DOD and NASA. Friction Stir Spot Welding is currently under development within this country and the technology readiness is low. The DOD and NASA application of FSW generally incorporates design approaches (*elastic design*) that preclude plastic deformation of structures during service. Engineering structures such as bridges, building, etc oftentimes use *plastic theory* or *ultimate design* and analysis methodologies that allow for a certain degree of plastic deformation under extreme loading conditions. Allowing the structure to deform plastically enables it to absorb more of the imposed energy. The degree of plastic deformation permitted depends upon the function of the structure and the number of anticipated extreme loading events. FSW allows the use of the "*Built-Up*" structures design approach where dissimilar aluminum alloys may be metallurgically joined with the properties at individual locations within the structure tailored to meet service requirements. Commercial implementation of aluminum FSW is hampered by the lack of standardized values for static and dynamic response, and environmental compatibility, of specific FSW joint types which may be used in "*Built-Up*" FSW structures.

Current Year Project Objectives

- (Arial 11 – justified) Develop design and analysis methodologies for built-up aluminum FSW beams, skin stiffened panels, and friction stir spot welded structures
- Design, fabricate, and test response of aluminum built-up beams, skin stiffened panels and friction stir spot welded panel
- Compare test results with the behavior predicted by the models developed
- Provide design and analysis guidelines

APPROACH (Arial 12 – All Caps)

The text needs to be Arial 11 - justified. Do not include page numbers – we will assign page numbers in the master copy. Maximum length needs to be two pages including the project information page (see previous page). Margins are currently set at ½ inch all sides.

Task 1 - Title – Approach (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 2 – Title – Approach (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 3 – Title – Approach (Arial 11- Bold)

The text needs to be Arial 11 - justified

SUMMARY OF CURRENT YEAR PROGRESS (Arial 12 – All Caps)

The text needs to be Arial 11 - justified. Do not include page numbers – we will assign page numbers in the master copy. Maximum length needs to be two pages including the project information page (see previous page). Margins are currently set at ½ inch all sides.

Task 1 - Title – Descriptions (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 2 – Title – Descriptions (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 3 – Title – Descriptions (Arial 11- Bold)

The text needs to be Arial 11 – justified

SUMMARY OF PLANNED EFFORTS FOR NEXT PERIOD (Arial 12 – All Caps)

The text needs to be Arial 11 - justified. Do not include page numbers – we will assign page numbers in the master copy. Maximum length needs to be two pages including the project information page (see previous page). Margins are currently set at ½ inch all sides.

Task 1 - Title – Planned (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 2 – Title – Planned (Arial 11- Bold)

The text needs to be Arial 11 - justified

Task 3 – Title – Planned (Arial 11- Bold)

The text needs to be Arial 11 – justified

NOTE: Executive Summary should not contain detailed data – should be a SUMMARY OF YOUR STORY for management review – SHOULD BE LIMITED TO 2 – 3 PAGES

APPENDIX M – IAB Annual Members' Report – Technical Template

CFSP Site: SDSM&T

Number	Project Title			Budget
CFSP04-AMP-01	Design, Analysis and Performance of "Built-Up" Aluminum Friction Stir Welded (FSW) and Friction Stir Spot Welded (FSSW) Structures			$89,000 (Year 1)
Report Date	**Start Date**	**End Date**	**PI and Senior Personnel**	**Students**
October 01, 2005	October 01, 2004	September 30, 2005	Bill Arbegast Anil K. Patnaik Casey Allen	Travis Reidy (MS) Barney Frankl (Sr) Matthew Herringer (Sr) Cassandra Degan (Jr) Neelima Nagotu (MS) Karl Koch (Sr)

ANNUAL REPORT (Arial 14 – All Caps)

CFSP04-AMP-01: Design, Analysis and Performance of "Built-Up" Aluminum Friction Stir Welded (FSW) - Arial 14

INTRODUCTION (Arial 12 – All Caps)

The objectives of this program are to expand the understanding and knowledge of the design and analysis methodologies for friction stir welded aluminum structures. The technology readiness level for aluminum FSW is high with current industrial implementations in DOD and NASA. Friction Stir Spot Welding is currently under development within this country and the technology readiness is low. The DOD and NASA application of FSW generally incorporates design approaches (*elastic design*) that preclude plastic deformation of structures during service. Engineering structures such as bridges, building, etc oftentimes use *plastic theory* or *ultimate design* and analysis methodologies that allow for a certain degree of plastic deformation under extreme loading conditions. Allowing the structure to deform plastically enables it to absorb more of the imposed energy. The degree of plastic deformation permitted depends upon the function of the structure and the number of anticipated extreme loading events. FSW allows the use of the "*Built-Up*" structures design approach where dissimilar aluminum alloys may be metallurgically joined with the properties at individual locations within the structure tailored to meet service requirements. Commercial implementation of aluminum FSW is hampered by the lack of standardized values for static and dynamic response, and environmental compatibility, of specific FSW joint types which may be used in "*Built-Up*" FSW structures.

Current Year Project Objectives

- Develop design and analysis methodologies for built-up aluminum FSW beams, skin stiffened panels, and friction stir spot welded structures
- Design, fabricate, and test response of aluminum built-up beams, skin stiffened panels and friction stir spot welded panel
- Compare test results with the behavior predicted by the models developed
- Provide design and analysis guidelines

FIRST LEVEL HEADINGS (Arial 12 – All Caps)

The text needs to be Arial 11 - justified. Do not include page numbers – we will assign page numbers in the master copy. Maximum length needs to be two pages including the project information page (see previous page). Margins are currently set at ½ inch all sides.

Task 1 of this project comprised both experimental work and the related theoretical studies on built-up FSW beams. In the experimental work, the following four types of beams were studied:

1. Type I "One Weld" Web
2. Type II "Two Weld" Web
3. Type III "Reinforced Flange"
4. Type IV "Closed Box"

Cross-sectional details of the four types of beams are shown in Fig. 1.

Second Level Headings (Arial 12, Title Case, Left Aligned, Bold)

In this type of beams, two T's sections were friction stir welded to fabricate an I-shaped beam. Fig. 1.2 shows the elevation details a typical beam. The corresponding dimensional details of the seven test beams in Type I are given in Table 1. Fig. 1.3 illustrates the assembly of different parts to fabricate a typical Type I beam. The figure shows two 6061-T6 T-sections with flange width of 2 inches and depth of 2 inches that were butt welded to fabricate a beam of four inches overall depth and 24 inches overall length. The thickness of the web and the flange of the T sections was 0.125 inch. Two point loads were to be applied to the test beam at the top as indicated by arrows in Fig. 1.2, and the support points were at the two ends of the test beams. Beams T1-S1-B1 to T1-S1-B5 were fabricated with 6061-T6 T-sections.

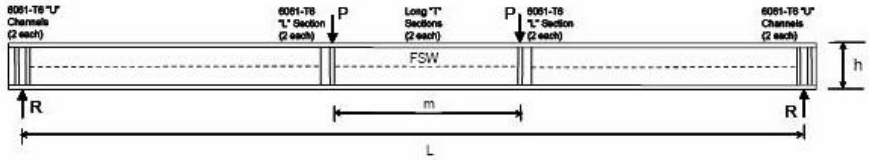


Fig. 1 Arial 11 Bold Title Case
(Figure not to scale)

Table 1 Arial 11 Bold Title Case

Beam #	Material Type	Span, L, inch	Spreader Span, m, Inch	Beam Depth, h, inch	Flange Width Inch	Flange Thickness Inch	Depth of "T", (h/2)*, Inch	Web Thickness, Inch
T1-S1-B1	6061-T6	22	11.5	4	2	0.125	2	0.125
T1-S1-B2	6061-T6	23	6	4	2	0.125	2	0.125
T1-S1-B3	6061-T6	44	6	4	2	0.125	2	0.125
T1-S1-B4	6061-T6	42	6	4	2	0.125	2	0.125
T1-S1-B5	6061-T6	48	6	4	2	0.125	2	0.125
T1-S1-B6	7075-T6511	24	6	2	2	0.080	1	0.080
T1-S1-B7	7075-T6511	22	6	2	2	0.080	1	0.080

* Depth of T-section is the length of the stem plus flange thickness.

