GOVERNOR BRYANT'S OCEAN TASK FORCE:

CHARTING THE FUTURE OF MISSISSIPPI'S OCEAN TECHNOLOGY ECONOMY

MASGP-17-094


GOVERNOR'S
OCEAN
TASK FORCE

THE UNIVERSITY OF
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October 31, 2017

Dear Governor Bryant,

On behalf of the Governor's Ocean Task Force stood up by Executive Order 1401 in June, it is my pleasure to present you with a Master Plan for economic development in the area of maritime technology. This Master Plan reflects the hard work of many individuals who are clearly committed and motivated to the future of Mississippi's growing footprint in Unmanned Maritime Systems and other related technologies. We all believe there are tremendous opportunities in front of us, and having a coordinated Roadmap to work with places Mississippi well ahead of the rest of the country in this very competitive arena. The vision is yours, and we are most happy to have the opportunity to work with you and your administration in developing the Master Plan.

In this document, you will find that the Governor's Ocean Task Force developed its strategy from three Guiding Principles:

1) Distinguish *unique* opportunities for Mississippi: No one else has it or does it, and few (if any) have capacity to establish it;
2) Strengthen the *market pull* for the Blue Economy in Mississippi by defining new investments and partnerships that position for us future competitiveness.
3) *Build and retain capacity* by using the geographic setting of the coast as a strategic advantage.

The Governor's Ocean Task Force was divided into six Focus Groups including i) Education and Workforce, ii) Engineering Capacity, iii) Advanced Development and Testing, iv) Applications, v) Economic Development, and vi) Policy and Ethics. These groups refined a set of Goals and Actionable Tasks and then further developed the nine Key Recommendations that constitute the Roadmap.

This Master Plan is only the end of the beginning. The Governor's Ocean Task Force is committed to implementation of the Master Plan through a series of cohesive project proposals to support the recommended programs, facilities, legislation and other critical activities. I hope you will allow us to continue this good work as I know first-hand that other states are learning of our efforts and pushing for similar activities. The competition exists, but our advantage is real. I look forward to your review of the Master Plan and indication that the Governor's Ocean Task Force can continue with implementation strategies. Please let me know if you have any questions regarding this Master Plan. For the Governor's Ocean Task Force, I am

Yours truly,

Monty Graham, Chair

Cc: Governor's Ocean Task Force
G. McCullough
R. Morgan

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NOVEMBER 2017

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EXECUTIVE SUMMARY

Governor Phil Bryant established, by Executive Order 1401 on June 1, 2017, the Governor's Ocean Task Force (GOTF). The GOTF was expressly created to provide expertise for the development of a comprehensive economic development master plan to increase the maritime economy and the synergistic relationship between the military and the government assets positioned along the Mississippi Gulf Coast.

A key underpinning to this Master Plan is a need to support the U.S. Navy's requirement for competitive advantage in ocean science and technology development as directed by the Chief of Naval Operations through the Task Force Ocean (TFO). Mississippi's challenge is to leverage this national TFO plan in a way that benefits the growing maritime Blue Economy, including research, education and workforce growth. This Master Plan recognizes the strong history of Mississippi's place in the technological evolution of U.S. Naval warfare including shipbuilding, Naval Oceanography and Meteorology, and Special Operations. Mississippi has a unique opportunity to research, develop, test, advance, and homeport the nation's next generation of unmanned maritime systems (UMS).

The Master Plan recommends investing in advanced facilities that support engineering joint ventures for Public-Private Partnerships (P3s) to accelerate technology development in months or weeks instead of years; UMS operational range development for testing and integrating these systems; warehousing and depot facilities to support Maintenance and Repair Operations (MRO) on UMS; and a national UMS Policy Center.

The Master Plan further identifies key areas of potential development that leverage the U.S. Navy's enormous buying power to create a much stronger market pull along the Mississippi coast. This market pull can be increased by coalescing our existing government, industry, and academic partners within a coordinated course of action, as well as by developing new partnerships with industry, technology-oriented philanthropic organizations, and capital resource entities. Strategic federal and state investments, including oil spill recovery funds, can create new infrastructure and technology-based programs and jobs to further leverage this buying power.

The Master Plan also recognizes the unique geographic setting of the Mississippi coast with respect to building our own capacity throughout the state without losing capacity to neighboring states at the edges. This creation of an inclusive plan with economic development opportunities extending northward is critical to its success. The Master Plan builds off the reality that much of Mississippi's overall economy is tied to the Blue Economy. As the maritime technology sector expands along the Coast, it will boost the State's economy with more technology-oriented, higher-paying jobs. Moreover, this plan builds a talent pipeline for a technology-based workforce to be trained at Mississippi universities and community colleges with Mississippi students from high performing Mississippi science, technology, engineering, and math (STEM) K-12 programs.

The following nine recommendations constitute a tangible Roadmap for implementing the Master Plan. The GOTF believes its work should continue this effort by developing a series of proposals targeting state, federal, and private resources. A set of "Goals and Targeted Actions" are provided within the Master Plan to guide these proposal activities.

THE ROADMAP

DISTINGUISH MISSISSIPPI

Present Mississippi as a well-positioned world leader in ocean science and maritime technologies.

+ **Recommendation 1:** Establish a marketing and branding plan to support a maritime technology corridor across the coastal counties with reach and relevance to non-coastal counties.

+ **Recommendation 2:** Establish a capital resources program supporting innovation, commercialization, and business development activities to better foster government, industry, and academic interactions leading to economic growth in the Blue Economy.

STRENGTHEN OUR MARKET PULL

Grow and expand attractors unique to Mississippi that create a competitive advantage.

