The University of Southern Mississippi

Note: This program is only offered at the Stennis Space Center Teaching Site.

Detailed Assessment Report
2010-2011 Hydrographic Science MS**

Mission/Purpose

The purpose of the M.S. program in Hydrographic Science is to provide students with technical and practical expertise in advanced hydrographic methods and standards that will enable them to assume leadership roles in using modern techniques in academic, government, military, and private organizations engaged in hydrographic activities.

Student Learning Outcomes, with Any Associations and Related Measures, Achievement Targets, Findings, and Action Plans

O 1: BATHYMETRY

1.1 Underwater Acoustics. Students will describe or explain the principles of underwater acoustics to include the sonar equation, the generation of acoustic waves, propagation loss, the effects of the physical properties of water on sound speed, ray path theory, the effects on reflection and echo strength due to characteristics of the seafloor, the effects of noise and directivity on echo sounding and sonar ranges, and the performance of sonar and acoustic devices based on specific system parameters. 1.2 Single-beam Echo sounders. Students will describe or evaluate how single-beam echo sounders work and are used in hydrography to include: different types of transducers, CW and chirp transmission, transducer mounting, analog and digital data recording, interpretation of data, accuracy and uncertainty of measurements to include all sources of errors, acoustic sweeps, and the selection of appropriate echo sounders based on system characteristics. 1.3 Side-scan Sonars. Students will explain or determine the principles and geometry of side-scan sonar and how these sonar are used in hydrography to include: the effect on performance due to frequency, beam angle, range scale, gain, towing speed, towing height, and mounting deployment; to determine the sources of image distortion; to position, interpret, and menstruate sonar contacts; and to create and analyze mosaics and seafloor topography. 1.4 Multibeam and Swath Sonars. Students will explain or determine the principles and geometry of multibeam echo sounders and how these sonar are used in hydrography to include: multibeam transducers and signal processing - transmit and receive arrays, beam forming and beam steering, and the effect of aperture size and element spacing on performance; the techniques used in bottom detection; determining depth coverage and depth uncertainty based on sonar characteristics, positioning and motion sensors, operator settings, and vessel speed; the calibration of multibeam systems with respect to the vessel reference frame and the determination of all position and depth uncertainties using the patch test; and establishing a reference surface. 1.5 Phase Differencing Bathymetry. Students will describe or explain the principles and geometry of interferometry and phase differencing bathymetric sonar and how these sonar are used in hydrography to include: the benefits and effects of multiple arrays in a phase differencing system, options for deployment and mounting, and specific applications. 1.6 Non-acoustic Bathymetric Techniques. Students will describe or explain the principles and capabilities of non-acoustic techniques and how these techniques are used in hydrography to include: laser bathymetry - differences between topographic and bathymetric lidar, system performance due to operational and environmental factors, and bottom detection techniques; passive and satellite remote sensing; mechanical techniques; and the use of inspection techniques.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:

90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met

Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. **The average rating was 3.75 for bathymetry.**

Document:

- *2011 Survey of Employers of USM Hydro Science Graduates*

M 5: Practical Exercises (MAR 668, HYD 601, & HYD 605)

Students will complete individual practical exercises dealing with acoustic theory in several courses (MAR 668 - Acoustics, HYD 605 - Applied Bathymetry, and HYD 601 - Hydrographic Data Management). The exercises will include: Acoustic wave transmission, reception and propagation. Transducer design. Ray Tracing. Sound velocity measurement and application.

Source of Evidence: Performance (recital, exhibit, science project)

Achievement Target:

90% of students will successfully complete, on the first try. A grade of B and above, for each practical exercise, is considered to be successful.

Findings (2010-2011) - Achievement Target: Met

91% of all students (10 of 11) successfully completed all assignments or practical exercises in MAR 668 and HYD 606.

Related Action Plans (by Established cycle, then alpha):

For full information, see the *Action Plan Details* section of this report.

Revise sequence of courses

Established in Cycle: 2010-2011

Revise sequence of courses, re-assign instructors, and make adjustments to syllabus and credit levels.

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:
90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 3.14 for bathymetry.**

Document:
- *2011 Survey of USM Hydro Alumni from 2005_2010*

O 2: WATER LEVELS AND FLOW

2.1 Tidal Fundamentals. Students will describe tidal theories, major harmonic constituents, the concept of amphidromes, and co-tidal charts. 2.2 Tidal Measurements. Students will explain the various types of water level gages and their calibration and select appropriate instruments and

locations for water level monitoring. 2.3 Tidal Streams and Currents. Students will describe or select the appropriate methods for measuring tidal currents. 2.4 Tidal Analysis and Prediction. Students will determine a preliminary sounding datum. 2.5 Tidal Information. Students will predict water levels at a particular time and place using tide tables, co-tidal charts they constructed, or numerical models. 2.6 Non-tidal Water Level Variations. Students will describe the temporal and spatial effects on water level caused by non-tidal factors and select appropriate locations for water level gages in areas affected by non-tidal variations.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:

90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met

Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. **The average rating was 3.75 for tidal control and water levels.**

Document:

- *2011 Survey of Employers of USM Hydro Science Graduates*

M 6: Practical Exercises (HYD 612)

Students complete a series of individual and group practical exercises including: • Planning for deployment of a tide gage to NOS standards and report(Tides and Water Levels) • Installation of tide gage and report to NOS standards (Tides and Water Levels) • Datum transfer and harmonic analysis of data from tide gage and report (Tides and Water levels)

Source of Evidence: Performance (recital, exhibit, science project)

Achievement Target:

90% of students will successfully complete, on the first try, a series of individual and group practical exercises. A grade of B and above, for each practical exercise, is considered to be successful.

Findings (2010-2011) - Achievement Target: Met

a. All students (14 of 14) successfully completed all exercises on their first try. This included exercises to install a tide gage station to NOS standards, tide data analyses, and application to sounding reduction. b. All students (9 of 9) successfully completed creating a co-tidal chart and tide zoning in the advanced tide module of HYD 608.

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:

90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met

Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A..