Third Level Headings (Arial 12, Title Case, Left Aligned, No Bold, Underlined, Italic)

Example of Equations

The slenderness (λ for LTB limit state is defined as:

$$\lambda = \frac{L_b}{r_y} \tag{1}$$

Where,

λ = Slenderness of the beam for LTB limit state
L_b = Unbraced length of the beam (length of the compression flange that remains laterally unsupported)
r_y = Radius of gyration of the beam section about its minor axis

$$\lambda_f = \frac{b_f}{2t_f} \tag{2}$$

Where,

λ_f = Slenderness of the beam for FLB limit state
b_f = Width of the compression flange
t_f = Thickness of the flange

SUMMARY AND CONCLUSIONS

In this study, fabrication issues, FSW issues, and structural behavior of four types of friction stir welded beams were investigated. The study revealed that structural behavior of friction stir welded beams is very similar to that of the corresponding monolithic beams with identical dimensions. Based on the fabrication of the four types of the beams, and the structural tests of Type I and Type II beams, the following salient points may be summarized:

1. Fabrication of FSW beams is feasible with relatively low cost fixtures and tooling. The fabrication of the beams can be done in reasonable short times.
2. Structural tests of the beams revealed that all the FSW test beams behaved in a predictable manner and similar to that expected of monolithic beams with identical dimensions and made from the same materials.

APPENDIX N – I/UCRC independent Evaluator Industry questionnaire

NATIONAL SCIENCE FOUNDATION

INDSUTRY-UNIVERSITY COOPERATIVE RESEARCH CENTERS EVALUATION

Industry Questionnaire

CENTER:

INSTRUCTIONS: Please answer all questions. For multiple choice questions, please CIRCLE the number that corresponds to your response. For the remaining questions, please FILL IN the blanks as indicated. *Please attach additional sheets as necessary.*

PLEASE RETURN BY:

Return to:

I. Research Program

1) What percentage of center research projects do you take an active interest in?

0-19% (1)	20-39% (2)	40-59% (3)	60-79% (4)	80-100% (5)	[7]

2) Among current and recent center projects, which two have had the greatest relevance for your organization/division? (list by project name or investigator)

[comment = 1; no comment = 0]

a) [8]

b) [9]

3) During the past year, how satisfied were you with the following features of the center's research program?

	Not Satisfied	Slightly Satisfied	Somewhat Satisfied	Quite Satisfied	Very Satisfied	
a) Capabilities of the researchers & quality of the research program	*1*	*2*	*3*	*4*	*5*	[10]
b) Breadth of the research topics covered	*1*	*2*	*3*	*4*	*5*	[11]
c) Focus of the research	*1*	*2*	*3*	*4*	*5*	[12]
d) Relevance of research to my organization's needs	*1*	*2*	*3*	*4*	*5*	[13]

4) How can the center improve its research program? What features of the research program would your organization definitely want to see continued?

Comments on items 3a-d rated "1" or "2" are particularly valuable. [14]

[comment = 1; no comment = 0]

II. Benefits

5) During the past year, approximately how many center-stimulated research projects were supported by your organization (include internal projects and projects contracted to outside performers)? Please estimate the dollar value of all center-stimulated research projects. Exclude center membership fee.

# of center-stimulated projects supported: ___ ___	[15-16]

Total approximate value of all projects combined (check one) [17-18]

___$10K(01)	___$250K(07)	___$800K(13)	___$3.0 Million(19)
___$25K(02)	___$300K(08)	___$900K(14)	___$4.0 Million(20)
___$50K(03)	___$400K(09)	___$1.0 Million(15)	___$5.0 Million(21)
___$100K(04)	___$500K(10)	___$1.5 Million(16)	_____Other (specify) (22)
___$150K(05)	___$600K(11)	___$2.0 Million(17)	
___$200K(06)	___$700K(12)	___$2.5 Million(18)	

6) During the past year, how many students trained in the center research projects were hired by your organization?

Students hired: ___ ___	[19-20]

7) During the past year, to what extent has participation in the center contributed to the following benefits for your organization?

	No Impact	Slight Impact	Moderate Impact	High Impact	Very High Impact	N/A	
a) ***Research & Development:*** Enhanced via increased technical awareness, accelerated or new projects or development of intellectual property in my organization.	*1*	*2*	*3*	*4*	*5*	*9*	[21]
b) ***Commercialization:*** Enhanced via improved or new products, processes, services, improved sales, or new or retained jobs.	*1*	*2*	*3*	*4*	*5*	*9*	[22]
c) ***Professional Networking:*** Enhanced via improved ability to recruit students, increased cooperation with other industrial members and scientists outside my organization.	*1*	*2*	*3*	*4*	*5*	*9*	[23]

8) If your organization has benefited technically from its participation in the center, please describe how (e.g. brief description of research advance or product/process improved, etc.) and, where possible, try to quantify benefit (e.g. dollars saved, months saved, waste/scrap reduced, etc.).

Note: this information is helpful for member recruitment and continuing government sponsorship.

[24]

[comment = 1; no comment = 0]

III. Center Administration and Operations

9) During the past year, how satisfied were you with center administrative operations?

Not Satisfied	Slightly Satisfied	Somewhat Satisfied	Quite Satisfied	Very Satisfied
1	*2*	*3*	*4*	*5*

[25]

10) How can the center improve its administration and operations program?

[26]

Please Circle and comment on any issues that can be improved.

(a) communication
(b) planning & development of research program
(c) management of projects
(d) project selection
(e) proposals & publications
(f) technology transfer
(g) intellectual property
(h) fundraising
(i) Other

What features of the center administration would your organization definitely want to see continued?

[comment = 1; no comment = 0]

IV. General Evaluation

11) Will your organization renew its membership?

Definitely Not	Probably Not	Uncertain	Probably Yes	Definitely Yes
1	*2*	*3*	*4*	*5*

[27]

12) What can the center do to make your renewal more likely?

[28]

[comment = 1; no comment = 0]

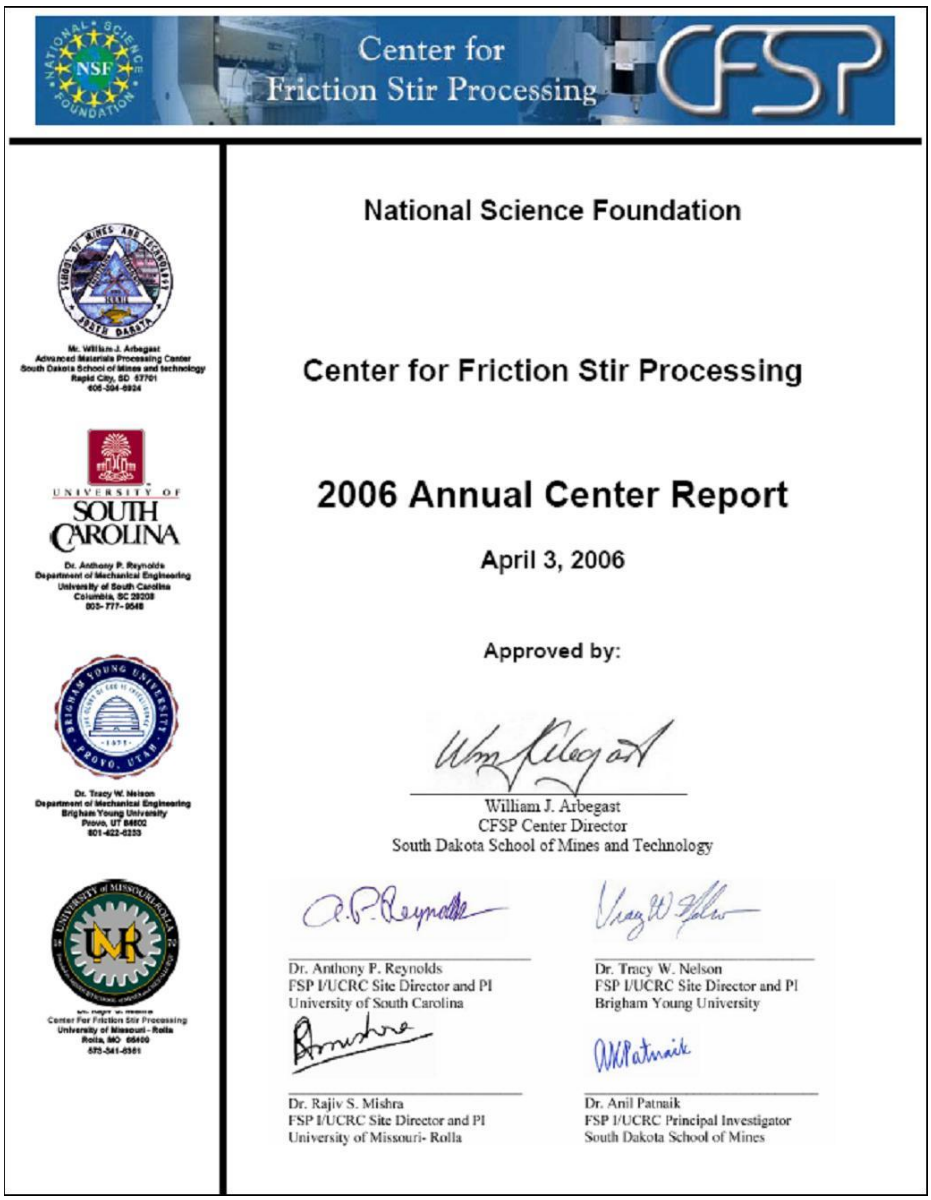
13) Organization Type/Size:

[29]

For Profit-Large (>500 Employees) (1)	For Profit-Small (<500 Employees) (2)	Non-Profit / Government (3)

THANK YOU FOR YOUR COOPERATION!