+ **Recommendation 3:** Establish a unique unmanned maritime systems (UMS) operational range that is cohesive across air, land, riverine, coastal, and shallow-to-deep ocean environments. The range will support both defense and non-defense activities requiring the ability to test and evaluate UMS and their interoperability across platforms and domains.

+ **Recommendation 4:** Establish and operate a UMS warehouse and depot to serve as a centralized facility to manage the range. The depot will work with defense and non-defense stakeholders to establish competencies and standards, conduct calibration and validation exercises, maintain an inventory of UMS vehicles, provide maintenance facilities, monitor field performance and communications, and conduct inter-comparisons under controlled laboratory and field settings to ensure performance and training requirements are met.

+ **Recommendation 5:** Establish a maritime systems innovation and commercialization center to foster new systems and platforms—focused on, but not limited to, UMS—within academic, industry, and business development spaces.

+ **Recommendation 6:** Establish a federally-supported regional engineering and development center, co-located with the innovation and commercialization center, to support development and application of maritime systems and platforms for ocean exploration, forecasting, and data collection.

+ **Recommendation 7:** Provide high-performance and cloud computing facilities (including data processing, integration, and archival support) to allow industrial, government, and academic partners to test autonomy, robotics, and artificial intelligence within maritime systems and platforms.

INCREASE OUR CAPACITY

Utilize and enhance foundational assets that create and retain Mississippi's competitive advantage.

+ **Recommendation 8:** Enhance high school, community college, and university education and workforce training programs to create a pipeline for success and retention of Mississippi students. These programs should complement the education required for a solid technology-based workforce and include technical career pathways, university-based certification and degree programs, and traditional STEM degrees. Build connections with local industry leaders to understand their workforce needs and to establish internship programs that provide hands-on experiences for students.

+ **Recommendation 9:** Establish a Mississippi-based national resource for understanding existing laws and regulations as well as the development of new policy and ethical considerations involving maritime systems and platforms, specifically UMS.

INTRODUCTION

The traditional Maritime Economy sectors in Mississippi–shipbuilding, oil & gas, transportation, fishing, and tourism–have long been recognized as vital sectors of the coastal economy. But, the impact of the greater Blue Economy has been largely underestimated, and this issue is not unique to Mississippi. Over the past few years, efforts to bring attention to Mississippi's Blue Economy have revealed that this sector, including the traditional Maritime Economy, may in fact represent the largest contributing economic sector in the State.

For a recent request submitted to the Mississippi Enterprise for Technology (MSET), a cursory search for companies operating in the Blue Economy along the Coast revealed as many as 109 organizations working in the sector in the lower three counties—Hancock, Harrison, and Jackson counties. Areas of focus in those organizations included specializations in technology development, urban concerns/coastal resiliency, observation and exploration, modeling/prediction/forecasting, marine-based research, and unmanned maritime systems (UMS[1]) development. Current and future efforts to quantify the Blue Economy in Mississippi must focus on identifying and understanding these organizations—federal, state, university, and private industry–that support essentially poorly categorized industries, projects, and programs related to water.

This initial GOTF Master Plan is meant to serve as a vision for the future for establishing Mississippi as a national resource for innovation, commercialization, policy, and talent development in ocean technologies and UMS. The Mississippi Gulf Coast is strongly positioned to attract and maintain maritime and ocean technology industries and, specifically, the UMS subset of the industry. This assessment reveals a clear opportunity to expand the economic base and add maritime and ocean technology businesses across the coast and impact the economic development of related businesses statewide.

One example is the larger opportunity to develop an operational range for UMS that is cohesive across air, land, riverine, coastal, and shallow-to-deep ocean environments exists across the Coast and would create a new market pull from competitive states. The Blue Economy is not limited to UMS, but includes all technology sectors relating to the marine and coastal environments. A targeted branding, marketing, and incentive strategy focused on the Blue Economy will attract new maritime industries to south Mississippi and contributes to supply chain growth throughout the State.

The GOTF Master Plan is intended to develop Mississippi-specific activities that work in parallel with the Chief of Naval Research's Task Force Ocean (TFO) initiatives to maintain US Navy competitive advantages maritime sensing and observation; modeling and prediction; application and decision aids; and human capital and technical workforce. As the TFO completes its recommendations, Mississippi will be well-positioned to contribute to the national need while enhancing our own economy through growth in the Blue Technology industries.

[1] In this document, UMS refers to Unmanned Maritime Systems—whether surface, sub-surface, or seafloor. "Autonomous" systems are a subset of these that incorporate decision-making algorithms within the vehicle. UxS refers to all unmanned systems including maritime, aerial, ground, or space-based systems.

METHODOLOGY

On June 1, 2017, Governor Bryant signed Executive Order 1401 (EO1401) creating the Governor's Ocean Task Force (GOTF). The Governor appointed 22 members, and named Dr. Monty Graham, Director of the School of Ocean Science and Technology at The University of Southern Mississippi, as Chairman of the GOTF. Key focus areas identified by EO1401 include: growing existing research and development for oceanography; unmanned maritime vehicles; technical workforce development; marine science research; and private sector activity. The GOTF was directed by Governor Bryant to develop a Master Plan for Mississippi that would include:

a. Cataloging existing investments in the areas of ocean technologies and unmanned maritime systems; understanding the State's competitive position in these fields; and recommending a strategy to bring the State into international competitiveness in this area.

b. Establishing a tangible and achievable roadmap to build capacity in maritime systems with an emphasis on national defense, energy exploration, marine resources, environmental monitoring, and aquaculture.

c. Proposing a strategy for working with state and federal lawmakers to develop a vibrant economy around these technologies that includes a means for encouraging maritime technology companies to locate in the state.