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:

90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met

Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 3.00 for water levels and flow.**

Document:

- *2011 Survey of USM Hydro Alumni from 2005_2010*

O 3: POSITIONING

3.1 Geodesy. Students will describe ellipsoids, gravity models, and predicted bathymetry from satellite altimetry; define the celestial sphere and geodetic systems, calculate transformations between co-ordinate reference systems; describe, evaluate and specify satellite positioning systems; calculate on the ellipsoid; evaluate and select the best positioning data filtering and cleaning procedures; and describe, transform or verify conformal and non-conformal projections, grid coordinates, scale factor, convergence, and arc to chord corrections. 3.2 Horizontal Positioning. Students will specify and plan horizontal control surveys, specify appropriate instruments, and understand logistical aspects; describe the principles of angular measurement instruments; describe the principles of distance measurement instruments; describe the principles of electromagnetic positioning systems; explain GNSS concepts and principles; evaluate and select appropriate methods, instruments and locations to limit uncertainties appropriate to specific applications; describe acoustic positioning concepts and specify deployment and calibration; catalogue sources and magnitudes of errors for each positioning method and system; and monitor system performance by analyzing least square adjustment results. 3.3 Vertical Positioning. Students will explain vertical positioning fundamentals; describe and establish the various vertical datums used in hydrographic operations; describe and evaluate methods and instruments for elevation measurements and computations; and describe the principles of heave compensation systems, heave data filters and select the appropriate one for specific applications. 3.4 Orientation. Students will describe the operation principles of orientation sensors; evaluate and select the appropriate orientation sensor for specific applications; and install, calibrate and analyze the data quality of orientation sensors. 3.5 Three-dimensional Geodesy. Students will describe the mathematical model for 3D Geodesy and the application of 3D Geodesy to hydrographic 3D positioning of survey platforms.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:

90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met

Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in

favorable positions to move forward in their careers. **The average rating was 3.75 for positioning.**

Document:

• *2011 Survey of Employers of USM Hydro Science Graduates*

M 3: Practical Exercises (HYD 600, 601, and 604)

A series of individual and group practical exercises including: • Level line and report (HYD 600 Geodesy) • Traverse using a Total Station and report (HYD 600, Geodesy) • Static Global Positioning System (GPS) survey and report (HYD 600, Geodesy) • Virtual GPS project and report (HYD 600, Geodesy) • Kinematic positioning projects on land and on water, and reports (HYD 604, Kinematic Positioning and HYD 601, Hydrographic Data Management)

Source of Evidence: Written assignment(s), usually scored by a rubric

Achievement Target:

90% of students will successfully complete (grade of B or above), on the first attempt, a series of individual and group practical exercises.

Findings (2010-2011) - Achievement Target: Met

Thirteen of 14 students achieved a grade of B or better, on the first attempt, at a series of individual and group practical exercises in HYD 600 (Classical Geodesy) and HYD 604 (Kinematic Positioning).

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:

90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 8 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met

Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 8: Electronic Nautical Chart

Successful application of the principals of geodesy where the student must merge several different data sets, with different coordinate systems, into standard charting horizontal and vertical datums, for the creation of an ENC (Electronic Nautical Chart).

Source of Evidence: Project, either individual or group

Achievement Target:
90% of students will be able to create an ENC, to international standards, on the first attempt. Any error in the ENC resulting from the incorrect application of the principles of geodesy, or by using the incorrect horizontal or vertical datum, is unacceptable.

Findings (2010-2011) - Achievement Target: Partially Met
Three of 13 students did not do well on the final series of exercises for HYD 606 to produce simple paper and electronic charts. The exercise was given after five full days of vendor training on software used to produce these charts. Assistance provided by the course instructor and the vendor instructor made little difference in performance. These three students have known issues with self motivation, computer skills, and attention spans. During the summer field project, all students were divided into two teams. Both teams successfully completed an ENC project. Intend to complete implementation of Action Plans to revise sequence of courses and course outcomes to better apply learning concepts to the summer project product deliverables.

Related Action Plans (by Established cycle, then alpha):
For full information, see the *Action Plan Details* section of this report.

Revise sequence of courses
Established in Cycle: 2010-2011
Revise sequence of courses, re-assign instructors, and make adjustments to syllabus and credit levels.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:
90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 3.10 for positioning.**

Document:

- *2011 Survey of USM Hydro Alumni from 2005_2010*

O 4: HYDROGRAPHIC PRACTICE

4.1 Types of hydrographic surveys. Students will describe the purposes and components of nautical charting surveys and related IHO survey specifications; describe the methods and instruments used in surveys to support port management and coastal engineering; and explain the principles and conduct of offshore industrial surveys including the role of ROV's in such surveys 4.2 Hydrographic specifications. Students will specify the appropriate bathymetric, oceanographic, geophysical, and geotechnical equipment required for specific applications and their appropriate location; create survey operations specifications for specific requirements; estimate costs and schedules; and create contract tender documents with specifications for all deliverables. 4.3 Routing. Students will explain line keeping; and evaluate and select the appropriate route guidance system for specific applications. 4.4 Data telemetry links. Students will explain the difference in radio data telemetry range and data capacity of various carrier frequencies and operational parameters; install and operate appropriate data telemetry links for specific applications; and explain and describe acoustic data telemetry links. 4.5 Digital signal processing. Students will describe basic signal and image processing concepts.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:

90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met

Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. **The average rating was 3.75 for hydrographic practice.**

Document:

- *2011 Survey of Employers of USM Hydro Science Graduates*

Related Action Plans (by Established cycle, then alpha):

For full information, see the *Action Plan Details* section of this report.

Plan Employer and Alumni Polls Procedure

Established in Cycle: 2005-2006

An employer poll and alumni poll was created in Jul 2009 and will be periodically maintained. Future polls will include private ...

Conduct survey of employers
Established in Cycle: 2009-2010
Identify employers then implement new survey of employers during June2010.

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:
90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 3.21 for hydrographic practice.**

Document:

- *2011 Survey of USM Hydro Alumni from 2005_2010*

M 11: Writing Assignments (HYD 605 and HYD 608)

90% of students will demonstrate their understanding of project planning and national and international standards by • Completing desktop survey design projects, including specifications, selection of equipment and survey procedures, cost plan, and scheduling, and report (HYD 605 - Applied Bathymetry). • Completing the Hydrographic Survey Specifications (HSS) for the field project (HYD 608 - Practical Hydrographic Science). They will then carry out the field project adhering to these specifications. They will also successfully complete a Report of Survey that describes how the specifications were met.

Source of Evidence: Project, either individual or group

Achievement Target:

90% of students will demonstrate their understanding of project planning and national and international standards. A grade of B and above, for each practical exercise, is considered to be successful.

Findings (2010-2011) - Achievement Target: Met

a. In PE#2 of HYD 605 Applied Bathymetry, the objectives for students were: understand survey design from end to end and to work through the design of a practical survey. 100% (11 out of 11) participating students successfully completed this achievement target in HYD 605. b. All students (9 of 9) successfully completed the writing of the team project specifications assignment in HYD 608. These specifications were used in their summer field project.

O 5: HYDROGRAPHIC DATA MANAGEMENT

5.1 Real-time data acquisition and control. Students will collect hydrographic data by operating data acquisition and control systems; describe on-line data sampling, validation and selection techniques, and the effects of gating and filtering parameters; and evaluate and specify data acquisition methods for specific applications 5.2 Analog data capture. Students will evaluate and select digital data capture equipment, formats, and strategies. 5.3 Data management, processing and analysis. Students will apply approximations and estimation procedures to survey measurements; evaluate and select the best filtering and cleaning procedures for specific applications; describe the properties and concepts of spatial databases, DBMS, GIS, SDI, metadata, and DEMs; select appropriate DEM types for specific applications; and explain and apply the use of GIS to marine environmental issues. 5.4 Data presentation. Students will perform plotting and contouring of hydrographic data and evaluate and select the best 3D modeling and visualization methods for specific applications.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:
90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. **The average rating was 3.50 for data management.**

Document:
- *2011 Survey of Employers of USM Hydro Science Graduates*

M 2: Practical Exercises (HYD 601)
Individual and group practical exercises in HYD 601. Successful completion of the exercises will only be possible if the student has a complete understanding of hydrographic data collection, processing and evaluation techniques.

Source of Evidence: Performance (recital, exhibit, science project)

Achievement Target:
90% of students will demonstrate their understanding of Hydrographic Data Management by successfully completing, on their first try, individual and group practical exercises in HYD 601. A grade of B and above, for each practical exercise, is considered to be successful.

Findings (2010-2011) - Achievement Target: Partially Met
This course had four exercises: PE#1 Summer Project Proposal (2-person teams); PE#2 Single Beam Operations (Part A group report, Part B individual report); PE#3 Side-scan Sonar/ Single Beam operations (Part A group report, Part B individual report); and PE#4 Multibeam Operations (Part A group report, Part B individual report). All students did well on PE#1; for PE#2, 5 of 10 students got less than a B on both parts; for PE#3, all students did well; and for PE#4, 2 of 10 students received less than a B on Part B. Complete Action Plans to revise the sequence of courses and course outcomes which should improve future Findings.

M 7: Field Project
Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:
90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Partially Met
Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 2.64 for Hydrographic Data Management.** Intend to complete implementation of Action Plans for revising course sequence and course outcomes.

Document:
- *2011 Survey of USM Hydro Alumni from 2005_2010*

O 6: ENVIRONMENTAL SCIENCE

6.1 Meteorology. Students will describe the vertical structure of the atmosphere, define meteorological elements, describe wind circulation and explain the relation with atmospheric pressure, describe climatology and the elements of weather systems, operate weather observing and recording instruments, interpret a synoptic chart, and describe the workings of the International Marine Meteorological service System. 6.2 Oceanography. Students will define and describe the physical properties of sea water in relation to depth and explain the effects of solar radiation; define marine circulation dynamics and the effects of friction; define the general circulation of the oceans and their driving mechanisms; define wave parameters and sea states and explain the relationship with wind; define wave propagation in coastal areas; describe oceanographic sampling methods and sensors; and use oceanographic instruments for specific applications. 6.3 Marine Geology and

Geophysics. Students will define rock types, the structure of the earth, and seabed samplers; describe geomorphological structures and processes and their effects on the sea bed and continental shelf; describe the earth's magnetic field and geomagnetic surveys; describe the earth's internal structure, gravity fields, and gravity surveys; define the objective of reflection/ refraction seismic profiling and the equipment used; and describe geotechnical sampling and equipment; describe sediment deposition and erosion and the fluvial process; and outline the basic concepts of environmental impact studies.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:

90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met

Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 14: Examinations

Students will demonstrate their understanding of the effects of meteorological conditions on hydrographic survey operations; the effects of the physical properties of sea water, ocean currents and circulation dynamics, and coastal wave propagation on hydrographic survey operations; and the structure of the earth and requirements of geomagnetic surveys through written examinations.

Source of Evidence: Writing exam to assure certain proficiency level

Achievement Target:

90% of students will demonstrate understanding of the required concepts by passing examinations in MAR 561 (Physical Oceanography), HYD 602 (Marine Geology), and HYD 609 (Marine Science) with a B or better.

Findings (2010-2011) - Achievement Target: Met
All students (10 of 10) obtained a B or better in written examinations.

O 7: LEGAL ASPECTS

7.1 Product Liability. Students will explain the legal liability of the Hydrographer for their products. 7.2 Contracts. Students will incorporate contractual considerations in planning and specifying hydrographic products and services. 7.3 Law of the Sea. Students will describe the historical development of LOS and its influence on hydrographic surveying and marine scientific research; describe the nature and characteristics of delimitation zones; and design and specify surveys for LOS delimitation. 7.4 Marine Law. Students will describe the basic process of marine accident investigations and court cases related to hydrographic issues.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 13: Practical Exercises (HYD 611)

Students will demonstrate their understanding of product liability, contracts, Law of the Sea, and Marine Law through class discussion and a final exam.

Source of Evidence: Writing exam to assure certain proficiency level

Achievement Target:
90% of students will actively participate in in-class discussions and achieve a grade of B and above on the final exam which is considered to be successful

Findings (2010-2011) - Achievement Target: Met
All students (11 of 11) successfully completed the final exam with a B+ or better.

O 8: NAUTICAL CHARTING HYDROGRAPHY

8.1 Siting of Aids. Students will describe fixed and floating ATONS; identify appropriate locations and siting for leading lines and ATONS. 8.2 Publications Students will describe the hydrographic data required for nautical publications and prepare a narrative and other documents describing findings from a surveyed area for updating nautical publications. 8.3 Chart Reproduction. Students will outline the process of chart reproduction and explain the difference between offset printing and print-on-demand technology. 8.4 Correction of Charts. Students will explain the importance of chart updates, their dissemination, and the procedures used to maintain chart databases. 8.5 Chart Compilation. Students will select soundings, contours, and features from a hydrographic survey for compiling a nautical chart using digital cartographic methods and using good cartographic practices.

Document:
- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:
90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. **The average rating was 3.25 for nautical charting hydrography.**

Document:
- *2011 Survey of Employers of USM Hydro Science Graduates*

M 4: Practical Exercises (HYD 606)

Students will be able to demonstrate their understanding of Nautical Chart Production by creating paper and electronic charts through a series of individual and group practical exercises (Nautical Cartography and GIS). The individual exercises lead the students through the process;

the group exercises ensure that the students understand the process and can complete the charts without instructor guidance. Successful completion of the field project will only be possible if the student has a complete understanding of Nautical Chart Production.

Source of Evidence: Performance (recital, exhibit, science project)

Achievement Target:
90% of students will be able to demonstrate their understanding of Nautical Chart Production by successfully creating paper and electronic charts, through a series of individual and group practical exercises (Nautical Cartography and GIS). The individual exercises lead the students through the process; the group exercises ensure that the students understand the process and can complete the charts without instructor guidance. Successful completion of the field project will only be possible if the student has a complete understanding of Nautical Chart Production.

Findings (2010-2011) - Achievement Target: Partially Met
Three of 13 students did not do well on the final series of exercises for HYD 606 to produce simple paper and electronic charts. The exercise was given after five full days of vendor training on software used to produce these charts. Assistance provided by the course instructor and the vendor instructor made little difference in performance. These three students have known issues with self motivation, computer skills, and attention spans. Intend to complete implementation of Action Plans to revise sequence of courses and course outcomes to better apply learning concepts to the summer project product deliverables.

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:

90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Partially Met

Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. **The average rating was 2.64 for Nautical Charting Hydrography.** Intend to complete implementation of Action Plans for revising course sequence and course objectives.

Document:

- *2011 Survey of USM Hydro Alumni from 2005_2010*

O 9: REMOTE SENSING

9.1 Coastline delineation. Students will use GNSS-based and ground survey techniques to delineate coastline features; explain the use of aerial photographs, different film, and the ortho-rectification process to map coastlines; and explain photogrammetric principles to determine topography. 9.2 Ice mapping. Students will characterize areas using optical reflectance, thermal emission, radar, and microwave emission. 9.3 Water surface mapping. Students will describe water surface mapping using lidar, altimetry, imaging radar, microwave radiometer, and thermal radiometer. 9.4 Bathymetric remote sensing. Students will describe lidar, radar altimetry, photogrammetric, and SAR methods to determine bathymetry and process remotely sensed data from one method to determine bathymetry. 9.5 Water column properties. Students will explain water column properties and detection of upwelling from SST.

Document:

- *FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors*

Related Measures:

M 7: Field Project

Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow

the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 12: Practical Exercises (HYD 603)

Students will demonstrate their understanding of coastline delineation, ice mapping, water surface mapping, bathymetric remote sensing, and remotely sensed water properties through practical exercises, written assignments, and tests.

Source of Evidence: Written assignment(s), usually scored by a rubric

Achievement Target:
90% of students will successfully complete, on the first try, a series of individual and group practical exercises and written assignments. A grade of B and above, for each, is considered to be successful.

Findings (2010-2011) - Achievement Target: Met
All students successfully completed the exercises and assignments with a grade B or better.

O 10: PROJECT MANAGEMENT AND LEADERSHIP

10.1 Students will understand all of the processes necessary to plan, carry out, analyze, and evaluate a hydrographic survey and to develop a survey plan from the hydrographic survey specifications and make adjustments to this plan as warranted by field conditions. 10.2 Students will take the role of a Party Chief and oversee all aspects of a hydrographic survey or take the role of Subject Matter Expert on a particular task. 10.3 Students will develop work schedules and personnel assignments and manage logistics and communications. 10.4 Students will understand the aspects of group dynamics and group leadership, interact with others within a group, and understand how to rely on others to accomplish a survey project.

Related Measures:

M 1: Employer Survey

Employers will be polled to determine level of understanding and preparedness of alumni. Evaluation will be based on Employer Evaluation Instrument responses.

Source of Evidence: Employer survey, incl. perceptions of the program

Achievement Target:
90% of employer respondents feel that their graduates have a good understanding of hydrography and are in favorable positions to move forward in their careers. Evaluation will be based on Employer Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (significantly below peers to substantially above peers), with an average of 3 (same as peers) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011. Four responses received of 18 sent. Three of six U.S. Government organizations, one of five commercial companies, and none of seven foreign hydrographic organizations. 100 % of employer respondents felt that their graduates have a good understanding of hydrography and that graduates are in favorable positions to move forward in their careers. The average rating was 3.50 for project management and leadership.

Document:
- *2011 Survey of Employers of USM Hydro Science Graduates*

M 7: Field Project
Demonstrate understanding of geodesy, tides, acoustics, data management, chart production, project planning, project management, and leadership during the Comprehensive Oral Exam. This Exam is a presentation of the results of the field project. The field project is a complete hydrographic survey conducted by the class with minimal input from instructors. Students plan and execute the survey, and then process and evaluate the data, and produce a paper and digital chart. The students deliver the data and charts, along with a Report of Survey, to the National Ocean Service (NOS) for assessment. They also present the results of this survey to a review panel made up of the program instructors. The entire field project process is designed to follow the procedures of an official hydrographic office.

Source of Evidence: Capstone course assignments measuring mastery

Achievement Target:
90% of students will successfully defend their presentation to the review panel. The defense will be evaluated relative to each of the 10 stated outcomes separately (bathymetry, water levels, positioning, hydrographic practice, hydrographic data management, environmental science, nautical charting, legal aspects, remote sensing, and project management). For a successful defense, the student must achieve a grade of B or above for each outcome.

Findings (2010-2011) - Achievement Target: Met
Nine of nine students successfully defended the results of their summer field project. The Oral Exam Review Panel consisted of six faculty and four experts from industry. The lowest rated student received a B+, all others A-, or A.

M 9: Writing Assignments (SOP document)
Students will demonstrate their ability to work in a group environment by participating in group projects in their courses. Each student will be required to complete a Standard Operating Procedure document for an assigned task and then support the entire class as the SME for that task. Each student will take the leadership role during field data collection and during group exercises.

Source of Evidence: Written assignment(s), usually scored by a rubric

Achievement Target:
90% of students will successfully complete the assigned SOP, without instructor assistance, in the Hydrographic Data Management course. A grade of B and above for the SOP document is considered to be successful.

Findings (2010-2011) - Achievement Target: Met
All students either individually or in teams produced a SOP. The quantity and quality of produced SOPs, however, was below student levels in past years.

M 10: Alumni Survey

Alumni will be interviewed within one year of graduation to determine the suitability and currency of presented material. 90% of alumni, questioned within one year of graduation, will feel that their learning was based on up-to-date information, and is relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. This evaluation instrument will be comprised of questions that specifically address all learning outcomes.

Source of Evidence: Alumni survey or tracking of alumni achievements

Achievement Target:
90% of responding alumni, questioned within 10 years of graduation, will feel that their learning was based on up-to-date information, and was relevant to their career. Evaluation will be based on the Alumni Evaluation Instrument responses. Each question in the instrument will have a 1 to 5 scale response (far below needs to substantially exceeded needs), with an average of 3 (met needs) considered to be a minimum affirmative response.

Findings (2010-2011) - Achievement Target: Met
Survey was conducted 20 June - 18 August 2011 for alumni that graduated 2005 - 2010. Received 29 responses of 56 sent. The average rating was 3.00 for Project Management and Leadership.

Document:
- *2011 Survey of USM Hydro Alumni from 2005_2010*

Action Plan Details for This Cycle (by Established cycle, then alpha)

Plan Employer and Alumni Polls Procedure

An employer poll and alumni poll was created in Jul 2009 and will be periodically maintained. Future polls will include private sector employers and foreign organizations.

Established in Cycle: 2005-2006
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Alumni Survey | **Outcome/Objective:** BATHYMETRY | HYDROGRAPHIC DATA MANAGEMENT | HYDROGRAPHIC PRACTICE | NAUTICAL CHARTING HYDROGRAPHY | POSITIONING | PROJECT MANAGEMENT AND LEADERSHIP | WATER LEVELS AND FLOW
Measure: Employer Survey | **Outcome/Objective:** BATHYMETRY | HYDROGRAPHIC DATA MANAGEMENT | HYDROGRAPHIC PRACTICE | NAUTICAL CHARTING HYDROGRAPHY |

Implementation Description: AY 2006-2007
Completion Date: 08/31/2015
Responsible Person/Group: M. van Norden

Map the curriculum

faculty will develop a spread sheet to map program course outcomes to the IHO CAT A outcomes.

Established in Cycle: 2007-2008
Implementation Status: Finished
Priority: High
Implementation Description: August 2008
Completion Date: 09/01/2010
Responsible Person/Group: M.van Norden

Regular progress meetings

All faculty will meet at least monthly to ensure outcomes are being met

Established in Cycle: 2007-2008
Implementation Status: In-Progress
Priority: High
Implementation Description: On going
Completion Date: 09/01/2015
Responsible Person/Group: All Faculty

Revise student learning outcomes

Learning outcomes will be revised to align with the IHO subject areas. Emphasize survey field work procedures and learning ENC production.

Established in Cycle: 2007-2008
Implementation Status: In-Progress
Priority: High

Implementation Description: August 2008
Completion Date: 08/01/2012
Responsible Person/Group: van norden, Meador, Wells
Additional Resources Requested: Up to date specialized hydrographic software and hardware. Program heavily dependent on equipment loans and software donations. No existing budget for software and hardware purchases to support academic exercises.
Budget Amount Requested: $25,000.00

Syllabi Standardization

To facilitate outcome assessments and IHO/Hydro program cross referencing all program syllabi will be standardized.

Established in Cycle: 2007-2008
Implementation Status: Finished
Priority: High
Implementation Description: August 2008
Completion Date: 09/01/2010

Responsible Person/Group: All Faculty

Collect and analyze student time allocations

Collect and analyze student time statistics spent on each course, course assignments, and other study time to determine whether curriculum objectives are being met or unintended outcomes are in-progress.

Established in Cycle: 2008-2009
Implementation Status: Finished
Priority: High
Implementation Description: Initial implementation begun in 08/2009
Completion Date: 01/01/2010
Responsible Person/Group: all students and M.van Norden

Conduct survey of employers

Identify employers then implement new survey of employers during June2010.

Established in Cycle: 2009-2010
Implementation Status: Terminated
Priority: High

Relationships (Measure | Outcome/Objective):
Measure: Employer Survey | **Outcome/Objective:** BATHYMETRY | HYDROGRAPHIC DATA MANAGEMENT | HYDROGRAPHIC PRACTICE | NAUTICAL CHARTING HYDROGRAPHY | POSITIONING | PROJECT MANAGEMENT AND LEADERSHIP | WATER LEVELS AND FLOW

Implementation Description: Subscribe to Survey monkey
Completion Date: 08/31/2011
Responsible Person/Group: Maxim van Norden

Robust equipment and software inventory

Negotiate equipment and software support with federal and industry partners to ensure availability of sufficient working equipment and software licenses.

Established in Cycle: 2009-2010
Implementation Status: In-Progress
Priority: High

Completion Date: 12/31/2015
Responsible Person/Group: M. van Norden

Revise sequence of courses

Revise sequence of courses, re-assign instructors, and make adjustments to syllabus and credit levels.

Established in Cycle: 2010-2011
Implementation Status: In-Progress
Priority: High

Implementation Description: 1. Changes to Fall program: Moved HYD 608 from Summer to Fall; Moved HYD 602 from Spring to Fall; Changed instructors for MAR 668 and HYD 620; Changed day/time for HYD 609 and HYD 620. 2. Planned Spring Semester changes: Change instructors for

HYD 611 and HYD 601; Change HYD 612 from 2 credits to 3 credits and times to MW, 1:00 - 2:15; Move HYD 602 to the Fall. 3. PlannSummer term changes: Move HYD 606 from Fall to Summer, change from 3 crs to 2 crs, change instructors; Move HYD 608 to Fall,
Completion Date: 07/31/2012
Responsible Person/Group: M. van Norden, Dave Wells, Stephan Howden

Analysis Answers

What specifically did your assessments show regarding proven strengths or progress you made on outcomes/objectives?

Our assessments showed that we have many proven strengths and have made substantial progress on objectives. On June 1, 2011, the FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers re-certified the USM Hydrographic Science Masters Degree Program at the Category A (highest) level. This was a result of a major effort by faculty to prepare the required documentation and prepare for the assessment visit that was conducted on May 4, 2011. These efforts included revisions made to the curriculum to better address the new standards published in "Standards of Competence for Hydrographic Surveyors, 11th ed." and a well-documented very high-caliber curriculum with over 4 GB of documents provided. This successful conclusion was a result of the Hydrographic Science Program strengths listed below: a. strong support from university management (President, Provost, and Dean); b. strong support by the U.S. Navy with a renewal of the Memorandum of Agreement in April 2011, the loan of survey equipment, and at least four student candidates per year for the program; c. strong support by industry partners that provide the latest software and hardware at highly reduced or gratis cost amounting to at least $500,000 in savings and are indicating support for sponsoring internships; d. one of only two institutions in North America offering a degree in Hydrographic Science; e. a well-qualified teaching faculty with international reputations; f. capital improvements made with the construction of the new Oceanographic Operations Support Building to support student practical exercises and summer project surveys; g. a strong research program ($1.2M in 2010) at the Hydrographic Science Research Center; h. an excellent equipment suite of student laptop computers and boats, as well as, sonar, GPS equipment, and other instruments available through the Hydrographic Science Research Center and the Navy Fleet Survey team; i. high entrance and graduation standards; j. very demanding student summer survey projects which are very representative of hydrographic survey projects conducted by U.S. government organizations and commercial survey companies; k. a location conducive to synergistic partnerships with Navy, NOAA, USACE, and others; l. an increasing trend in student enrollment which currently is at 15 full-time students, including 6 sponsored by U.S. government organizations, 2 from foreign navies, and 7 other students.

What specifically did your assessments show regarding any outcomes/objectives that will require continued attention?

1. The faculty had already concluded in the AY 2008 - 2009 assessment that the student learning outcomes of the then current curriculum did not reflect all the expected outcomes required by the FIG/IHO/ICA International Board. In addition, surveys of alumni and of employers indicated some dissatisfaction with the curriculum and execution of program courses. Corrective actions (discussed in paragraph 3) were initiated in AY 2009 - 2010 and continue through AY 2011 - 2012. These will require continued monitoring and assessment to gage effectiveness.

2. Surveys of employers and alumni are also being conducted on a biennial basis. The summary result of the 2011 employer survey was 3.6. Likewise the summary result of the 2011 alumni survey of students who graduated in 2005 - 2010 was 3.0. For both surveys the range was 1 to 5 with 1 meaning Significantly Below Peers and 5 meaning Significantly Above Peers. (3: Same as Peers, 4: Above Peers).

Acknowledging that there is always a human motivational factor that prevents these responses to ever reach the 5 level, efforts will continue to address employer and alumni criticism of the program so that employers and students realize their expensive investment in labor and dollar expenditures. Specific concerns expressed by alumni and employers in surveys conducted in 2009 and 2011 included: a. the 1st semester of the program was too theoretical and should include practical on-the-water exercises to stimulate student interest; b. graduates lacked in-depth knowledge of tidal datums and models; c. incoming students with no prior knowledge in MATLAB programming were severely disadvantaged; d. incoming students with no prior hydrographic experience had trouble understanding the basic concepts behind the practical exercises; e. graduates lacked in-depth knowledge and skills in producing hydrographic products and deliverables required by employers and their customers; f. graduates lacked project management skills; g. faculty lacked experience on the latest equipment and software; h. the Remote Sensing course was focused on ocean processes and not on the required learning in shoreline delineation; i. and faculty needed to better understand student concerns.

3. Starting in AY 2009 - 2010 the faculty began revising the curriculum to address the new standards published by the International Board for re-certification. In addition, other corrective actions to address the above alumni and employer concerns were implemented. These revisions and actions will require continued monitoring for assessing their effectiveness. We strongly believe that the corrective actions discussed below will greatly improve the effectiveness of this program. The following specific actions were completed or are currently in-progress: AY 2009 - 2010 a. strengthened learning objectives in Nautical Science (HYD 609) and moved it from the Summer term (3rd semester of the curriculum) to the Fall semester to enable on-the-water practical exercises during the 1st semester of the program; b. increased on-the-water practical exercises in Data Management (HYD 601) within budgetary limits; c. temporarily increased tide and water level instruction by adding a learning module to Practical Hydrography (HYD 608); AY 2010 - 2011 d. implemented pre-semester short refresher sessions on calculus and linear algebra (3 days), and Mathlab programming (3 days); AY 2011 - 2012 e. moved Practical Hydrography (HYD 608) from the Summer term to the Fall semester to introduce basic concepts in the 1st semester of the program; f. added a module on project planning and deleted the tide learning module to the syllabus for Practical Hydrography (HYD 608); g. plan to include the more in-depth instruction on datums and models in Tides and Water Levels (HYD 612), taught in the Spring Semester, and increase the credit hours from 2 to 3; h. plan to move Nautical Cartography (HYD 606) from the Fall semester to the Summer term to provide more timely and responsive instruction to support the student summer project and requirements for nautical charts and other deliverables; i. plan to keep the curriculum within the prescribed 36 credit hour limit by decreasing the credit hours from 3 to 2 for Nautical Cartography (HYD 606); j. plan to add a tenured faculty member with experience on the latest hardware and software; k. plan and implement a revision to the syllabus for Remote Sensing (HYD 611), Spring Semester, to better align with the recent learning objectives established by the International Board in the 11th edition; l. and added weekly meetings with the student class to discuss student concerns, administrative requirements, hydrographic professional qualifications and societies, international/national hydrographic organizations, and survey companies and employers. We are also continuously assessing the performance of our program with the one-minute assessment forms provided to each student at the end of each lecture or exercise.

4. Continued growth will depend on more allocation of academic resources or obtaining grants from private industry donors. The Hydrographic Science program presently is assigned one tenured professor, one full-time instructor, one contract professor, one non-tenured research professor, and several adjunct faculty. Class size varies from 11 to 15 graduate students per course. It also receives instructional support from other DMS faculty and staff. Available funds to support the academic program has been inadequate to support equipment maintenance or replacement, to attend

professional conferences to learn new innovative techniques, to support students in need of tuition relief, and to promote the program and increase the number of students. Therefore, efforts to obtain additional funding and hardware/software resources from government organizations and private industry will be a high priority and require continued attention.

Annual Reports

Program Summary

1. The Hydrographic Science Program began in August 1999 as a partnership between the U.S. Navy and USM to establish a Masters Degree program in Hydrographic Science that met the Navy's needs for well-trained hydrographers. The Navy had recognized that there were limited opportunities for Navy military and civilian personnel to acquire the appropriate level of knowledge and competency in hydrography and bathymetry needed to support national security objectives. Furthermore, the development of offshore hydrocarbon exploration in the Gulf of Mexico coastal and offshore waters has also created an increased demand for qualified hydrographers trained in state-of-the-art methods and techniques. The Program is designed to provide a graduate-level education for students from Mississippi, the Gulf of Mexico coastal region, the nation as a whole, and the international hydrographic community.

2. The Program is designed to meet the very rigorous and detailed standards set by an International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers (IBSC) with members from the Federation Internationale des Geometres (FIG), International Hydrographic Organization (IHO), and International Cartographic Association (ICA). The current standards are published in the 83-page document, "Standards of Competence for Hydrographic Surveyors, 11th edition, 2010." To enforce these standards, the IBSC assesses the curriculum of each institution professing a hydrographic program and only with a positive assessment, awards official recognition. If awarded, this recognition or certification is awarded at the Category A level (the highest level) or the Category B level (the lower level). Our Hydrographic Program was originally awarded its Category A level in April 2000 against the 8th edition of the standards.

3. On May 4, 2011, the International Board came to Stennis Space Center to assess all aspects of the Program to include: funding resources and institutional support, faculty credentials, detailed course syllabi, equipment for practical exercises, entrance and graduation standards, facilities, research projects, a detailed map of Program learning objectives against the 11th edition of the Standards, and much more. A 4GB DVD of required documentation was previously prepared and sent to each Board member prior to the assessment visit. On June 1, 2011, The USM Hydrographic Science Masters Degree Program was awarded a re-certification at the Category A level.

4. On July 30, 2011, nine students completed the Hydrographic Science Program and were recognized in a ceremony at Stennis Space Center where Dr. Joe Whitehead, Dean of COST gave the keynote address. Our program has graduated 120 Masters Degree students over the past eleven years and two students have completed the Ph.D. program in Marine Science with an emphasis in Hydrographic Science. At its inception, student enrollment in the program came solely from the Navy, both military and civilian. Since that time the program had progressed to having a diverse mixture of both sponsored and unsponsored students. A growing number of students come on their own due to the high demand for graduates in this well-paying field. Sponsored and unsponsored students have also come from seventeen different nations. The current 2011 - 2012 class has fourteen students of which six are sponsored by U.S. Government agencies, two were sent by foreign hydrographic services, and six are unsponsored students including one international student. In addition, three students are currently enrolled in the Marine Science Ph.D. program with an emphasis in Hydrographic Science.

5. For the U.S. Government, the immediate impact of the USM Hydrographic Science Program has been the formation of a cadre of technically accomplished scientists and leaders available to the Naval Oceanographic Office (NAVOCEANO) and its Fleet Survey Team (FST), the Navy Research Laboratory, NOAA's Office of Coast Survey, the National Geospatial-intelligence Agency, and the U.S. Army Corps of Engineers. The current (2011) Director, NAVOCEANO Navigation Department; the Commanding Officer, Fleet Survey Team; and the Director, Joint Airborne Lidar Bathymetry Technical Center of Excellence are all alumni of this program. Other alumni are employed in private industry including Fugro, David Evans and Associates, EGS, Teledyne Odom, and CARIS. Navy and NOAA scientists have deployed around the world, conducting operations critical to national security, national and international seaborne commerce, and disaster response. Our alumni have also implemented the use of innovative technologies greatly enhancing the effectiveness and efficiency of hydrographic operations. They are at the forefront of employing airborne bathymetric lidar for nearshore bathymetric measurements, using buoys equipped with precision GPS receivers to measure tides in lieu of shore-based tide gauges, and collecting data relative to the ellipsoid rather than traditional tidal datums.

6. The Program summer capstone field project is the culmination of this intense curriculum in all facets of hydrography in which the students must demonstrate learned capabilities to a Comprehensive Exam examiner panel. We conducted two simultaneous survey projects in two completely different areas. The class of 2010 - 2011 completed hydrographic surveys of the Rigolets LA and the Bay of St Louis MS. The student survey teams collected valuable high-quality deliverables to include: high-resolution bathymetric surfaces from multibeam sonar data, side-scan sonar mosaics of bay bottoms, side-scan snippets of underwater navigation hazards, reports to the Coast Guard of newly discovered hazards to navigation, updates to the Coast Pilot, an S-57 data set, new or updated paper navigation charts, Electronic Navigational Charts, and detailed comprehensive Reports of Survey. The Bay of St Louis survey was noteworthy because students used an EdgeTech Interferometric sonar, serial number 1, the first of its kind which did not even have a manufacturer operator's manual. The processed data and selected chart products will be forwarded to local communities and NOAA for their use. The Comprehensive Exam examiner panel included not only USM Hydrographic Science faculty but also representatives from the Navy who were very impressed with the knowledge and skills of the students and their achievements in the summer projects.

7. All students were able to attend the U.S. Hydro Conference which was held in Tampa FL, April 25 - 28, 2011. Faculty and students presented the three papers listed below, Mr. van Norden chaired the Vertical Datum Session, and faculty and students manned the USM exhibit and booth. "Ellipsoidally Referenced Surveys (ERS); Issues and Solutions," David Dodd, Hydrographic Service Center - University of Southern Mississippi, and Jerry Mills, National Ocean Service "Validation Plan for the new Coastal Zone Imaging and Mapping LIDAR System," David Dodd, Kurt Oberhofer, Antoine Cottin, Josephine Maisano, David Wells, Pat Heidingsfelder, Kenneth Barbor, Abel Dean, Casie Carrott, Hydrographic Service Center - University of Southern Mississippi "Feature Detection Performance of a Bathymetric Lidar in Saipan,"Russell Quintero, Jerry Mills, National Ocean Service.

8. Students associated with the Hydrographic Research Center also attended the 12th JALBTCX Airborne Coastal Mapping Charting Technical Workshop, 21 - 22 June 2011, in Baltimore MD. Faculty and students presented the three papers listed below: "A Suspended Particulate Matter Algorithm (SPM) for use with CZMIL," Sarah Epps and Steve Lohrenz " Hydrographic Validation Plan for CZMIL, Horizontal and Vertical Accuracy Assessment, including target detection, of CZMIL," David Dodd, Casie Carrott, Kurt Oberhofer, Pat Heidingsfelder and Antoine Cottin "Topographic Validation Plan for CZMIL A Tool for Positional Accuracy Assessment Dedicated to Remotely Sensed Data, "Antoine Cottin

9. Rapid technological changes in hydrography and the desire to remain one of the premier hydrographic institutions require expensive hardware and software. Nearly all the equipment assigned to support the academic program in Hydrographic Science was purchased in 1999 - 2002 with start-up funds provided by the Navy. Funds are needed each year to replace or repair broken components, pay for software maintenance, replace consumables, replace computers every four years, fund boat operating costs, pay annual certification fees, and fund travel to hydrographic conferences. Our actions to address funding issues included: a. renewed a Memorandum of Agreement with NAVMETOCCOM which was signed by President Saunders and RDML Jonathan White on April, 4, 2011; b. continued academic partnerships with software and hardware vendors to obtain low cost or free software and donations of new equipment - these partnerships are worth about $500, 000 in savings; c. and tripled technology fees to substantially cover the true technology costs of this program.

10. Academic Year 2010-2011 marked a watershed period in advancing the capacity and capability of the Hydrographic Science Research Center to conduct a broad array of hydrographic research. The primary research project for the period remained the Coastal Zone Mapping and Imaging Lidar (CZMIL). 2010-2011 was the sixth year of this multi-year development program in which USM and its industry partner, Optech, build the next generation airborne lidar bathymetry system under U.S. Army Corps of Engineer sponsorship. CZMIL funded six graduate assistantships (two Ph.D. candidates and four Masters Degree students) and ten research faculty/staff. During this year, CZMIL activity transitioned to the fabrication phase for Optech, while USM prepared for the at sea validation of the system. In earlier years of the project, USM made capital investments in its optic lab and equipment. This equipment has been widely used in various ocean measurement and monitoring projects as well as early CZMIL algorithm development and validation. Within this year's $1.2M grant for CZMIL, USM made capital investments in its hydrographic instrumentation necessary to validate the hydrographic accuracies of CZMIL. This $400,000 capital investment included: POS MV inertial measurement unit, Topcon RTK GPS base station and rovers, Edgetech 4600 swath bathymetry side scan sonar, Reson 7125 multi-beam echo sonar, and Knudsen 3.5kHz sub-bottom profiling single beam sonar. The remaining funds in the CZMIL grant were devoted to the formulation of the validation plan, preliminary establishment of ground control points for the calibration of CZMIL and integration of the hydrographic and optic suites in preparation of the CZMIL validation. The research staff and graduate students attended U.S. Hydro 2011 and the 12th JALBTCX workshop and presented papers discussing our validation plans. As the new equipment arrived, the research staff and graduate assistants integrated the equipment onto our research vessel, demonstrated its operability, and developed standard operating procedures for the suite of equipment. In addition to the at sea validation of CZMIL, the hydrographic survey suite will enable advance development research in shallow water survey techniques, enhance the academic program's field experience, and provide opportunities in multi-disciplinary research with other investigators within the Department. The specific hydrographic equipment was selected because of their ability to glean water column and bottom information in addition to the traditional bathymetric measurements. CC Technologies, Inc., a privately-owned international surveying and mapping company specializing in deepwater services, donated a C-Nav® receiver with subscription services for academic and research use. C-Nav® is a dynamic DGNSS Precise Point Positioning system, providing worldwide positioning capability of a decimeter or better. CC Technologies desires to develop a method for C-Nav® users to establish tidal observations from GNSS derived heights. To assist in this development, CC Technologies has requested the HSRC develop methods for the translation of C-NAV® GNSS heights from the antenna to Mean Sea Level. This low foot print and easy to use equipment should be routinely incorporated in ocean measurement experiments throughout the Department.

11. Other papers submitted and grants funded involving hydrographic science faculty and students during AY 2010 - 2011 were: Gonsalves, M. (2010). Contrasting a Ship-Based Acoustic Patch Test with

an Automated Calibration Routine for a Circular-Scanning Airborne Lidar System. Canadian Hydrographic Conference 2010, June 21-23, Quebec City, Quebec CA. Paper S4.2. Proceedings in Press. Gonsalves, M. (2010). Using a Dynamic Ocean Surface to Perform a Geometric Calibration of a Bathymetric Lidar. Oceans 2010, Seattle, WA. Proceedings in Press. Wesson, J., D. Burrage, V. Maisonet and S. Howden (2010). Aircraft and In Situ Salinity and Ocean Color Measurements: Bridging the Satellite Salinity Coastal Gap. IGARRS 2010, July 25-30, Honolulu, Hawaii. Proceedings in Press. Howden, S. D., D. Barrick and H. Aguilar. Applications of High Frequency Radar for Emergency Response in the Coastal Ocean: Utilization of the Central Gulf of Mexico Ocean Observing System during the Deepwater Horizon Oil Spill and Vessel Tracking, in Ocean Sensing and Monitoring III, edited by Weilin W. Hou, Robert Arnone, Proceedings of SPIE Vol. 8030 (SPIE, Bellingham, WA, 2011) doi: 10.117/12.884047. Harlan, J., E. Terrill, L. Hazard, C. Keen, D. Barrick, C. Whelan, S. Howden and J. Kohut (2010). The Integrated Ocean Observing System High-Frequency Radar Network: Status and Local, Regional, and National Applications, Marine Technology Journal, 44, pp 122-132. L. C. Bender III, S. D. Howden, D. Dodd, N. L. Guinasso Jr. (2010): Wave Heights During Hurricane Katrina: An Evaluation of PPP and PPK Measurements of the Vertical Displacement of the GPS Antenna, Journal of Atmospheric and Oceanic Technology, pp. 1760-1768: 10.1175/2010JTECHO761.1 Wesson, J., D. Burrage, V. Maisonet and S. Howden (2010). Aircraft and In Situ Salinity and Ocean Color Measurements: Bridging the Satellite Salinity Coastal Gap. IGARRS 2010, July 25-30, Honolulu, Hawaii. Proceedings in Press. Grants Funded involving Hydrographic Science faculty: a. Title: Nutrient Criteria and Primary Productivity Driving Ocean Color Distribution Observed by Remote Sensing in the Mississippi Bight Student PI: Ryan Vandermeulen PIs: Stephan Howden, Kjell Gundersen Funding Agency: National Aeronautical and Space Administration in response to Graduate Student Research Program Amount: $30,000 Duration: 8/1/2010-7/31/2011 b. Title: Statement of Work for the TAMU proposal entitled Continued Development of the Gulf of Mexico Coastal Ocean Observing System: Sustained Monitoring in the Mississippi Bight through the CenGOOS. PIs: Stephan D. Howden Funding Agency: National Oceanic and Atmospheric Administration Program: NOAA/NOPP Amount: $1,665,983 Duration: 6/1/2011-05/31/2016 Status: Pending c. Title: Monitoring and Assessment of Coastal Ecosystems in the Northern Gulf; YR 5 PIs: Stephan D. Howden, Charlotte Brunner, Kevin Dillon, Kjell Gundersen, Laodong Guo, Steven Lohrenz, Chet Rakocinski, Donald Redalje, Alan Shiller Funding Agency: National Oceanic and Atmospheric Administration Program: Northern Gulf Cooperative Institute Amount: $278,839 Duration:10/01/10-09/31/11 Status: Funded d. Title: Time-series and Underway Assessments of Ocean Acidification and Carbon System Properties in Coastal Waters PIs: Steven Lohrenz, Stephan Howden , Laodong Guo, Wei-Jun Cai (UGA) and R. Byrne (USF) Funding Agency: NOAA/NGI Amount: $401,342 Duration: 7/1/2010-6/30/2011 Status: Funded

Continuous Improvement Initiatives

1. Continue employer and alumni polls. Changes for course improvement will be made based on feedback from employer and alumni polls where it is feasible and makes sense.

2. All faculty will meet at least monthly to ensure outcomes are being met.

3. New edition (11th) IHO/FIG/ICA Standards of Competence for Hydrographic Surveyors provides the latest requirements for learning objectives. Current USM Hydrographic Science Program learning objectives will be revised to align with the latest new edition subject areas. This is a continuous process as our program must be realigned with the standards of each new edition. A realignment of the program course structure in AY 2009-2010 and AY 2010-2011 was in response to the 10th (2008) and 11th (2011) editions.

4. Continue to solicit university, government, and private organizations for additional resources.

5. Revise course sequence to best meet International Board learning objectives, faculty availability, and student feedback.

6. Continue the informal Hydrographic Science and Marine Science faculty discussion group to study Scientific Teaching by Handelsman, Miller and Pfund (2007) and to apply to each of our courses the concepts of scientific teaching, active learning, assessment, diversity, and institutional transformation that this book espouses.

Closing the Loop

1. Successfully updated 9/1/2010 Action Plan to address International Board changes from 1/1/2011: "Faculty will develop a spread sheet to map program course outcomes to the IHO CAT A outcomes."

2. Successfully updated 9/1/2010 Action Plan to address International Board changes from 1/1/2011 : "Facilitate outcome assessments and IHO/Hydro program cross referencing, all program syllabi will be standardized."