APPENDIX O – CFSP NSF Annual Report Format and Example



Center for Friction Stir Processing

CFSP

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National Science Foundation

Center for Friction Stir Processing

2006 Annual Center Report

April 3, 2006

Approved by:

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South Dakota School of Mines and Technology

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FSP I/UCRC Site Director and PI
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Dr. Rajiv S. Mishra
FSP I/UCRC Site Director and PI
University of Missouri- Rolla

Dr. Anil Patnaik
FSP I/UCRC Principal Investigator
South Dakota School of Mines

Major Accomplishments

SDSMT: "Built-Up" Aluminum FSW and FSSW Structures

- Completion of fabrication of Type 1 and Type 2 beams, mechanical, metallurgical and static structural tests, data analysis, theoretical work, and documentation
- Static structural test of a built-up beam configuration with two sheets welded to square tubes to form box beams (Type 4)
- Process development of Type 3 beam FSW configurations
- Fabrication of several stiffened panels with angle stiffeners or T-stiffeners, related mechanical, metallurgical and static structural tests, data analysis, theoretical work and documentation
- FSSW trials
- Preliminary work for FSW residual stresses –procured residual stress measurement system
- Fabrication of panels for fatigue studies and coupon tests (in progress)

SDSMT: Intelligent Process Control System Algorithms for Aluminum and Steel FSW

- Performed four experiments (FSW05088, FSW05128, FSW06008 and FSW06010) and got weld data for various parameter settings
- Fourier analysis of data from welds of the experiments has verified the hypothesis which is stated in Toshio Morihara's master's work. The hypothesis is FFT's of y force appear to give information that can be used to classify the volumetric quality of a weld
- In order to classify FFT's, we trained a neural network and got approximately 97% accuracy on the weld quality classification. Thus, we concluded that a neural network and FFT based algorithm can be used to classify quality of weld
- We are attempting to remove machine dependent noise from the distorted feedback signals (FSW06010-Noise Detection Experiment)
- Shape of the trajectories of feedback signals in phase space can be correlated to quality of weld. We are continuing to investigate this processing parameters and weld evaluation for training the control system that is being developed

SDSMT/CNDE TIE: Effects of Defects in Friction Stir Welds

- An existing pin tool (#-250-750) was used with a large shoulder, small and fine threads, and a shortened pin length of 0.246".
- Trial welds were made (work order number FSW05185) for 0.25" thick panels, metallography was completed, area of the defect was measured, and diameter of the defect was calculated assuming the wormhole to be spherical. A process map was also created.
- Trial welds (work order number FSW05185) were sent to CNDE at Iowa State University.
- A Boeing pin tool (#04003) was used with a pin length of 0.121" for making trial welds on 0.125" thick panels.

- Trial welds were made (work order number FSW06008) for 0.125" thick panels, metallography was completed, area of the defect was measured, and diameter of the defect was calculated assuming the wormhole to be spherical. The development of a process map is in progress.

UMR: Microstructural Modification through Friction Stir Processing

- Training of the graduate students to program and run the robotic and two-axis FSW machines, and to conduct metallurgical and mechanical tests
- Obtained F357 investment cast boxes
- FSP trials on investment cast 357 specimens, and related metallurgical and mechanical tests, data analysis and theoretical work
- Design of pin tools for FSP of cast boxes

UMR: Robotic Friction Stir Welding of Thin Sheets

- Training of the graduate students to program and run the robotic and two-axis FSW machines, and to conduct metallurgical and mechanical tests
- Obtained 6111 and 5083 alloy sheets from General Motors
- Obtained sheet welding fixtures and tools from Friction Stir Link
- FSW trials on thin sheet welding of coupons, and related metallurgical and mechanical tests, data analysis and theoretical work

USC: Thermal Management for Improved Properties and Weldability in Aluminum and Titanium

- Completed 12 of 32 DOE welds for the Thick Plate Transient studies.
    - Hardness profiled for all welds.
    - Temperature data obtained.
- Completed fatigue testing of 7050 thin plate fast and slow welds with as welded geometry.
- Begun fatigue testing of 7050 thin plate fast and slow welds with surface modified geometry (flash removed, edges polished).
- Residual stress measurement in thick and thin plate 7050 welds has been completed.
- Torque/x-force/y-force vs. rpm have been mapped for 6019 and 6056 at one welding speed.
- Thermal simulation now includes modeling of heat flow into the tool.
- Thermal simulations with varying heat generation volumes have been tested.
- Effect of hardness minimum depth on crack path has been simulated using critical COD criterion.
- Submerged (underwater) welding apparatus complete.

BYU: Friction Stir Welding of X-65 Steel

- Process windows developed for smooth truncated cone pin, step spiral pin, and convex shoulder, step spiral pin tools.
- Full consolidation achieved from 2-7 inches/minute and 350-750 rpm
- Grains sizes between 0.5 and 10 μm achieved
- Upper bainite observed in stir zone
- Weld metal and HAZ have higher strength than base metal
- Weld parameters observed to affect locations of maximum deformation
- Weld and HAZ material exceeds base metal minimum specified properties.

BYU: Friction Stir Welding of Alloy 718

- Process parameters explored with truncated cone pin and step spiral pin tools
- Significant grain size reduction observed in weld zone
- Weld properties intermediate between annealed and precipitation hardened base metal
- Convex scrolled shoulder, step spiral pin tools tested in 304L stainless
- Reduced tendency for sigma formation in 304L

RESEARCH GOALS

SDSMT: "Built-Up" Aluminum FSW and FSSW Structures

- Develop design and analysis methodologies for built-up aluminum FSW beams, skin stiffened panels, and friction stir spot welded structures
- Design, fabricate, and test response of aluminum built-up beams, skin stiffened panels and friction stir spot welded panel
- Compare test results with the behavior predicted by the models developed
- Provide design and analysis guidelines

SDSMT: Intelligent Process Control System Algorithms for Aluminum and Steel FSW

- Expand the understanding and knowledge of the requirements for performing FSW on large "Built-up" aluminum structures and to develop process control system algorithms that ensure highest quality welds.
- Systematic removal of the assumptions on the types of materials involved.
- Use of other forces for control algorithms.

SDSMT/CNDE TIE: Effects of Defects in Friction Stir Welds

- Find the effects of defects on the strength and reliability of friction stir welded joints in aluminum 7075 T73 alloy.
- Develop a data relating the defect size to fatigue and tensile properties, as well as non-destructive evaluation data**.**

BYU: Friction Stir Welding of X-65 Steel

- Process Develop weld schedules for FSW of X-65 in thicknesses up to 13 mm
- Develop relationships between process parameters and resultant properties in this alloy
- Extend tool life in FSW of X-65

BYU: Friction Stir Welding of Alloy 718

- Develop parameters for FSW of Alloy 718
- Determine mechanical properties achievable in 718
- Increase process speed for FSW of 718
- Explore effects of tool geometry on sigma phase formation

UMR: Microstructural Modification through Friction Stir Processing

- Process-microstructure correlations
- Microstructure-strength-fatigue correlations
- Establish the method for best incorporation of particles
- Basic property data for surface modified material

UMR: Robotic Friction Stir Welding of Thin Sheets

- Welding parameters-microstructure-strength correlations
- Microstructure-formability correlations

USC: Thermal Management for improved properties and weld ability in Aluminum and Titanium

- Perform DOE for determination of critical parameters during start up of thick plate welds.
- Use simulations to assess the efficacy of extrinsic cooling/heating for management of process temperatures.
- Complete fatigue and fracture characterization of the 7050 thin plate welds.
- Begin weld process development and characterization of the 6019 plate.

SHORT DESCRIPTION OF COMMUNICATION WITH CENTER MEMBERS

Communication has been maintained throughout the first year via the Center website, email and mail. A secure website has been established by UMR. The website outlines the Centers objectives, participants, and focus of the Center for the general public. A secure Section of this website has been set up for the centers university sites and industrial sponsors to access proprietary reports and communication. Quarterly reports have been prepared and sent to all industrial sponsors via mail and website distribution. Likewise, the semiannual meeting notes and presentations were provided to the sponsors in CD format as well as on the CFSP website. Progress reports for the current

projects are posted on the CFSP website. All other reports that are currently being produced will be placed in a secure portion of the CFSP website from where the members can download the reports. The IAB Chair communicates with the Center members and the University researchers.

PROJECT SELECTION PROCESS USED BY THE CENTER

Project proposals for year 2004-2005 were presented by the PI's of the project to the Center members at the fall 2004 kick-off meeting, and the members approved the projects by voice vote. At the spring 2005 IAB meeting the industrial members agreed to develop a selection process and present it at the fall 2005 meeting for approval.

