Charting a Course for Successful Futures in the Maritime and Transportation Industry: SMART Center Development of a Maritime Technologies Academic Academic Pathway
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Executive Summary

In an effort to respond to a critical workforce need in the maritime and transportation industry, the National Science Foundation Advanced Technological Education (NSF ATE) Southeast Maritime and Transportation (SMART) Center and its host partner, Tidewater Community College (TCC), created a new Maritime Technologies academic pathway. The pathway was created in collaboration with educators and industry leaders located in the Hampton Roads region of Virginia, many of whom are global leaders in the shipbuilding and ship repair segment of the industry. According to Virginia Business magazine, Virginia leads the country in number of U.S. shipbuilding jobs, employing one out of every 90 Virginians either directly or indirectly. The SMART Center’s work on developing a maritime technologies pathway was designed to increase the number of skilled technicians earning both academic and industry credentials and today is serving students and workers coming from a variety of pathway starting points including high school, community college, registered apprenticeships, and the military. Today the Maritime Technologies pathway is one of the fastest growing academic tracks at TCC and is helping accelerate placement of educated, skilled technicians in critical maritime and transportation jobs. It is an industry-supported, scalable model that the SMART Center is working to introduce to other community colleges in the southeast and nationwide.

Industry Background

The maritime and transportation industry is a vital component of our national security and global economic competitiveness. Overall the industry facilitates the movement of people and cargo by waterway. Our nation’s 360 commercial ports provide approximately 3,700 cargo and passenger handling facilities. Those marine terminals then facilitate the seamless transport of goods through an intermodal transportation system by train (on 174,000 miles of railway) and by truck (on 45,000 miles of interstate highway).

Currently the marine portion of our nation’s transportation system accounts for $2 trillion worth of domestic and international cargo. The projected future growth of industry value is exponential because, as former U.S. Transportation Secretary Ray LaHood noted, “water transportation represents a more fuel-efficient, cost-effective way to move goods and reduce roadway congestion.” The U.S. Department of Transportation’s Bureau of Transportation Statistics estimates that by the year 2020 the value of marine freight will increase by 43% domestically and 67% internationally.

In addition our nation’s shipbuilding and ship repair industry maintain 117 shipyards involved in shipbuilding in 26 states and an additional 200 shipyards involved in ship repair. The Federal government, including the U.S. Navy, U.S. Army, and U.S. Coast Guard, is an important source of demand for U.S. shipbuilders. In 2011, the U.S. private shipbuilding and repairing industry directly provided 107,240 jobs, $7.9 billion in labor income, and $9.8 billion in gross domestic product, or GDP, to the national economy. Including direct, indirect, and induced impacts, on a nationwide basis, total
economic activity associated with the industry reached 402,010 jobs, $23.9 billion of labor income, and $36.0 billion in GDP in 2011. Sharing many of the same technician-level skilled trades position as the shipbuilding and ship repair sector, the pleasure craft and marinas segment of the maritime and transportation industry has an annual economic value of $121.5 billion and supports 964,000 induced, direct, and indirect American jobs at nearly 35,000 businesses.

All four segments of the maritime and transportation industry – seagoing, ports and logistics, pleasure craft and marinas, and shipbuilding and ship repair – are undergoing a seismic shift. The majority of the workforce in all four segments is either already, or will be, retirement age within the next 5-7 years. As our nation’s maritime and transportation industry workforce has matured over the past 20 years there has been a steady decline in the number of young people and students choosing post-secondary education and training to fill those vital technician and professional roles. Workforce development has not kept pace and industry employers are seeking new ways and new partners to help identify, engage, train, and employ workers to meet the projected industry growth pattern. A lack of technicians in the maritime and transportation industry not only affects our nation’s economy but could compromise our national security as those roles are vital to building, repairing, and maintaining U.S. Naval vessels.