Task Force members were assigned to individual focus groups: Policy and Ethics, Engineering Capacity, Applications, Economic Development, Education and Workforce Training, and Advanced Development and Testing. Each focus group was assigned one of the GOTF members as the focus group lead, and each group recruited other advisors and subject matter experts for support. From these additional advisors, a technical lead was chosen to assist each focus group lead. Each focus group was instructed to survey the State's current assets (related to their specific areas), identify the capabilities and infrastructure, and determine the gaps.

More specifically, this survey included ocean technologies and maritime systems focused on national defense, energy exploration, marine resources, environmental monitoring, and aquaculture. Specific emphasis was focused on UMS manufacturers; the organizations that support the development/enhancement of these systems; data acquisition and handling; data analytics and product development; operations and maintenance; and communications providers. The existing infrastructure within the State to support UMS deployment, test, evaluation, and use is also included in the survey.

Each group's efforts resulted in a synopsis of the current state of their focus areas and recommendations on how the State should strategically advance future development of ocean technologies and maritime assets along the Gulf Coast. Recommendations from all six groups were compiled into a list of Goals and Targeted Actions. These Goals and Targeted Actions support the Roadmap by providing steps be taken during implementation of the GOTF Master Plan.

AREAS OF FOCUS

The work of the focus groups is summarized here to provide a high-level understanding of capacity, opportunities, and challenges within these areas. Gaps are specifically identified as they lead to the development of goals and targeted actions.

EDUCATION AND WORKFORCE

Mississippi has a long history of building collaborative partnerships with government, academia, and the private sector to develop the human capital needed for high-growth, high-demand, technology-based industries. These relationships are poised to continue to grow and develop with the ocean technology and unmanned maritime systems focus, necessitating partnerships among educational institutions ranging from K12 to community colleges to universities. Unfortunately, Mississippi suffers from a chronic loss of Science, Technology, Engineering, and Math (STEM) students after graduation, which hinders growth in these sectors.

Education and Training Programs

The growing importance of STEM subjects to the workforce is demonstrated in Mississippi's K12 schools with the existing STEM related Career and Technical (CTE) Curricula and initiatives such as Robotics programs and the Computer Science for Mississippi Initiative (CS4MS). The purpose of CS4MS is to implement computer science courses in all schools and grades by 2024. High schools are projected to provide a four-course sequence to allow students to earn a CTE endorsement in Computer Science at any comprehensive high school, not just CTE Centers.

Most high schools recognize the importance of preparing students for STEM-related careers. Lacking are programs that specifically correlate those STEM classes to careers within the Blue Economy. Examples of existing programs include ocean science classes or participation of teams in competitions such as the National Ocean Sciences Bowl. However, these programs do not necessarily inform students of the types of STEM jobs available within the State for any type of employer–federal or state government, large or small company, university or nonprofit. High school programs also need more internship opportunities for students that fit both need and schedule.

Post-secondary programs throughout the State offer fields of study and practice valuable to ocean technology and UMS industries. Programs include physical, life, and environmental sciences; engineering; earth, atmosphere, and ocean sciences; mathematics; computer science; cybersecurity; and other STEM related programs. The challenge is to ensure marine technology and UMS-specific education matches the need for alternative approaches to training based on progressive technological and systems advancements. Education and training programs must effectively blend theoretical and practical application, preparing marine technology and UMS operators and developers to translate complex information, patterns, and trends into usable data. Several research-intensive Mississippi universities have existing certification and degree programs as well as active oceanographic, hydrographic, or unmanned systems research engineering programs that address these issues.

The University of Southern Mississippi houses the School of Ocean Science and Technology (SOST). Most of the SOST academic and research programs are on the Coast, spanning from the Gulf Coast Research Laboratory in Jackson County to the Division of Marine Science's oceanographers and hydrographers at Stennis Space Center. The SOST will expand into a new marine research facility at the Port of Gulfport, where the Ocean Engineering program will be supported along with the research vessel Point Sur's shore operations. The SOST offers degrees ranging from undergraduate degrees in Marine Science and Ocean Engineering, to master's degrees, including one of only two Hydrographic Science degrees in the nation, and doctoral degrees. The SOST currently manages over $90M in contracts and grants in ocean engineering, oceanography, hydrography, fisheries,

aquaculture and other fields. USM also has research and education programs in Computer Science and Engineering, and a world-renowned Polymer Science and Engineering program.

USM recently offered the Nation's only university-sponsored academic certification in UMS. This inaugural class of 15 Navy-sponsored students represented a rigorous curriculum designed to give decision-making skills to the Navy warfighter when using UMS as an asset in ocean surveillance. USM and the Navy are developing a set of competencies that will expand the current Tier 1 certification to more advanced Tier 2 and 3 certifications and degrees.

In USM's School of Computing, advanced algorithms for big data analytics are being developed which, once validated, can provide the leading-edge technologies for handling the large amounts of data that are anticipated to be collected, processed, and analyzed in the implementation phase of the GOTF Master Plan.

Mississippi State University (MSU) leads a wide range of research, service, and academic programs that support Mississippi's Blue Economy. The Bagley College of Engineering (BCoE) offers undergraduate, master's, and doctoral degrees that support coastal industries, including Chevron, Ingalls, and industries at Stennis Space Center, as well as federal, state, and local government. Recently, the BCoE started classes at Mississippi Gulf Coast Community College so students can earn either an electrical or a mechanical engineering degree from Mississippi State without leaving the Coast.

MSU has many significant research programs on the Coast. The Northern Gulf Institute, led by MSU and co-led by USM, has its program office and 30 employees in the MSU Science and Technology Building at Stennis Space Center. The building also houses the Associate Director of the Alliance for System Safety of UAS through Research Excellence (ASSURE) and the FAA Center of Excellence for UAS. MSU leads the Mississippi-partnership recently chosen to direct the new Department of Homeland Security Science and Technology Small Unmanned Aircraft Systems Demonstration Range Facility.