QUANTITATIVE INFORMATION

Number and Diversity of Students

- SDSMT:
  - Male: 9
  - Female: 2
- BYU:
  - Male: 5
  - Female: 1
- USC:
  - Male: 5
  - Female: 1
- UMR:
  - Male: 4
  - Female: 0

Number and Diversity of Faculty and Senior Personnel

- SDSMT:
  - Male: 5
  - Female: 0
- BYU:
  - M ale: 3
  - Female: 0
- USC:
  - Male: 4
  - Female: 0
- UMR:
  - Male: 2
  - Female: 0

Industrial Members

- SDSMT: 6
- BYU: 5
- USC: 5

- UMR: 4

Degrees Granted to Students Involved in Center Activities

- SDSMT: 0
- BYU: 1
- USC: 0
- UMR: 0

Amounts and sources of income to the center, patents, licenses and publications created

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

GENERAL CENTER IDENTIFICATION NUMBER

Year of Initial Funding: 2004

Center Director and Contact Information

Mr. William J. Arbegast
Center Director, NSF Center for Friction Stir Processing (CFSP)
Director, Advanced Materials Processing and Joining Laboratory (AMP)
South Dakota School of Mines and Technology
501 East Saint Joseph Street
Rapid City, South Dakota 57701, USA
(605)-394-6924
william.arbegast@sdsmt.edu

Partner University Site Directors and Contact Information

Dr. Anil Patnaik
Assistant Professor
Department of Civil and Environmental Engineering
South Dakota School of Mines and Technology
501 East Saint Joseph Street
Rapid City, South Dakota 57701, USA
Phone: (605)-394-2442

Dr. Tracy W. Nelson
Associate Professor
Mechanical Engineering Department
Brigham Young University
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Dr. Anthony P. Reynolds
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rsmishra@umr.edu

OPERATING BUDGET AND TOTAL FUNDING

Total Center Funding

- SDSMT: $375,000
- BYU: $190,000
- USC: $235,500
- UMR: $186,000
- Total: $986,500

NSF I/UCRC funding received

- SDSMT: $80,000
- BYU: $50,000
- USC: $50,000
- UMR: $50,000

Other NSF Funding Received

- SDSMT:
  - $70,000 (two year MIPR for ARL Membership Fee)
  - $50,000 (Two Year CFSP/CNDE TIE Supplemental)
- BYU: None
- USC: $33,530 (MIPR for NASA Membership Fee)
- UMR: $6,000 (REU supplemental)

Industry Membership Fees (non-MIPR)

- SDSMT: $175,000
- BYU: $140,000
- USC: $139,970
- UMR: $130,000 (includes $35K in-kind)

Additional Support

- SDSMT Cost Share:
  - $31,475 Student Salary Support (includes fringe and OH)
- BYU Cost Share:
  - $40,000 in waived indirect costs
- USC Cost Share:
  - $62,700 waiver of indirect cost on membership fees
- UMR Cost Share:
  - $60,500 (waiver of indirect cost on membership fees and NSF grant + $12,800 from UMR Intelligent Systems Center)

CAPITAL AND IN-KIND SUPPORT

Equipment

- SDSMT: $2,275 –Waive Equipment User Fees
- BYU: $75,000 for new water-jet cutting equipment
- USC: 6019 Aluminum Plate from Kaiser.
- UMR: $5,000 (from Intelligent Systems Center)

Facilities

- SDSMT: None
- BYU: 800 square foot laboratory for new FSW equipment
- USC: None
- UMR: None

Personnel

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Software

- SDSMT: Access to numerical modeling software
- BYU: Access to numerical modeling software
- USC: None
- UMR: None

Other Support

- SDSMT: None
- BYU: Advanced Metal Products provided PCBN tooling as an in-kind membership fee
- USC: Kaiser Aluminum provided aluminum plates as in kind for partial membership fee
- UMR: Friction Stir Link's $35K fee as fixtures, tooling and other support for the robotic FSW machine

INDUSTRY MEMBERSHIP DESCRIPTORS FOR THE CURRENT AWARD

Membership identification

- **Current Members:**
  - SDSMT: Boeing Phantom Works, Army Research Laboratory, Pacific Northwest National Laboratory, MTS Systems, BAE Systems (United Defense), Sikorsky Aircraft
  - BYU: Advanced Metal Products, Hitachi Ltd, JFE Steel Corp, Mitsubishi, Toshiba Corp.
  - USC: Spirit Aerosystems (formerly Boeing-Wichita), NASA Langley Research Center, EADS Airbus, Lockheed-Martin, Kaiser Aluminum
  - UMR: Boeing Phantom Works, Pacific Northwest National Laboratory, General Motors, Friction Stir Link

- **Members At Start of Center Award:**
  - SDSMT: Boeing Phantom Works, Army Research Laboratory, Pacific Northwest National Laboratory, MTS Systems, BAE Systems (United Defense)
  - BYU: Advanced Metal Products, Hitachi Ltd, JFE Steel Corp, Mitsubishi, Oak Ridge National Lab, Toshiba Corp
  - USC: Spirit Aerosystems (formerly Boeing-Wichita), NASA Langley Research Center, EADS Airbus, Lockheed-Martin, Kaiser Aluminum
  - UMR: Boeing Phantom Works, Pacific Northwest National Laboratory, General Motors, Friction Stir Link

- **New Members Added:**
  - SDSMT: Sikorsky Aircraft Systems
  - BYU: None
  - USC: None
  - UMR: None

- **Identify Members Who Left The Center:**
  - SDSMT: None
  - BYU: Oak Ridge National Lab (They have indicated they will join again next year)
  - USC: None
  - UMR: None

Annual Membership Fees

- $35,000 Primary
- $30,000 Secondary
- $30,000 Tertiary

Human Resources

- Researchers
  - SDSMT: faculty scientists/engineers = 5
  - BYU: faculty scientists/engineers = 3
  - USC: faculty scientists/engineers = 3
  - UMR: faculty scientists/engineers = 2

- Students
  - SDSMT: graduate students = 4, undergraduate students = 6
  - BYU: graduate students = 1, undergraduate students = 4
  - USC: graduate students = 2, undergraduate students =2
  - UMR: graduate students = 4, undergraduate students = 1

- Administration, number of full and part time professional and clerical staff
  - SDSMT: student administrators = 1 graduate student
  - BYU: Clerical and Professional Staff = 1
  - USC: Laboratory engineer= 1 , Administrative assistant= 1
  - UMR: Clerical and Professional Staff = 1

- Diversity information on the above with plans to increase diversity, if necessary
  - SDSMT: 2 female students
  - BYU: 1 female student, 1 female staff member. Currently recruiting another female undergraduate student and a female graduate student.
  - USC: 8 Male; 1 Female (recruited for a Spring 06 start.)
  - UMR: see above

CENTER DIRECTOR DESCRIPTORS

Center Director (South Dakota School of Mines and Technology)

- Position/Rank of the Center Director
  - Mr. William J. Arbegast
  - Director, Advanced Materials Processing and Joining Laboratory (AMP)

- Status of tenure –
  - N/A

- Identify the name and position of the person to whom the Center Director reports to
  - Gautam Pillay, Ph.D., Vice President for Research

- Director Assignment of Duties
  - Center Administration: 15%
  - Other Administration: 30%
  - Research: 45%
  - Teaching: 5%
  - Other: 5%

Site Director (South Dakota School of Mines and Technology)

- Position/Rank of the Site Director
  - Dr. Anil Patnaik
  - Assistant Professor, Department of Civil and Environmental Engineering

- Status of tenure –
  - Not Tenured

- Identify the name and position of the person to whom the Center Director reports to
  - Dr. Scott Kenner, Chair, Department of Civil and Environmental Engineering

- Director Assignment of Duties
  - Center Administration: 5%
  - Other Administration: 0%
  - Research: 25%
  - Teaching: 60%
  - Other: 10%

Site Director (Brigham Young University)

- Position/Rank of the Site Director
  - Dr. Tracy Nelson
  - Associate Professor
  - Department of Mechanical Engineering

- Status of tenure –
  - Tenured

- Identify the name and position of the person to whom the Center Director reports to
  - Dr. Larry Howell, Department Chair, Department of Mechanical Engineering

- Director Assignment of Duties
  - Center Administration: 20%
  - Other Administration: 30%
  - Research: 25%
  - Teaching: 20%
  - Other: 5%

Site Director (University of South Carolina)

- Position/Rank of the Director
  - Dr. Tony Reynolds
  - Associate Professor
  - Department of Mechanical Engineering

- Status of tenure –
  - Tenured

- Identify the name and position of the person to whom the Center Director reports to
  - Jamil Khan, Ph.D., Department Chair, Department of Mechanical Engineering