The SMART (Southeast Maritime and Transportation) Center

The Southeast Maritime and Transportation (SMART) Center is a National Science Foundation Advanced Technological Education (NSF ATE) Center. It is one of 41 ATE Centers and the only ATE Center solely focused on increasing the pipeline of skilled technicians for all four segments of the maritime and transportation industry. It opened in October, 2010 with a 4-year, $2.3 million NSF grant.

The Center’s seven-pronged strategy toward meeting its mission includes:
(1) Consolidating education criteria for specific maritime occupations
(2) Developing career pathways and education programs to align with standards
(3) Facilitating portability of credentials among regional employers
(4) Laying groundwork for future industry-developed certifications for critical job roles
(5) Promoting awareness of careers in maritime, transportation and logistics to high schools, community colleges, four-year institutions, and beyond
(6) Creating a maritime and transportation education and industry repository
(7) Serving as regional and national model to catalyze synergy between research, career pathways, and education for industry, students, and faculty

Working with industry partners is one-half of the SMART Center’s focus. The SMART Center works closely with key industry partners to help design, develop, and implement models for maritime and transportation industry career pathways, and to facilitate needed education, certification, and preparation of middle-skill workers to serve as our nation’s next generation of maritime and transportation industry workforce. Its industry partners represent 50,000+ employees and include some of the most widely-recognized names in the U.S. and the world including Huntington Ingalls Industries, BAE, Oceaneering International, and the U.S. Department of Maritime Administration.
The other half of the SMART Center’s work focuses on working with educators and in particular community college partners. Community colleges play an increasingly critical role in equipping students with the skills needed to assume vital roles in industries that form our nation’s backbone such as the maritime and transportation industry. According to authors Dan Hull and Richard “Dick” Hinckley in their book *Adult Career Pathways: Providing a Second Chance in Public Education*, “the community college finds itself at the center of an economic and educational crisis as:

- demands for a technologically skilled workforce increase
- financial and societal pressures on unemployed workers mount
- remediation needs of the underprepared adult student population grow”

By facilitating effective partnerships between community colleges and industry employers to help prepare future maritime and transportation industry workers with needed STEM and technical training through the community college system, the SMART Center is creating a pipeline of knowledgeable, well-equipped workers for industry partners thereby lowering their pre-employment training time and costs and enabling them to meet the projected industry workforce need.

**Development of the Maritime Technologies Pathway**

One of the SMART Center’s primary goals is developing effective career pathways. An important component of the Center’s career pathway development work has been its work to create portable, stackable credentials for maritime technicians. The SMART Center worked with host Tidewater Community College (TCC) and industry and educator partners to create a Maritime Technologies academic pathway that specifically focused on creating a more educated and skilled workforce primarily of skilled craft

### Industry Pathway Entry Points

Currently there are three primary academic pathways into the maritime and transportation industry:

**High School**

High school students can enter the maritime and transportation industry pathway by taking dual enrollment (DE) courses in conjunction with a local community college while they are still in high school.

**Community College**

Current 2-year college students attending schools in locations that have maritime and transportation industry employers can choose through open enrollment to take courses or pursue a degree program in maritime and transportation-related fields.

**Registered Apprenticeships**

The registered apprenticeship model is considered the “gold standard” for recruitment, training and retention of workers in the maritime and transportation industry, particularly in shipbuilding and ship repair. Apprentices enroll in a 4-6 year program during which they learn a specific trade or skill, receive on-the-job training, and take classroom-based apprentice-related instruction (ARI). Apprentices earn a salary and benefits during the program as well as an academic credential and industry credential upon completion.
technicians for employment by shipbuilding and ship repair companies as well as pleasurecraft firms and marinas.

**Bringing Partners to the Table**

Shortly prior to receiving its NSF grant, the SMART Center began work to create a coalition of maritime and transportation employers headquartered in the Hampton Roads region. Until that time there was a tense, competitive environment, particularly among the shipbuilding and ship repair companies, and employers were reluctant to openly discuss workforce needs and concerns.