The University of Mississippi (UM) National Center for Physical Acoustics (NCPA) boasts a 30-year history in developing novel sensor applications for a wide variety of problems, including underwater acoustics. Interpreting the signals received from these sensors is an active field of study, specifically sub-bottom profiling and tomographic techniques for finding sub-surface features. NCPA works closely with the Department of Physics and School of Engineering to educate graduate students in cutting edge sensor and signal processing technologies to produce the next generation of scientists and engineers. Private sector partners have always played an important role in project development at NCPA which strives to transition bench-top research into deployable solutions.

UM also has a long history of partnering with the University of Southern Mississippi in developing a variety of undersea vehicle technologies including integration of sensor platforms in vehicles, data storage, and exploration of the Gulf and beyond. Scientists from the National Center for Natural Products Research at UM have used these tools to explore undersea flora with unique, potentially therapeutic compounds as a front line in novel drug development.

Both Mississippi Gulf Coast Community College and Pearl River Community College play key roles in workforce training in technical career pathways through their existing programs. New programs to specifically address technical career opportunities in maritime systems should be developed as the GOTF Master Plan is implemented.

EDUCATION AND WORKFORCE

Existing Skill Framework/Preliminary Workforce Analysis

Preliminary workforce analysis to determine current marine technology and UMS education and workforce requirements revealed an increased manpower need in support of the Navy Shipbuilding Plan. While the increased manpower is not specifically for UMS, the increased workforce includes the need for UMS and similarly-trained personnel. Forty-one percent of the increased manpower will be in the civilian and contractor workforce, with the remaining increase in Naval Operational Oceanography (23%), enlisted personnel (26%) and officers (7%). Further analysis indicated that two-thirds of the current Stennis Space Center (SSC) Naval Oceanography (NAVO) workforce has at least a Bachelor's degree.

Research suggests that the increased use and integration of remote and cyber platforms will have a dramatic impact on the approach to training and recruiting methodologies, creating the need to include not only functional skills relevant to capabilities of marine technologies and UMS, but also the fundamentals of communication and information systems. Additionally, values such as integrity, teamwork, dedication to strategic goals/mission, the ability to maintain confidentiality, and creative problem solving under pressure are critical components of new training programs. Interviews with Navy leadership and the UMS Certification Program Directors revealed there is no recognized or widely accepted set of UMS standards or skill frameworks. The lack of historical experience in training and education specific for UMS, as compared to other disciplines and fields of practice, makes preparing the workforce with relevant skills to support UMS difficult.

A robust, research-based, practitioner-focused skills framework can provide the foundation for recruiting, training, and developing a marine technology and UMS workforce that closely aligns with the needs of the future jobs. The framework can identify the broad range of skills discussed above, and the required level of education for various career paths. Skillsets will drive the recruitment and enlistment criteria to more closely reflect the needs of the jobs.

Gaps:

Need for plans and programs to grow and retain the top STEM-performing high-school graduates in the Mississippi technology workforce.

Need for more diverse STEM programs in high schools throughout the state focused on target industry sectors—specifically maritime technologies and UMS—within the context of the GOTF master plan. Internship and earlier career path opportunities should be associated with these programs.

Need for UMS Certification. Certification efforts are in their infancy, and development to meet unknown workforce needs will require close interaction among certification provider (USM), manufacturers, and end-users (defense and non-defense).

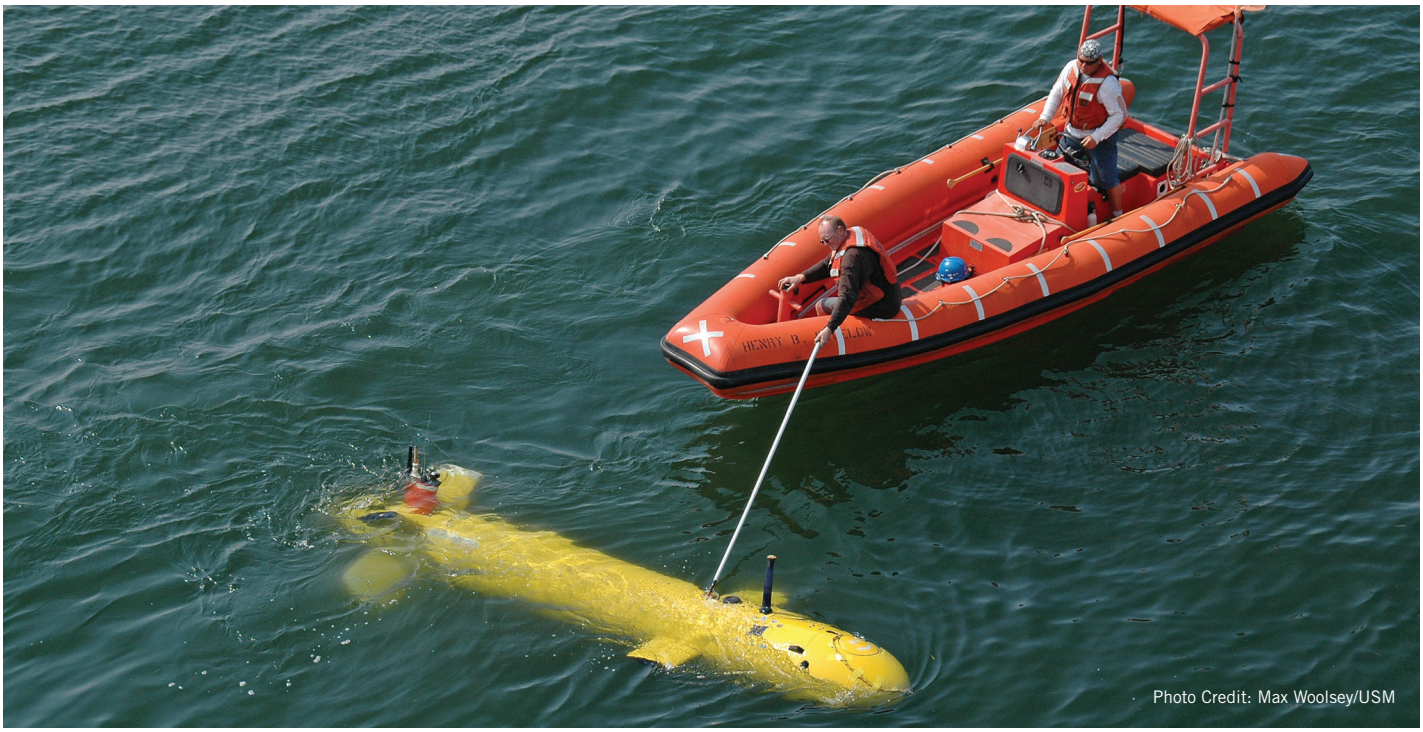
Need for UMS operator training across domains of air-sea-space currently exists due to the growing demand.