- Director Assignment of Duties
  - Center Administration: 10%
  - Other Administration: 10%
  - Research: 45%
  - Teaching: 30%
  - Other: 5%

Site Director (Missouri University of Science and Technology)

- Position/Rank of the Site Director
  - Dr. Rajiv S. Mishra
  - Associate Professor, Department of Materials Science and Engineering

- Status of tenure –
  - Tenured

- Identify the name and position of the person to whom the Center Director reports to
  - Dr. Richard Brow, Chair, Department of Materials Science and Engineering

- Director Assignment of Duties
  - Center Administration: 5%
  - Other Administration: 0%
  - Research: 60%
  - Teaching: 25%
  - Other: 10%

CENTER OUTCOMES

Students Receiving Degrees and Type of Degree Earned

- SDSMT: 1 MS in Materials Engineering and Science
- BYU: 1 BS in Mechanical Engineering; 1 MS in Mechanical Engineering
- USC: 1 MS in Mechanical Engineering; 1 PhD in Mechanical Engineering
- UMR: None

Students Hired by Industry by Type of Degree

- SDSMT: 1 MS in Materials Engineering and Science
- BYU: 1 MS in Mechanical Engineering
- USC: 1 MS in Mechanical Engineering; 1 PhD in Mechanical Engineering.
- UMR: None

Publications with Center Research

- SDSMT: 5 publications in area FSW but not supported by Center funds
- BYU: None
- USC: 7 publications in the area of FSW but not supported by Center funds
- UMR: None

Publications with IAB Members

- SDSMT: 2 publications in area FSW but not supported by Center funds
- BYU: None
- USC: None
- UMR: None

Number of Presentations

- SDSMT: 4 presentations in the area of FSW but not supported by Center funds
- BYU: None
- USC: 3 presentations in the area of FSW but not supported by Center funds
- UMR: None

INTELLECTUAL PROPERTY EVENTS

Invention Disclosures

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Patent Applications

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Software copyrights

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Patents Granted/Derived

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Licensing Agreements

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

Royalties Realized

- SDSMT: None
- BYU: None
- USC: None
- UMR: None

APPENDIX P – CFSP External Evaluator Report Example

National Science Foundation
Industry/University Cooperative Research Center for
Friction Stir Processing

NSF I/UCRC-FSP

South Dakota School of Mines and Technology, Brigham Young University
University of South Carolina, and University of Missouri – Rolla

2006 Evaluator's Report
Vision, Mission and Objectives

Vision: The Center for Friction Stir Processing (CFSP) vision is to provide the forum for industry/university cooperative research on the further development and validation of emerging technologies involving solid-state materials joining and processing known as Friction Stir Processing (FSP).

Mission: The Center's mission is to be the leading academic organization that develops relevant scientific knowledge for understanding and expanding technology in the area of solid-state materials joining and processing known as Friction Stir Processing for the benefit of its members and in support of the overall mission of the National Science Foundation (NSF). Specifically to:

- Advance, develop and promote research into the principles and technology of FSP science and engineering through research, development, education, and technology exchange among academic, industry, and government entities
- Increase the quantity and quality of professionals prepared to work in this area
- Involve the faculty of the consortium university(s) in research in areas of common interest to sponsors and the university(s)
- Perform research that will promote the global competitiveness of sponsor friction stir processing facilities

Objective: The overall objective of the Center is to develop and deliver relevant scientific knowledge that will help its members with future challenges. Center programs are designed to complement the members' in-house research and development in the area of friction stir processing by bringing together theoretical, experimental and application experts from industry and academia in order to:

- conduct pre-competitive leading edge research related to emerging and traditional FSP technologies
- develop next generation friction stir processing models
- develop next generation computational design tools

- develop innovative methods to effectively train students and engineers in the area of FSP to enlarge the cadre of scientists and technologists capable of working effectively in this area

CFSP Organizational and Research

University and Companies: For this evaluation time period, the CFSP had four affiliated universities: South Dakota School of Mines and Technology (SDSM&T), Rapid City, SD; Brigham Young University (BYU), Provo, UT; University of South Carolina (USC), Columbia, SC; and The University of Missouri – Rolla (UMR), Rolla, MO. SDSM&T is the lead institution and BYU, USC and UMR are site universities funded by NSF. The Wichita State University has petitioned the CFSP to become an additional university site and acceptance of the planning grant proposal is expected during the next reporting period.

The Center has been active since October of 2004. Researchers at the four participating universities have significant expertise and professional interest in the area of friction stir processing. SDSM&T leads center research related to Design Space Integration Into Processing Space, Intelligent Process Sensors and Controls, Structural Design and Analysis and FSP equipment; BYU leads center research in the areas of “Hard to Join” Materials and High Temperature Pin Tools; USC leads center research in Process Modeling, Process Optimization, Joint Performance and Fracture and Fatigue; and UMR leads center research in Microstructure-Property Correlations, Microstructure Modification, materials Processing, Life Cycle Analysis and Technology Diffusion. The scientists, unique laboratories and specialized equipment of these institutions are highly complementary. Many members of the faculty and research staff of CFSP institutions enjoy international reputations in their disciplines. They hold many prestigious awards both as researchers and educators and are active members in related national and international organizations.

Nineteen companies have signed the CFSP membership agreement as of October 2005. Current CFSP members include MTS Systems Corporation, Pacific Northwest National Labs, The Boeing Company, BAE Systems Corporation, US Army Research Laboratory, Sikorsky Aircraft, NASA Langley Research Center, Spirit Aerosystems, Kaiser Aluminum, EADS Airbus, Lockheed Martin Space Systems – Michoud Operations, JFE Steel Corporation, Mitsubishi Heavy Industries, Ltd., Toshiba Corporation, Hitachi, Ltd., Oak Ridge National Laboratory, Advanced Metal Products, Inc, General Motors Corporation, and Friction Stir Link. With the exception of the government research laboratories, these firms are large in size, for profit organizations, and internationally recognized in engineering design, manufacturing and production of military and commercial (aerospace and land systems) products and testing systems hardware. Three of these companies have "in kind" memberships (no cash support); however, they do participate as advisors on all sponsored research projects. Two of these companies have dual membership at SDSMT and UMR.

The time period covered in this report can be characterized as one of general stability. Negotiations are currently underway with multiple firms to become full members of CFSP. These potential new members include Alcan and SKB, Sweden.

Organization: The Center Director is responsible for all Center activities and reports directly to the Vice President for Research at the South Dakota School of Mines and Technology and the Industrial Advisory Board (IAB). The Site Directors at the lead and site universities are responsible for Center activities at their university and report directly to their respective appropriate university administrators and to the Center Director. The Site Directors also provide liaison between the Center and the appropriate academic departments of the member universities. Site Principal Investigators manage specific research projects funded by the Center and report directly to the appropriate Site Director, the appropriate university administrators, and to the sponsors supporting the project.

The Center has formed a multi-university administrative oversight and policy committee consisting of the Vice President or Provost of Research (or his/her designee) at each university to resolve any and all Center administrative issues, including review of academic standards, recruitment strategies, retention issues, funding issues, space requirements, and equipment requirements related to the Center. This committee assures faculty recognition for participation in the Center in tenure and promotion decisions, and to assure that the research is appropriate for graduate education. Additionally, the lead university and each participating university has provided a reasonable level of clerical and accounting support staff for Center operations.

All sponsors participate in the strategic planning of the Center. The IAB assists the Center Director, Co-Directors and faculty in:

- Identifying pre-competitive, generic, industry-related, multidisciplinary research problems in friction stir welding and processing
- Recommending research projects for future work
- Assisting in identifying appropriate industrial internship opportunities for graduate students and postdoctoral students
- Identifying new sponsors
- Reviewing the research and educational accomplishments of the Center
- Recommending the restructuring of on-going programs and/or redirecting on-going programs to meet IAB needs and concerns

Although individual sponsors of the Center join the Center through one of the university sites, there is only one IAB for the Center. The IAB selects a Chairperson for a two-year term at the IAB meeting held in October.

Membership fee sponsors and in-kind sponsors have one representative on the IAB. A company may have more than one Center membership and, thereby, may have more than one Center representative on the IAB.

Administration: The Center Director and Site Directors work with the IAB on strategic plans for the Center and on recruiting new sponsors. The Center Director in cooperation with the Site Directors submits an annual operating and research budget to the IAB for review and recommendations prior to the spring IAB Meeting of each year. The Site Directors, upon recommendation of the IAB and the Center Director, authorize the use of membership fees by the Project Principal Investigators in support of Center research. The Site Directors work with the appropriate departments on recruiting graduate students for the Center and set standards for student participation; monitor student progress towards a degree; set goals for recruiting students (especially minority and women); promote multidisciplinary nature of the research program; and, help students to organize industrial internships. The Site Directors develop a strategy to integrate Center technologies into the academic curriculum at each participating university to the maximum extent possible.