“We want a well-educated workforce that isn’t just receiving training in how to perform a job function, but understands why those functions are necessary and how each function is part of the larger corporate goal. It is not only in our company’s best interest to have a well-educated workforce that is on an academic as well as career pathway, but it is in the overall industry’s best interest. Our technicians are not only performing vital jobs today but they represent the leadership of our company in the future.”

- Brad Mason, Director of Operations for AMSEC, LLC (a division of Huntington Ingalls Industries) and chair of the Maritime Technologies Consortium

SMART Center PI Barbara Murray had established good working relationships with Hampton Roads employers – many of whom represented the largest shipbuilding and ship repair firms in the U.S. through previous work on a Department of Labor (DOL) grant. As part of the new NSF ATE grant Murray convened a Maritime Technologies Consortium comprised of:

- secondary STEM and CTE teachers, administrators and guidance counselors;
- community college faculty, instructors, and career coaches; and
- employers from all four segments of the maritime and transportation industry.

The SMART Maritime Technologies Consortium was convened to inform the Center of regional workforce needs, assist in development of effective and industry-validated career pathways, and provide input on secondary and post-secondary curriculum and course development for Center partner community colleges and high schools.

In its earliest stages the consortium agreed that a maritime technologies pathway which provided a way for students and workers to earn stackable academic credentials was critical to meeting its imminent and long-term workforce needs.
Getting Clarity
The first step to create the clear pathway of stackable credentials was obtaining agreement among industry employers about the core skills, competencies, and knowledge required for each occupational “track.” The focus of the shipbuilding and ship repair segment was creating a larger pipeline of middle-skill technicians – specifically tradesmen and women in the following areas as identified by SMART Center industry focus groups:

- welding
- marine electrical
- marine mechanical
- ship fitting
- machining
- pipe fitting

SMART Center host partner Tidewater Community College (TCC) already had several noncredit workforce training courses and a handful of Career Studies Certificates in maritime and transportation-related areas, including in marine welding and marine electrical.

After identifying the highest priority technician needs in the shipbuilding and ship repair industry the SMART Center worked with another NSF ATE Center, Mat-Ed, to hold a DACUM (Developing a Curriculum) which would inform the Center’s host partner TCC about needed curriculum, course, or program of study changes to create a comprehensive Maritime Technologies academic pathway that aligned with industry standards.

Stackable Academic Credentials
As a result of the SMART Center’s Maritime Technologies Consortium, focus group, and DACUM work TCC leadership realized the value of permitting students to “stack” their academic credentials toward additional certificates and ultimately a 2-year Associates degree. According to the DOLETA, stackable credentials are a “part of a sequence of credentials that can be accumulated over time to build up an individual’s qualifications and help them to move along a career pathway or up a career ladder to different and potentially higher-paying jobs.”

The value of stackable credentials is that they:
- increase the likelihood of a student completing their academic pathway by building momentum
- aligned with employer competency needs

Definition and Value of Stackable Credentials
According to the Center for American Progress “Stackable credentials carve education up into small increments that are more manageable for an adult learner. Any necessary remediation or basic adult education is the bottom of the ‘stack.’ A one-year, specialized postsecondary certificate is added to the stack to provide the working adult with specific job skills. If desired, an applied associate’s degree can be added to the stack.”

Stackable credential models are specifically designed to reduce barriers to academic certificate or degree attainment because they are comprised of an integrated set of industry credentials which build upon the ones a student or student-worker has already attained. Students or student-employees do not have to repeat courses or previous training.
- are aligned with employer competency needs
- facilitate student transitions (between the workplace and academic environment, between careers, and between academic environments)

In addition to allowing students to embed credits earned for one academic credential toward another, or “stack” certificates toward additional certificates or the new A.A.S. Maritime Technologies degree, TCC was greatly increasing the incentive for students to complete courses and earn an academic credential. The value of academic credentials, particularly for middle-skill work (jobs which require more education than a high school diploma but less than a four-year college degree) is critical for a majority of our nation’s workers and particularly those in the maritime and transportation industry.