Need for established workforce competencies in UMS.

Need for a National Maritime Center for Policy and Ethics. Currently, there is not one. The pedagogic mission suggests this initiative should be university-based.

Need for workforce training and career technical specialists. The workforce demand for career technical specialists in mechanics, electronics, maintenance, and repair is expected to grow with the marine technology and UMS industries, yet workforce training of career technical specialists in marine technology and UMS is lagging.

ENGINEERING CAPACITY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ENGINEERING CAPACITY

Blue Engineering in Mississippi

A robust Blue Economy based on research, development, augmentation, validation, and application of unmanned maritime systems requires a steady supply of engineers and ideas. Together these two, engineers and ideas, are described as 'Engineering Capacity'.

Recent efforts to catalogue existing maritime 'blue' engineering capacity across organizations—federal, state, university, and private industry—indicate that Mississippi's blue engineering capacity is mainly centered on ocean-based projects and programs that are loosely organized at the project level. The tracking of engineers in the job market is ill defined for maritime. For example, an engineering company working on systems and sensors to understand nearshore waves is categorized under the broad category of 'professional engineering'. All of the engineering companies in the State can be identified; however, identifying those working specifically in the maritime sector is a much more difficult task.

This engineering capacity requires a modern collaborative environment, whether it be collaboration for science or collaboration for development. This means that engineers and scientists must have forums to communicate and collaborate. These forums may be a physical location, a virtual space, or, preferably, a combination of the two.

Unmanned Systems

For the purposes of the Governor's Ocean Task Force, the Engineering Capacity focus group targeted the UMS sector as an emerging field that is extremely relevant to organizations in the State, such as the Navy and NOAA, which represent existing, internal markets for these systems and the information they provide. In understanding the engineering capacity associated with UMS in the State, all organizations that support the development/enhancement of the systems, data acquisition and handling, data analytics and product development, operations and maintenance, and communications providers must be examined.

ENGINEERING CAPACITY

Existing Capacity

A catalog of Mississippi-based UMS assets was compiled. Using customized Asset Sheets, organizations were cataloged according to how they support UMS – associated with systems, services, or infrastructure. These Asset Sheets provide details of how each asset supports UMS; similar sheets were collected for organizations that are not currently supporting UMS efforts, but have the capacity to do so. The information on these sheets, combined with information gleaned from discussions with UMS users, formed the basis for the information that follows.

The review of organizations that support UMS systems identified twelve federal agencies, eight state agencies and universities, and thirty-six private companies. Based on the review, Mississippi has a large number of assets—systems manufacturers, service providers, operators, human capital, technology support, training programs, etc.—that support UMS. Another thirty companies that currently do not support UMS, but have the capability to do so, were identified.

Companies located in the State that are key participants in UMS, or could support UMS, include the following:

- Leidos
- General Atomics
- Lockheed Martin
- Teledyne
- Stark Aerospace
- Insitu
- Raytheon
- Aurora Flight Sciences

Gaps:

Need for a method to assemble and track data on engineering capacity. Currently, data is limited and largely held by industry at the project level.

Need for physical or virtual spaces to develop an innovative environment for collaborative research and development or engineering prototyping among academia, government, industry and non-profit organizations. These spaces should have capacity to handle both classified and unclassified projects with appropriately cleared staff.

Need for a systems maintenance and repair operation (MRO) in Mississippi. Without properly trained workforce and adequate MRO facilities, unmanned vehicles and sensors will continue to be sent out of state.

ADVANCED DEVELOPMENT AND TESTING

Current Capabilities in Mississippi

Advanced development and testing efforts related to the Blue Economy are currently taking place throughout the State but are often very specific to a system or technology, such as an aircraft with sensors that look down at the ocean or a new ship launched along the Coast. In some cases, an organization procures any needed equipment for development and testing, which tends to be costly. This results in a number of individual organizations spending project monies on the same types of equipment. A better solution would be to contract the use of another organization's development and test equipment, but this is currently difficult for several reasons: 1) Some equipment is not easily accessible (a federal asset, for example); 2) There is a lack of information on the assets available in the State and how to access them; 3) Research, development, and testing elements are conducted out-of-state, making personal interaction difficult, particularly during technology creation and development.