Each CFSP I/UCRC graduate student have a Center faculty mentor and, if available, at least one Center industrial advisor. The faculty mentor is responsible for advising the student on university, departmental, and Center policies.

With the exception of UMR becoming a participating site university during this reporting period, the structure of Center has not changed significantly since its inception and there have been no faculty personnel changes. There have been no major policy changes. The IAB plays a very active role in forming the long-range and short-range plans for the research program. Industry continues to be instrumental in defining the current thrust areas. Generally, ideas for research are generated by both the participating faculty and industry partners or from suggestions made on comments at the semi-annual IAB review meetings. Faculty proposals are generated from these ideas. The strategy for a long-range (5 year) plan continues to entail asking Center participants to envision where they would like Center research to be in five years. The Center staff then develops plans to reach these research goals by identifying major milestones and technology barriers. These plans are used by faculty to monitor their progress.

Research: CFSP research topics continue to focus on the needs of the sponsors and the capabilities of the university(s). The primary areas of research include:

- Friction Stir Joining

- Friction Stir Microstructural Modification
- Friction Stir Post-Processing
- Friction Stir Structural Designs and Application
- Friction Stir Intelligent Controllers and Efficient Tooling
- Friction Stir Cost Benefits Analysis

While the research program can be modified based on input received from the IAB, numerous specific projects within these topical areas are conducted. Brief descriptions of this year research projects were reported to the members during 2005 via quarterly reports distributed by mail and published on the website. Additional specific problem-oriented research projects are identified in collaboration with industrial projects and others will be added as capabilities grow. New projects are tailored to the specific needs of new members.

Environment: The CFSP Center Director and the four site Co-Directors have been very active in their recruiting efforts and developing research proposals for federal funding. During the rating period, there have been nineteen industrial and government partners. Several additional companies and organizations have been contacted. In this regard, the Fall IAB meeting hosted by SDSM&T invited others to the IAB meeting in an effort to attract new members to the Center. Their 2005 recruitment objectives to obtain a total of five memberships for UMR were accomplished.

As stated above, the CFSP serves a number of government laboratories and diverse, internationally recognized and generally large in size for profit companies in the aerospace and land systems and testing equipment. Financial support for the Center comes from NSF grants and member companies and organizations that form the IAB. Each company member provides funding and member company dues are used for research.

Center Accomplishments

Knowledge/technical advances: The past year is marked by a substantial number of major accomplishments for CFSP. In particular, SDSM&T researchers made significant advances in: “Built-Up” Friction Stir Welding (FSW) of aluminum and steel structures; intelligent process control system algorithm development for aluminum and steel FSW; and, FSW of dissimilar alloy steels (a REU Program). The UMR team created a Friction Stir Welding and Processing (FSW/P) database and developed process parameter correlations capability. BYU research staff made significant FSW of high temperature materials advances for a wide range of parameters and different tool designs. The USC continues to make significant developments aluminum and Titanium FSW thermal management, in particular, improved algorithms for

prediction of temperature fields have been implemented and process development tools based on analysis of process response variables are being developed and validated.

Technology transfer: All sponsors have non-exclusive rights to the entire CFSP I/UCRC research portfolio under the conditions outlined in the Membership Agreement. All Sponsors have an opportunity to directly contribute to CFSP I/UCRC research and education programs by serving as industrial mentors and/or thesis committee members as appropriate and consistent with the policies and procedures of participating Universities. They have the opportunity to propose case study problems, specific research problems, and focus areas for research. The case study problems are used to train CFSP I/UCRC students on the use of current CFSP technologies. Additionally, all Sponsors have the opportunity to host postdoctoral research associates and/or graduate students as industrial interns. Technology transfer between the faculty/student research teams and industrial partners from the Center's perspective will be promoted by:

- Pre-doctoral and post-doctoral industrial internships
- The direct involvement of the industrial advisor on the research team
- Web based submission of reports
- Semiannual research retreats

The participating member companies responding to this year's survey purported the dollar value benefit to them from all of the research projects combined ranged from $0-$62,000 per company. One member reported an estimated value of $700,000 saved for three projects. For most firms, commercialization of the research had no to slight impact with the exception of many members who reported that Center research had a moderate to high impact on "Improvements to existing products, processes and/or services" and "Development of new products, processes and/or services".

Educational impacts: The CFSP has been operational for one year. During this evaluation period, the I/UCRC has 2 journal articles in preparation. The Center participants have also contributed to text books. The research at the Center is now coming to a maturity level that will result in publications, once approval is given from the IAB.

Analysis: Responses to the annual survey sent to members, personal discussions during the two IAB meetings and the use of LIFE forms remain the primary sources to measure member interest and satisfaction in CFSP current and proposed research programs and accomplishments. During the reporting period, most members reported that they took an active interest in more than 40-59% of the Center's currently funded projects. (CFSP distribution results

mean of 3.5 (60-79%) compares to the national average mean of 2.9 (40-59%) for FY 2003-2004). The CFSP member satisfaction levels with the Center are extremely good overall and in particular, most of the members reported that they are quite satisfied to very satisfied with all features of the CFSP Research Program. With the exception of one respondent, all reported that they were quite satisfied to very satisfied with "the relevance of Center research to support their organization's short term and long term needs. Company representatives reported that their organizations benefited primarily through increased technical understanding, the availability of laboratory resources and exposure to cutting edge FSP capabilities. There are, however, comments that suggest there is a perception that the universities are not collaborating and coordinating their site specific research programs as effectively as they should. The 2005 fall Industry Advisory Board (IAB) approved going forward with Wichita State University as an additional CFSP site university. Wichita State University brings complementary capabilities and the prospect of attracting additional companies to the Center. This provides the opportunity for the Center to revisit and modify its overall research program goals, project objectives, timelines/major milestones and deliverables to eliminate this perception. Doing so would also ensure there is no duplication of efforts among sites. This would not only help current members but, most significantly, would also help prospective Wichita State members identify how their individual organizations could benefit by participating in the Center. Additionally, the membership would be able to revisit it periodically and be able to recommend how it could be adjusted to suit their changing needs.

The Center's Research and Development technical benefits mean values fell short of the FY 2003-2004 I/UCRC's national norms. Member companies stated that the hiring of students and staff with expertise in the Center's core competency areas was a very valuable benefit and critical to their keeping abreast of technology advances (one student was hired during this evaluation period). Company access to expensive laboratory equipment and trained specialists also provided them exposure to research capabilities that that they did not have to develop. As quantified above, many members reported a very high dollar value to the technical benefit resulting from center-stimulated research projects and processes. However, since the Center has been in operation for less than two years and because most of its IAB members have been members less than two years, their ratings, assessments and comments need to be interpreted with caution. The primary challenge in this regard is for the Center to ensure that the technology being developed is transferred effectively to its members. Specific deliverables complete with technology transfer mechanisms in place coupled with a clearly defined research program will help retain current members and assist in recruiting new members.

In summary, the respondents are quite satisfied with the Center's research capabilities and performance. It was apparent from both IAB meetings that the CFSP research and administrative staff has an excellent working relationship with the current industrial members. Most reported high levels of satisfaction with all aspects of Center Administration and Operations. They enjoyed the Center's IAB meetings, the technical and scientific presentations, poster sessions and the stimulating intellectual discussions. The CFSP has a very informative, up to date and easy to use website with all Center generated information (including LIFE forms and responses to same) for its membership. The Center Directors have made member site visits and distribute all CFSP meeting materials in CD format. However, some of the members' open ended responses suggest that communications need to improve. This is always an issue with any organization and it is difficult to satisfy every one in this regard. Perhaps, periodic newsletters or success stories in addition to the quarterly progress reports distributed by mail and all the information and reports posted on the website between the IAB meetings may help address this issue.

The following highlights significant events occurring during CFSP formation and development.

2001-2005 Calendar for Development of I/UCRC-FSP

December 2001	SDSM&T submits a letter of intent to form an I/UCRC
March 2002	SDSM&T, BYU, USC and UMR submitted collaborative Planning Grant Proposal to NSF – not approved
March 2003	SDSM&T, BYU, USC and UMR submits second collaborative Planning Grant Proposal to NSF
August 2003	NSF I/UCRC Planning Grants awarded to SDSM&T, BYU, USC and UMR effective 1 Oct 2003
December 2003	SDSM&T hosts BYU, USC and UMR for a planning/membership recruitment strategy meeting
February 2004	BYU hosts potential industry sponsors planning/membership recruitment meeting
August 2004	NSF I/UCRC for Friction Stir Processing at SDSM&T, BYU and USC established; UMR NSF operational grant delayed

August 2004	Dr. Ronald R. Beck assumes NSF Center Evaluator duties
October 2004	SDSM&T hosts inaugural IAB meeting
December 2004	Planning Grant final report approved by NSF
January 2005	A REU request submitted to NSF in December 2004 approved by NSF
April 2005	USC hosts 2nd IAB meeting
May 2005	UMR receives NSF operational grant
October 2005	SDSM&T hosts 3rd IAB meeting. IAB members approves submission of a Planning Grant Proposal to NSF for Wichita State as a site university

Respectfully submitted,

Ronald R. Beck, PhD.
NSF Center Evaluator

APPENDIX Q – Examples of outputs of NCSU Spreadsheet

NOTE: these charts are excised from the North Carolina State University I/UCRC Center Statistics Spreadsheet and were incorporated into the 2007 Annual IAB Member Report

- Friction Stir Joining
- Friction Stir Microstructural Modification
- Friction Stir Post –Processing
- Friction Stir Structural Designs and Applications
- Friction Stir Intelligent Controllers and Efficient Tooling
- Friction Stir Cost Benefits Analysis

CENTER UNIVERSITY PARTNERS

FY2006-2007

PART 2: UNIVERSITY PARTNERS

In the green box below is a record of Partner Universities for your Center. Please update and/or delete as necessary.

	University Name	Director (Last Name)
Primary University:	South Dakota School of Mines and Tech	Arbegast

	University Name	Co-Director (Last Name)
Partner University 1:	Univ. of South Carolina	Reynolds
Partner University 2:	Brigham Young Univ.	Nelson
Partner University 3:	Univ. of Missory-Rolla	Mishra
Partner University 4:	Wichita State University	Burford
Partner University 5:	South Dakota School of Mines	West
Partner University 6:		

CENTER MEMBESHIP

The 2007 Center membership consists of the following companies:

Member Name	Organization Type	Fee Category	Member Status
Example Company A	*Large Industry (> 500 employees)*	*Primary*	*Existing*
Advanced Metal Products	Small Industry (< 500 employees)	Primary	Existing
Army Research Laboratory	Government (U.S.)	Primary	Existing
BAE Systems	Large Industry (> 500 employees)	Primary	Existing
Boeing	Large Industry (> 500 employees)	Primary	Existing
Boeing	Large Industry (> 500 employees)	Primary	Existing
Boeing	Large Industry (> 500 employees)	Primary	Existing
DoE Natl Labs: Pacific Northwest	Government (U.S.)	Primary	Existing
DoE Natl Labs: Pacific Northwest	Government (U.S.)	Primary	Terminated
EADS- Airbus (Germany)	Large Industry (> 500 employees)	Primary	Existing
Friction Stir Link	Small Industry (< 500 employees)	Primary	Existing
General Motors	Large Industry (> 500 employees)	Primary	Existing
General Motors	Large Industry (> 500 employees)	Primary	Existing
General Motors	Large Industry (> 500 employees)	Primary	Existing
Hitachi (Japan)	Large Industry (> 500 employees)	Primary	Existing
JFE Steel	Large Industry (> 500 employees)	Primary	Existing
Kaiser Aluminum	Large Industry (> 500 employees)	Primary	Existing
Lockheed Martin	Large Industry (> 500 employees)	Primary	Existing
Mitsubichi Coprotation (Japan)	Large Industry (> 500 employees)	Primary	Existing
MTS Systems Corporation	Small Industry (< 500 employees)	Primary	Existing
NASA Langley Research Center	Government (U.S.)	Primary	Existing
Sikorsky Aircraft Systems	Large Industry (> 500 employees)	Primary	Existing
SKB- Sweden	Small Industry (< 500 employees)	Primary	Existing
Toshiba - Japan	Large Industry (> 500 employees)	Primary	Existing
Spirit AeroSystems	Large Industry (> 500 employees)	Primary	New
Bombardier Aerospace	Large Industry (> 500 employees)	Primary	Existing
Cessna Aircraft	Large Industry (> 500 employees)	Primary	Existing
Federal Aviation Administration	Large Industry (> 500 employees)	Primary	Existing
General Motors	Large Industry (> 500 employees)	Primary	Existing
Hawker Beechcraft	Large Industry (> 500 employees)	Primary	Existing

MEMBER SUMMARY	
TYPE	Counts
Small Industry (< 500 employees)	4
Large Industry (> 500 employees)	21
Government (U.S.)	4
Government (non-U.S.)	0
Non-profit	0
Other Organization	0
TOTAL	*29*
FEE CATEGORY	Counts
Primary	29
Secondary	0
Tertiary	0
TOTAL	*29*
MEMBER STATUS	Counts
Existing	27
New	1
Terminated	1
TOTAL	*29*
	Counts
EXISTING & NEW MEMBERS:	*28*

CENTER FUNDING

During 2007, the Center for Friction Stir Processing had the following funding resources:

	South Dakota School of Mines and Tech	Univ. of South Carolina	Brigham Young Univ.	Univ. of Missouri-Rolla	Wichita State University	#NAME?
Annual Membership Fees (See Note 1 below)						
Fee Charged for Primary Membership:	$ 35,000.00					
Fee Charged for Secondary Membership:	$ 30,000.00					
Fee Charged for Tertiary Membership:	$ 30,000.00					
Cash Support						
Total from Member Fees (See Note 3):	$ 175,000.00	$ 200,000.00	$ 140,000.00	$ 125,000.00	$ 185,000.00	$ 825,000
Additional Industry Support (See Note 4):	$ -	$ -	$ -	$ -	$ -	$ -
NSF/IUCRC Award & Supplements (See Note 5):	$ 117,000.00	$ 125,000.00	$ 126,000.00	$ 75,000.00	$ 50,000.00	$ 492,000
Other NSF Support (See Note 6):	$ -	$ -	$ -	$ -	$ -	$ -
Other Federal Government (See Note 7):	$ -	$ -	$ -	$ -	$ -	$ -
Non-Federal Government (See Note 8):	$ -	$ -	$ -	$ -	$ -	$ -
State Support (See Note 9):	$ -	$ -	$ -	$ -	$ -	$ -
University (See Note 10):	$ 44,000.00	$ 80,000.00	$ 47,000.00	$ 30,000.00	$ 37,500.00	$ 248,500
Other Cash Funding (See Note 11):	$ -	$ -	$ -	$ -	$ -	$ -
Cash Support Subtotal						
Capital Support and In-Kind Contributions (See Note 2):						
Estimated Value of Contributed Equipment:	$ -	$ -	$ 35,000.00	$ -	$ -	$ 35,000
Estimated Value of Contributed Facilities:	$ -	$ -	$ -	$ 25,000.00	$ -	$ 25,000
Estimated Value of Contributed Personnel:	$ -	$ -	$ -	$ -	$ -	$ -
Estimated Value of Contributed Software:	$ -	$ -	$ -	$ -	$ -	$ -
Estimated Value of Other Support:	$ 6,000.00	$ 7,500.00	$ 35,000.00	$ -	$ 15,000.00	$ 62,500
Capital Support and In-Kind Contributions Subtotal:						
Financial Information						
Overhead Rate charged to Membership Fee (See Note 12):	0%					
Typical or Negotiated Overhead Rate:	38%					
% Budget allocated to administration (See Note 13):	5%					

		Primary Site	Partner1	Partner2	Partner3	Partner4	Partner5
	TOTAL COUNTS	South Dakota School of Mines and Tech	Univ. of South Carolina	Brigham Young Univ.	Univ. of Missouri-Rolla	Wichita State University	Totals
Intellectual Property							
Inventions Disclosed:	6	3				0	3
Licensing Agreements:	0					0	0
Patent Applications:	0					0	0
Patents Granted:	0					0	0
Inventions Producing Royalties:	0					0	0
Software Copyrights:	2	1				1	0
IUCRC Graduate Degrees Awarded							
Bachelors (See Note 1):	20	5		3	2	0	10
Doctorates (See Note 1):	0					0	0
Masters (See Note 1):	14	4	1		2	0	7
IUCRC Graduates Hired by IUCRC Members							
Bachelors (See Note 2):	0					0	0
Doctorates (See Note 2):	0					0	0
Masters (See Note 2):	2	1				0	1
Publications Acknowledging IUCRC Support							
Number of presentations made (See Note 3):	60	20	4	2	4	0	30
Faculty & Student Publications Based on Center Research (See Note 4):	30	8	2	1	4	0	15
Publications Co-authored with Industry Members (See Note 5):	12	2			4	0	6

CENTER OUTCOMES

The following information reflects the status of the intellectual property developed during the current 2007 research year:

CENTER DEMOGRAPHICS

	CITIZENSHIP			
Personnel Categories	TOTAL COUNTS	US Citizens or legal permanent residents	Foreign (Temporary students or visa holders)	Citizenship not reported
Directors	12	12	0	0
Faculty	28	26	2	0
Professional administrative	6	6	0	0
Research staff	8	8	0	0
Postdocs	2	0	2	0
Doctoral students	14	0	14	0
Masters students	40	22	18	0
Undergraduate students	46	38	8	0
REU supplement students	10	10	0	0
RET supplement teachers	4	4	0	0
TOTALS	170	126	44	0

	GENDER			
Personnel Categories	TOTAL COUNTS	Male	Female	Gender Not reported
Directors	12	12	0	0
Faculty	28	24	2	2
Professional administrative	6	0	6	0
Research staff	8	8	0	0
Postdocs	2	2	0	0
Doctoral students	14	12	2	0
Masters students	40	30	10	0
Undergraduate students	46	40	2	4
REU supplement students	10	8	0	2
RET supplement teachers	4	2	2	0
TOTALS	170	138	24	8

	DISABILITY		
Personnel Categories	TOTAL COUNTS	Disabled	Not-disabled/ Not reported
Directors	12	0	12
Faculty	28	0	28
Professional administrative	6	0	6
Research staff	8	0	8
Postdocs	2	0	2
Doctoral students	14	0	14
Masters students	40	0	40
Undergraduate students	46	0	46
REU supplement students	10	0	10
RET supplement teachers	4	0	4
TOTALS	170	0	170

Personnel Categories	NSF SUPPORT		
	TOTAL COUNTS	Receiving I/UCRC Support	Not receiving I/UCRC supp. / not reported
Directors	12	6	6
Faculty	28	4	24
Professional administrative	6	3	3
Research staff	8	0	8
Postdocs	2	0	2
Doctoral students	14	4	10
Masters students	40	7	33
Undergraduate students	46	6	40
REU supplement students	10	5	5
RET supplement teachers	4	2	2
TOTALS	170	37	133

Personnel Categories	HISPANIC OR LATINO ETHNICITY		
	TOTAL HISPANIC/ LATINO COUNT	US Citizens or legal permanent residents	Foreign (Temporary students or visa holders)/ Citizenship not reported
Directors	0	0	0
Faculty	1	1	0
Professional administrative	0	0	0
Research staff	0	0	0
Postdocs	0	0	0
Doctoral students	0	0	0
Masters students	1	0	1
Undergraduate students	0	0	0
REU supplement students	0	0	0
RET supplement teachers	0	0	0
TOTALS	2	1	1

Personnel Categories	RACE OF US CITIZENS AND PERMANENT RESIDENTS								
	TOTAL US CITIZEN/ PERM RESIDENT COUNTS	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed - Asian and White	Other Mixed Races	No Race Reported
Directors	12	1	0	0	0	5	0	0	6
Faculty	26	2	2	0	0	8	0	0	14
Professional administrative	6	0	0	0	1	2	0	0	3
Research staff	8	0	0	0	0	4	0	0	4
Postdocs	0	0	1	0	0	0	0	0	-1
Doctoral students	0	2	4	0	0	0	0	1	-7
Masters students	22	4	3	0	0	10	0	0	5
Undergraduate students	38	0	0	0	2	21	0	0	15
REU supplement students	10	2	0	0	1	2	0	0	5
RET supplement teachers	4	1	0	0	0	1	0	0	2
TOTALS	126	12	10	0	4	53	0	1	46

Glossary/Acronym List

AMP – Advanced Material Processing Center (AMP) is a Center for Research and Development for Friction Stir Welding Processes and is a part of the South Dakota School of Mines and Technology.

Anvil – Stable platform to support metal being stirred and to counteract the load created by the friction stir welder.

Center Annual Member's Report – The Annual Member's Report is a report prepared by the Center Director for the IAB and presented at the Fall IAB meeting. It includes Program Overview, FSW Technology Development Roadmap, Project Master Schedule, Project Executive Summaries, and Current Projects.

Center Director – The CFSP Center Director is responsible for all Center activities and reports to the IAB. The Site Directors at the lead and site universities are responsible for Center activities at their university and report to the Center Director.

Center Evaluator – The NSF requires a formal evaluation of the center to be conducted by an independent evaluator. The duties of the evaluator are defined by the NSF I/UCRC Program Office: There must be an independent evaluator who cannot be from the department within the institution receiving funds for the I/UCRC award.

CFSP – The Center for Friction Stir Processing (CFSP) is a multi-university I/UCRC established in 2004.

CRAD – The term Contract Research And Development refers specifically to projects developed between the CFSP and Industry members.

DD Form 448 – Application for funds relating to Military research and development. DD Form 448 is closely tied to Military Interdepartmental Purchase Request (MIPR).

DOD – Department of Defense.

DOE – Department of Energy (may refer to Department of Education elsewhere, but not in this work).

Executive Summaries – The Executive Summary gives an overview of the project including objectives and past year's accomplishments.

External Evaluator – See "Center Evaluator".

Fixture – Any set of devices designed to hold the piece or pieces being welded.

Friction Stir Processing (FSP) – Friction Stir Processing is a technology that uses the ideas from Friction Stir Welding (see below) to change material properties such as locally eliminating casting defects and refining microstructures.

Friction Stir Welding (FSW) – Friction Stir Welding is a solid-state joining technique in which a pin tool is rotated and plunged into the joint line between two work pieces. The heat from the rotating tool plasticizes the material and the pieces are stirred together. Often, the tool is moved along the joint line to create a weld, but spot welding is also popular.

FTIR/DSC – Fourier Transform Infrared spectrometer/Differential Scanning Calorimeter.

Gray and Walters – Authors Dennis O. Gray and S. George Walters, "Managing the Industry/University Cooperative Research Center: A Guide for Directors and Other Stakeholders" (http://www.ncsu.edu/iucrc/PurpleBook.htm).

IAB – The Industrial Advisory Board that oversees center operations. This is made up of representatives of the industrial members of the center.

IP – Intellectual Property refers to the ownership of an idea, design, or invention.

ITAR/EAR – International Traffic in Arms Regulations/Export Administration Regulations prohibit the unlicensed export of specific technologies for reasons of national security or protection of trade. If University research involves such specified technologies, the EAR and/or ITAR may require the University to obtain prior approval from State or Commerce before allowing foreign nationals to participate in the research, partnering with a foreign company and/or sharing research—

verbally or in writing—with persons who are not United States citizens or permanent resident aliens.

I/UCRC – The NSF Industry/University Cooperative Research Center program develops long-term partnerships among industry, academe, and government. Each center is established to conduct research that is of interest to both the industry and the center.

LIFE Form – The Level of Interest and Feedback Evaluation Form was created to be used in an NSF I/UCRC Program Evaluators Meeting so that evaluators have an easy way to give their feedback on projects to the center researchers.

Membership Agreement – Document which outlines rules pertaining to joining the CFSP.

MIPR – Military Interdepartmental Purchase Request funds relating to Military research and development.

MySQL – Open Source database software used to store information; often used in conjunction with a website.

NASA – National Aeronautics and Space Administration

NDA – A Non-Disclosure Agreement is used to prevent proprietary or sensitive information from being leaked beyond people authorized to have access to the information.

NSF – National Science Foundation

P3 – Center Policies, Procedures, and Practices define a set of policies by which the CFSP operates.

PaDMS – Paperless Data Management System, developed by AMP in conjunction with ITS, for controlling documents related to individual research projects and tasks.

PHP – Recursive Acronym for PHP: Hypertext Preprocessor, is a widely-used open-source general-purpose scripting language that is especially suited for web development.

Pin Tool – Part including pin and shoulder which directly stirs metals being welded.

Project Principal Investigator – The lead researcher on a project. Not necessarily the principal investigator for the NSF grant.

Project Management Review – Oral presentation of project summary for IAB review and LIFE Form approval at IAB Meeting.

Project Technical Review – Oral presentation at IAB Workshop giving a detailed review of project progress.

RET – Research Experience for Teacher is a supplemental research program developed by the NSF designed to allow teachers to participate in research.

REU – Research Experience for Undergraduates is a supplemental research program developed by the NSF designed to allow undergraduate students to participate in research.

RSS – Rich Site Summary is a format for delivering regularly changing web content.

Run Parameters – Specifications including travel speed, rotation speed, and force applied when stirring any metal into a weld or processed piece.

Run ID – Unique number placed on any given weld project. All welds will have a Run ID.

SEM – Scanning Electron Microscope

Site Director – The Site Directors at the lead and site universities are responsible for Center activities at their university and report directly to their respective university administrators and to the Center Director. The Site Directors also provide liaison between the Center and the appropriate academic departments of the partner universities.

Sponsor – An industry member of the CFSP is also known as a sponsor of the center.

Technology Development Roadmap – A description in block diagram form of the current state of science and technology, the vision of the future, and road blocks and research activities to resolve them.

TIE – A TIE project is a supplemental project between two I/UCRCs.

Wiki – Type of web site using wiki software to create a set of interlinked pages. Often wikis are used to provide guides or information in encyclopedic fashion as on Wikipedia.

Index