According to the Center for Law and Social Policy (CLASP), “postsecondary education and credentials are key to economic mobility for individuals and economic competitiveness for our nation….generally workers with higher levels of education have higher wages, work more hours, and suffer lower rates and shorter durations of unemployment. Recent data indicates that professional certifications, licenses, and educational certificates have labor market value, especially for people without a bachelor’s degree and people with professional degrees.”

In addition to creating a stackable credit system toward academic certificates and an A.A.S. degree, TCC began awarding credit for classes which apprentices would have otherwise taken as non-credit solely to meet the federal ARI requirement. By articulating credit for ARI, TCC’s new Maritime Technologies career pathway as defined by DOLETA “has the goal of increasing an individual’s educational and skills attainment and employment outcomes.”

Today the Maritime Technologies pathway program at TCC is a clear sequence of education coursework that provides students with academic and, in some cases, industry credentials. There are 5 stackable certificates in the TCC pathway to an A.A.S. Maritime Technologies:

- Marine gasoline engine technology
- Marine diesel technician
- Marine electrical
- Marine mechanical
- Maritime welding
Outcomes

There have been numerous positive outcomes from the SMART Center’s work with industry and educator partners to create a Maritime Technologies pathway.

**Industry validation:** By working with industry employers to inform and validate curriculum, the SMART Center is helping to combat one of the most frustrating aspects of higher education for both students and employers – skill gaps. *(BRM: Quote from Billy Goodwin or Alan Walker?)*

**Program enrollment and completion:** Analysis of TCC enrollment and completion data shows that since the inception of the Maritime Technologies pathway more students are not only enrolling in pathway courses but a greater percentage of students are completing courses and academic credentials.

“Today, far too few students complete certificates and degrees, having taken on too much debt. Furthermore, when students do complete a certificate or degree program, they hear employers say they do not have the right skills for the jobs that are available.”

- Center for American Progress: “A Path Forward” Report

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**Maritime Pathways Course Completion**

*Calendar Years 2009-2013*

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th># of Completions</th>
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<tr>
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<tr>
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</tr>
<tr>
<td>2012</td>
<td>711</td>
</tr>
<tr>
<td>2013</td>
<td>713</td>
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*Courses Included: CAD 160, MAR 120, MAR 130, MAR 137, MAR 140, MAR 160, MAR 210, MAR 297, SDV 101, WEL 165, WEL 170, WEL 171, WEL 210, WEL 220,…*
**Increasing diversity:** TCC data analysis shows that SMART maritime technologies pathway course and degree program enrollments have seen an increase in students from targeted demographic groups, namely:

- first-generation college students
- women
- minorities
- veterans
- dual-enrolling high school/community college students

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**Maritime Pathways Course Enrollment**

**Student Demographics**

*Veteran data available starting summer 2010 semester*

<table>
<thead>
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<th>2010</th>
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<th>2012</th>
<th>2013</th>
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<td>Minority</td>
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<td>261</td>
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**Maritime Program Enrollment**

**AAS - Maritime Technologies (Plan 746)**

*Veteran data available starting summer 2010 semester*

<table>
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<th></th>
<th>2011</th>
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<tbody>
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<td>Apprentices</td>
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<td>Veteran*</td>
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<td>Women</td>
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</tr>
<tr>
<td>Minority</td>
<td>0</td>
<td>5</td>
<td>23</td>
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**Federal recognition:** As a result of PI Murray’s work to create a Maritime Technologies pathway at TCC and her advocacy for greater awareness and recognition of the maritime and transportation industry by the U.S. Department of Labor, Murray was one of 25 national transportation experts invited to serve on the federal interagency task force to modify the Transportation, Distribution, Logistics (TDL) framework for DOL. A key “win” for the SMART Center and the industry at large was the addition of a new tier to the TDL model identifying key industry sectors. **For the first time ever, maritime transportation is recognized as a key industry sector.** The DOL TDL competency model is used by employers to establish hiring and training standards as well as by educators in develop industry-validated academic pathways, programs, and curriculum.