Up-and-Coming Programs

There are various Mississippi-based organizations that are currently working on efforts to grow the Blue Economy in terms of technology advancement, reduced costs, increased accuracy, and efficiency. These include federal laboratories, private companies with internal R&D efforts, and entrepreneurs. Recent efforts in federal programs like the Defense Advanced Research Projects Agency (DARPA), Office of Naval Research (ONR), and Naval Research Lab (NRL), as well as in companies such as Huntington Ingalls and Shell Oil Company, are focused both on the development of new techniques or new applications of existing techniques, and on the integration,interchangeability, and extensibility of systems to provide customized solutions to a number of scenarios. Challenges for these programs are all relatively consistent and include:

- Interoperability
- Autonomy
- Integration
- Communications
- Training
- Propulsion & Power
- Manned-Unmanned Issues

For example, long-term Navy goals are focused on Manned-Unmanned (MUM) Teaming, where actions and reactions of all types of fleet forces can be optimized based on the specifics of a scenario to be addressed. This strategy requires forethought during system design, with attention to open architectures in hardware and software components, interface standards, and even materials used. Intricacies of how systems will work together and development of rules of engagement are still a work-in-progress. A number of Mississippi assets exist that can be applied to the challenges facing these programs.

A need has emerged for a range that supports the operation of these systems in environments that closely mimic the environments where missions, whether military, humanitarian, or commercial, will be carried out. To showcase the need for such an operational range, the Commander Naval Meteorology and Oceanography Command (CNMOC) recently held a demonstration in the Gulf of Mexico exhibiting how a range would work in support of various Naval missions. There is growing support within the Navy for a permanent location for an operational range, a new concept in ranges.

ADVANCED DEVELOPMENT AND TESTING

The requirements for an operational range are anticipated to be far less complicated than other types of Navy ranges. The operational range will be well understood environmentally, but not require many expensive in-water assets. The Navy anticipates the use of its own survey systems, as well as those within NOAA, to gather in-situ measurements and use them to refine computer models of the range area. The Navy seeks to support a variety of training missions within an operational range with access to both shallow and deep waters, brown water as well as blue water, and riverine access and influences. The Mississippi Coast is uniquely suited for this goal. The Navy has anticipated many of the initiatives associated with the establishment of the operational range. These include:

- Environmental surveys/assessments
- Mission impact studies on the environment and local marine life
- Permitting process/COAs
- Inventory of systems (separate from NAVOCEANO)
- Command and Control Centers (2 anticipated)
- Expansion of CODAR on Singing River Island
- Improvements to Navy models
- Safety plans
- Communications/power infrastructure (e.g., in-water docking station)

The Navy is not currently equipped to handle each of these efforts, so there will be opportunities for contractor support from companies with relevant expertise. Additionally, there will be on-demand-type requirements for support from dive teams, patrol/other small boats, and other suppliers.

Gaps:

Need for an entity that addresses the combination of air and sea UMS operations. Given the goals of the Navy and other organizations to use a combination of satellite-, air-, and sea-based systems depending on the "mission", future efforts will require a working knowledge of which resources are best suited for which operations, uses, and applications. As the Navy leads this effort, other agencies will follow, and various industry uses will be identified.

Need for an incubator/accelerator focused on the development of new ideas in the Blue Economy with dedicated space supporting academia, government agencies, industry, and entrepreneurs and early stage companies. The facility should provide shared equipment needed for developing, prototyping, and testing; and should house organizations with the expertise for developing not only the technology, but also the business case for the technology. As a result, ideas for new sensors and systems can be developed, prototyped, tested, and commercialized from a single location.

Need for a location that the Navy, or any industry alliance, has identified as the gold standard for an operational range supporting all types of UMS. This range would need to be supported by adequate warehousing and depot spaces needed to manage large fleets of UMS vehicles and sensors while also providing the technical capacity to maintain the fleet.

Need for a national cohesive air-water corridor from river to coast to blue and deep water that is manageable as an operable range for purposes of defense and non-defense development, validation, verification and data acquisition testing across platforms.

APPLICATIONS

Applications for Existing Industry

Several maritime-based industries within the State use remotely operated and autonomous unmanned systems and other robotic instrumentation and sensors. Industries such as oil and gas; ports and transportation; commercial fishing; and aquaculture have recently started to utilize autonomous and remotely operated systems. Many industries are looking to expand their investments in these technologies.

Remotely operated vehicles (ROVs) are regularly used by the oil and gas industry. Examples include mapping of pipelines or inspecting wells and equipment. Autonomous underwater vehicles (AUVs) are being used for bathymetric data and sub-bottom profiling. The use of wave gliders has been on the rise as battery life and propulsion systems improve. There is potential for unmanned surface vehicles (USVs) to replace surface ships as relays for tethered ROVs and AUVs. Ports, harbors, and maritime transportation have benefited from unmanned technology and sensor development. Technology that can benefit ports and harbors includes unmanned systems for detecting, tracking, and assessing threats. Vehicle automation can advance maritime transportation to complete operations in environments that are geopolitically or environmentally hazardous.

The commercial fishing industry has recently started to utilize remotely operated technology. Fishermen often leverage the use of vessel monitoring systems mandated for compliance and enforcement in federal fisheries for safety and data collection. Fish trackers and unmanned aerial systems operate from vessels that help target schools of fish and look for potential bycatch issues are used by commercial fleets.

Robotic equipment in aquaculture can both increase production and reduce diver intervention for routine maintenance. Augmented reality technologies for diver operations can aid communication and improve efficiency underwater.

The Departments of Defense (DoD) and Homeland Security (DHS) are increasingly utilizing unmanned systems. The U.S. Navy operates the largest fleet of unmanned systems in the world from Stennis Space Center. The DHS Science and Technology Directorate recently selected Mississippi as the new base of operations for small unmanned aircraft systems.

Technology, Systems, and Systems Integration

Mississippi has significant assets for supporting UMS applications including government, industry, and university resources and expertise related to multi and hyperspectral, LIDAR, synthetic aperture radar (SAR), and other similar remote sensing sensor systems; image processing, data storage and processing; and decision support tools development and validation. The State and its federal partners have established both land and sea UAV flight zones within the state. Mississippi has prime sites along the Coast to manage operations of a large operational range encompassing multiple domains (air, water, space) requiring advances in:

- Development of inter-operational programs to address critical needs
- Processes for verification and validation of novel technologies leading to operational prototype (feedback to engineering)
- Valuation of data acquired through applications

Leading-edge technologies for big data analysis, on-board processing, artificial intelligence, machine learning, and cyber security in maritime technology and UMS markets are critical capabilities that should be developed in the State.

APPLICATIONS

Modern technological hardware is being designed as open and extensible platforms capable of acquiring accurate data almost anytime and anywhere. These hardware platforms have enormous application potential. The market for data about the physical world and about action occurring within the world is virtually limitless. UMS and other marine technologies are often primarily associated with data collection. The market for applications that transform that data into usable information holds the potential for tremendous economic growth.

Mississippi has three separate entities that co-exist on a continuum of moving basic engineering into the market place while closing the loop on market needs as a means of informing basic engineering and research: Mississippi Enterprise for Technology, National Oceans and Applications Research Center, and the Marine Industries Science and Technology Cluster. The Mississippi Enterprise for Technology (MSET) operates the Mississippi Technology Transfer Center—authorized by State statute and agreements with the Mississippi Development Authority and NASA—at Stennis Space Center. The Mississippi Technology Transfer Center houses many advanced technology companies specializing in fields such as engineering, aerospace, geospatial technology, defense solutions, environmental sciences, marine technology, energy innovation, and IT. MSET is committed to supporting existing industry and to establishing robust partnerships with new businesses to promote entrepreneurship and technology-based economic development within the State.

The National Oceans and Applications Research Center (NOARC) non-profit organization chartered by the State of Mississippi to grow UMS and marine technology companies in the State for ocean and coastal applications. To that end NOARC exists to leverage public and private capital resources, accelerate applications development through public/private partnerships, and leverage the UMS operational range for commercial and economic development.

The Marine Industries Science & Technology (MIST) Cluster is a regional group of organizations involved in the development and implementation of applied technologies for operating in, working around, and monitoring the marine and coastal environments. The MIST Cluster Program is where technology innovators come together with industry end-users to understand each other's capabilities and needs and collaborate to foster expanded business and address shared issues. The MIST Cluster Program provides services to Mississippi blue tech industries including helping government agencies and large businesses identify local companies that can assist them in meeting small business goals and to connect with the innovative culture within these small high-tech companies. The MIST Cluster serves as a repository and catalyst for understanding and advancing the Blue Economy in Mississippi.

Gaps:

Need for the development of a marketing plan to highlight the multiple sectors of marine technology and UMS development and application in Mississippi based on a broad view of the potential economic impact.

Need for trained accredited engineers in Mississippi to keep pace with computational needs, systems calibration, platform or vehicle validation, testing and advanced development needs of defense and non-defense industry should Mississippi serve as the nation's operational range and depot.

Need for a fully developed strategy to pull together existing critical investments. Three entities with linking missions that should function collaboratively and seamlessly are: NOARC as the State's lead program for application development, MSET as the State's lead agency for technology-based economic development, and MIST Cluster as the State's lead maritime technology cluster program.

ECONOMIC DEVELOPMENT

Business Retention and Expansion Program

A thorough and comprehensive business retention and expansion strategy will protect and grow Mississippi's existing ocean and maritime technology industries. Robust data on marine technology sectors need to be gathered using state of the art survey tools and methods. Innovative methods to identify Blue Economy and UMS companies may be necessary to combat the difficulties seen in using standardized classification codes. Additionally, industry surveys must include sectors not traditionally thought of as maritime specific. The initial target company list should consist of major players within the ocean/maritime industry, in addition to blue technology companies, and focus on the Navy's Task Force Ocean Focus Areas: Sensing and observation; modeling and prediction; application and decision aids; human capital and technical workforce.

Emerging Markets

There are a number of emerging markets associated with the Blue Economy sectors. Examples of these include the increased use of unmanned systems for ocean sensing and forecasting, including handling of increasingly large datasets and their real-time interpretation; large unmanned transportation; floating ports; and defense-related support. Enormous capacity exists within the State in federal and state agencies, and private organizations to support marine technology and UMS development and testing, evaluation, utilization, and maintenance. To be successful, continuous understanding of advances in select, Mississippi-relevant markets is needed. Coordination of efforts across all types of organizations to strategically push these markets forward is essential to effectively capitalize on developing opportunities.

Efforts to identify and foster the development of emerging Blue Economy markets need to be further developed and supported. Technology incubators and accelerators provide physical environments where early-stage companies can be co-located with subject matter experts and where innovative thinkers can collaborate. The process of technology commercialization requires knowledge and understanding of the applications and market for the innovation. In Mississippi, there is a wealth of technology being developed and used; however, there is little to support entrepreneurs in terms of funding (angel and venture), or for verification, validation, and modification of an invention. The process should encourage partnering among government, industry, higher education, non-profit and private sector entities to stimulate a strong network of technology and innovation.

Cluster Branding and Sales Plan

A well-structured and consistent communication strategy is a key component to the implementation of the GOTF Master Plan. For a cluster management organization to stand out as a point of reference and be recognized for its unique assets, it must be well-branded and marketed. The marketing and branding strategy is a comprehensive process that begins with gathering and analyzing data, understanding assets, and clearly defining a strategic mission. After this process is completed, the Governor's Ocean Task Force can begin to develop a communication and branding strategy and identify tools to reach the target audience.

Gaps:

Need for a coastal region or state-wide business retention and expansion plan aimed at industries operating in the Blue Economy.

Need for a business incubator environment on the coast capable of supporting the engineering needs and expenses of small startup companies or emerging collaborative technologies.

Need for a marketing and targeting strategy. Despite effort being made to develop the MIST Cluster in Mississippi, there lacks a coherent message that quality of life, workforce training, collaborative engineering spaces and growth opportunities all exist in Mississippi.

POLICY AND ETHICS

Legal Environment

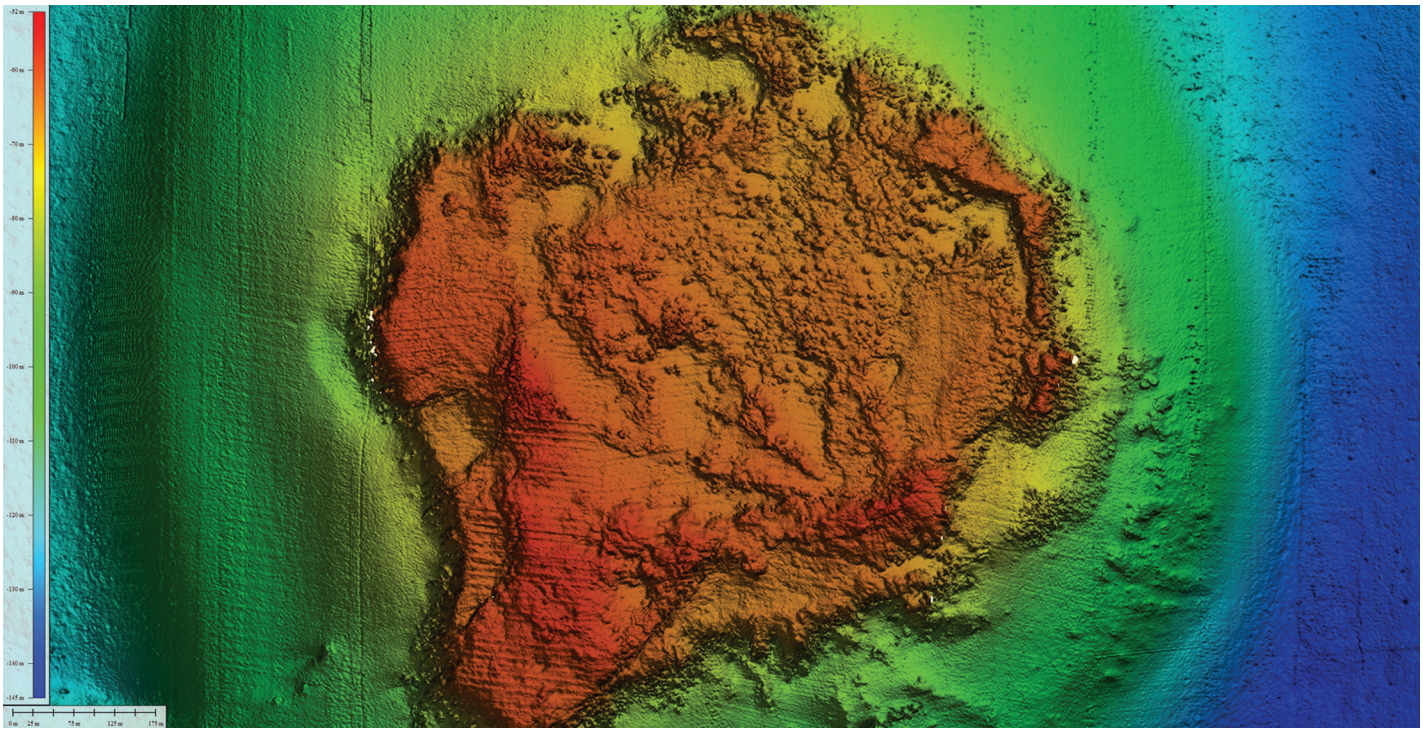
The legal and policy framework governing UMS activities is complex. On the federal level, more than 20 agencies administer over 140 laws affecting ocean waters and resources. In Mississippi, three state agencies (Mississippi Department of Marine Resources, Mississippi Secretary of State Office, and Mississippi Department of Environmental Quality) and associated Commissions implement a variety of coastal management and permitting programs. UMS activities occur in both state (0–3 nautical miles offshore) and federal waters (3–200 nautical miles offshore). Additional layers of legal complexity emerge as UMS seek interoperability across platforms and domains.

Consider, for instance, the complexity surrounding the necessary environmental reviews for an operational range. A review under the federal National Environmental Policy Act (NEPA) is required for any major federal action significantly affecting the quality of the environment. The NEPA review, which may include the preparation of an Environmental Assessment or Environmental Impact Statement, is handled by the federal agency controlling the project. Where multiple federal agencies are involved—for example, where a project needs permits from different agencies—the regulations require that a Lead Agency be designated to prepare and issue the NEPA document. Federal agencies are permitted to hire contractors to prepare the required environmental documents, but the documents must be reviewed and issued by the Lead Agency. Several federal agencies are in a position to be designated the lead agency, including the Navy, the U.S. Army Corps of Engineers, or the U.S. Coast Guard.

On the state level, the Mississippi Coastal Program has not been formally revised since 1988. The Mississippi Coastal Program was legislatively mandated in Section 57-15-6 of the Mississippi Code and approved by NOAA under the provisions of the Coastal Zone Management Act (CZMA) on September 29, 1980. