Understanding and Predicting Changes in the Workforce for Ocean Sciences, Technology, and Operations

Deidre Sullivan
Marine Advanced Technology Education Center
Monterey Peninsula College
980 Fremont Street
Monterey, CA 93940
phone: (831) 646-3081 fax: (831) 646-3080 email: dsullivan@mpc.edu

Tom Murphree, Ph.D.
Department of Meteorology, Naval Postgraduate School
254 Root Hall, 589 Dyer Road
Monterey, CA 93943-5114
phone: (831) 656-2723 fax: (831) 656-3061 email: murphree@nps.edu

Leslie Rosenfeld, Ph.D.
Department of Oceanography, Naval Postgraduate School
328 Spanagel Hall, 833 Dyer Road
Monterey, CA 93943
phone: (831) 656-3253 fax: (831) 656-2712 email: lkrosenf@nps.edu

N000140610833
http://www.marinetech.org/OSTO/

LONG-TERM GOALS

Our major long-term goals for this project are:

1. Develop improved assessment of the ocean science, technology, and operations (OSTO) workforce.
2. Anticipate future requirements for this workforce.
3. Identify educational processes needed to develop this workforce.

OBJECTIVES

Our major objectives are:

1. Characterize the present workforce that supports ocean observing, analysis, and forecasting operations (OOAF).
2. Characterize the present workforce that supports OSTO components that are similar to the OOAF component.
3. Identify the types of information required to monitor the evolution of the OSTO workforce over the next two decades, identify the most probable future workforce scenarios, and design initial workforce prediction systems.
4. Identify education and training objectives and practices that effectively address current and anticipated OSTO workforce needs.

APPROACH

Our approaches for the four main objectives are:

1. Characterize the present OOAF workforce via surveys of regional ocean observing system (OOS) organizations.
2. Characterize the present OSTO workforce via: (a) surveys of OSTO employers and employees; and (b) focus groups with employees.
3. Identify information needed to monitor the evolution of the OSTO workforce, identify probable future workforce scenarios, and design initial workforce prediction systems via a workshop on OSTO workforce analysis and prediction.
4. Identify education and training objectives and practices via a workshop on OSTO workforce education.

Our focus within the broad OSTO workforce is on the workforce for current and future ocean observing, analysis, and forecasting systems (OOAF) operations. But we are also examining the workforces for related sectors of ocean economy with similar knowledge and skill sets (KSS), such as:

1. Oil and gas industry
2. Telecommunications
3. Navigation
4. Hydrographic surveying
5. Ocean engineering
6. Basic and applied research

We expect the results of our work to lead to improvements in:

1. Analyses of the nation's OSTO workforce, for example:
   a. Assessments of key workforce variables (e.g., worker numbers, locations, education, salaries)
   b. Relationships between variables (e.g., breakdown by occupation of employee age, education level, salary, workplace location, years until retirement, gender)

2. Analyses of competitive landscape, for example:
   a. Workers in most demand
   b. Workers in shortest supply
   c. Employers in competition for workers
   d. Salaries paid for different types of workers

3. Assessment of potential evolution of OSTO workforce, for example:
   a. Potential changes in worker supply and demand
   b. How workforce factors may affect changes in employer operations
   c. How technology, changing organizational missions, and changing markets may influence the need for workers

4. Assessment of education programs closely related to OSTO workforce, for example:
   a. Assist employers in recruiting new workers
   b. Contribute to development of educational programs that will produce next generation of OSTO employees

5. Information on professional development and certification programs that will contribute to:
    a. Maintaining and improving employee knowledge, skills, and abilities
    b. Recruiting qualified new employees

The workshop for objectives 3 and 4 was held in Monterey, CA on 10-12 November 2008. Workshop participants included 45 people with expertise in: ocean science and technology; ocean operations (e.g., operational oceanography, marine related industry, ocean policy and management, ocean observing systems); workforce monitoring, planning, and prediction; professional certification; and ocean science and technology education (community college through graduate school)

The workshop topics included: (1) worker supply and demand problems; (2) the need and methodology for workforce monitoring and prediction; (3) the role professional certification might play in recruiting, developing, and maintaining the workforce; and (4) how educational institutions, from community colleges through graduate schools, can better support national OSTO workforce needs.

This project is being conducted in collaboration with Dr. Sharon Franks and Dr. Cheryl Peach at Scripps Institution of Oceanography (SIO), Dr. Lisa Campbell at Texas A&M Univsersity (TAMU), Janice McDonnell at Rutgers University (RU), Bruce Gilman of the Marine Technology Society, and Drew Michel of ROV Technologies, Inc. In addition, we have been greatly assisted by numerous orgnaiztions that have provided us with data on their workforces.

WORK COMPLETED

We have developed and implemented an online tool for collecting and analyzing workforce data. With this tool, we have collected data from OSTO employers, including organizations that are members of regional OOS. We have also directly collected data from large employers, including industry employers (e.g., businesses involved in ocean science and engineering consulting, marine technology, oil and gas extraction) and federal government organizations (see Table 1). Preliminary data have been analyzed. For many of these employers, we have conducted interviews of senior level managers to collect information that is not well captured via surveys or from human resource offices. We have also prepared a draft report that summarizes the state of workforce prediction for science, technology, and operations workforces.

We have researched 340 marine industries identified in the *Sea Technology Buyers Guide*, *The Marine Technology Reporters Top 100* industries, and the Alliance for Coastal Technologies database using GIS software (ESRI – Business Analyst) that contains data from 12 million U.S. businesses from the *InfoUSA* database (see Table 2). This has allowed us to map the distribution of key marine industries, and understand their size and annual sales. This composite database has formed the foundation for our marine industry survey. To date over 250 companies have been contacted and 113 have participated in the survey.

Additionally, we have conducted a number of meetings to coordinate and collaborate with related workforce, professional development, and education efforts being conducted by government agencies, research organizations, and professional societies. In March 2008, we conducted a session and workshop (*Present and Future Ocean Sciences, Technology, and Operations Workforce)* at the Ocean

Sciences Meeting in Orlando, Florida. We hosted a workshop on the Ocean Workforce for 45 participants from eleven different types of organizations November 10-12, 2008. The workshop agenda, presentations and preliminary findings from the discussion groups can be found here http://www.mpcfaculty.net/Maria_Osiadacz/default.htm

RESULTS

Our major results are the workforce data sets we have developed and the analyses of that data we have conducted. The data sets include data from our online data collection process and from collaborations with employers (e.g., industry and government employers). The data analyses are focused on determining:

1. The major variables that help describe the workforce, including the status, evolution, and future of the workforce
2. The major relationships between these variables that help describe the processes that force changes in the workforce
3. Key methods for modeling these relationships to allow simulation and prediction of the workforce.

Some of the preliminary findings from our data collection and analysis work include:

1. The OOAF workforce is relatively well educated (e.g., 40-65% have a masters or higher degree)
2. A relatively large significant percentage he OOAF workforce is close to retirement (e.g., 40-65% at or within five years of typical retirement age range of 60-65 years)
3. Competition for workers is significant in hiring and retention (e.g., for certain science, engineering, and technology positions, OOAF employers appear to be in direct competition with industry OSTO employers).
4. For many OOAF positions, undesirable work locations and time spent at sea appear to be major obstacles to hiring and retention.
5. There is a widespread need for workers with interdisciplinary knowledge and skills (e.g., physical oceanography and electrical engineering, biology and math, geology and software development).
6. Electrical engineers, computer software engineers, and electronics technicians are in highest demand by industry.
7. Despite the economic downturn, 75% of the companies surveyed to date anticipate growth in the next two years.

Organizations	Number of OSTO Personnel in Workforce	Status of Analyses of Workforce Data	Interviews of Senior Managers
Naval Meteorology and Oceanography Command	928	Initial Analyses Completed	Completed
IOOS Regional Association Member Organizations	740	Initial Analyses Completed	Completed
NASA/Goddard Space Flight Center	67	Initial Analyses Completed	TBD
Minerals Management Service / Offshore Minerals Management	820	Initial Analyses Completed	06-07Oct08
NOAA / National Ocean Service	1259	Initial Analyses Completed	08-10Oct08

Table 1. Table showing some of the organizations from which data have been collected and analyzed, or soon will be. The organizations shown are federal government agencies (Navy, NASA, MMS, and NOAA) and IOOS regional organization members (universities, businesses, state and federal agencies, non-governmental organizations).

MAJOR INDUSTRY CATEGORY	INDUSTRY SUB-CATEGORY	TOTAL COMPANIES	ANNUAL SALES USD	NUMBER OF EMPLOYEES
PRODUCTS 272 Companies	Computers	8	12,665,000	58
	Equipment	82	728,611,000	4,394
	Instruments	168	2,157,889,000	8,008
	UW Vehicles	14	74,288,000	225
SERVICES 68 Companies	Construction	3	6,447,000	23
	Engineering	25	76,933,000	2,493
	Environmental	10	29,509,000	151
	Multi-purpose	16	1,107,940,000	13,772
	Other	2	1,059,000	6
	Surveying	10	144,328,000	716
	Transportation	2	14,382,000	33
TOTALS	**11 categories**	**340**	**$4,354,051,000**	**29,879**

Table 2. US Marine Industries ~ Products and Services in support of the OSTO Workforce Study Annual sales and number of employees

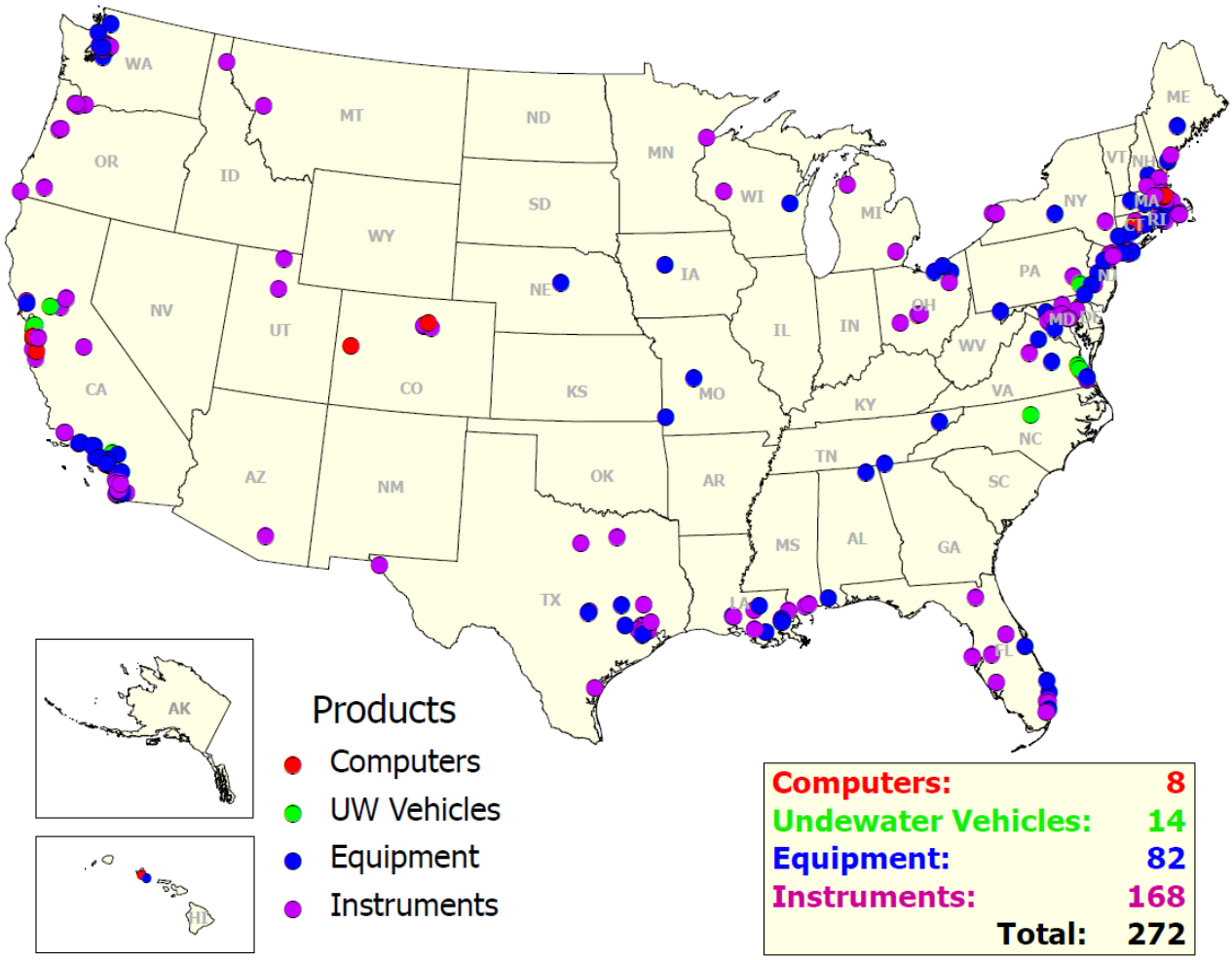

Figure 1. Locations for 272 Marine Product Developers.

IMPACT/APPLICATIONS

The results from this project will contribute to: (1) the analysis, monitoring, and prediction of the nation's ocean science, technology, and operations workforce; and (2) the education and professional development. Thus, these results have the potential to impact the development, implementation, and effectiveness of a wide range of ocean related activities, including resource extraction, environmental management, and national defense. Our meetings and collaborations with employers, employees, educators, and professional and industry organizations has revealed a great deal of concern about the future evolution of the ocean workforce, and high degree of interest in the results of this project.

RELATED PROJECTS

In a closely related ocean workforce project, we are assessing the need for a national certification program for oceanographic professionals. Certification is a way to recognize individuals who have demonstrated professional competence in an occupational field. We are focusing our study on the pros and cons of an optional credential granted by non-governmental agencies such as professional

societies. We distinguish professional certification from educational certificate programs that attest to the completion of a course of study. Potential advantages of a certification program include increased visibility for the profession, aid in evaluation of job applicants, encouragement of career-long learning, and increased confidence in the oceanographic community by users of oceanographic products and services. Possible disadvantages include costs and labor involved in administration of a program, and the personal effort that applicants would need to undertake. The experiences of certification programs in related fields (e.g., meteorology, environmental science, ecology, and fisheries) and foreign certification programs for marine scientists have provided useful insights into the process of designing, implementing, and maintaining a certification program. We have collected and analyzed information on the need for a certification program through meetings with professional societies; employer and employee surveys and interviews; and facilitated workshops. This project is funded by the National Ocean Service of the National Oceanic and Atmospheric Administration. The project web site is: http://marinetech.org/cpop

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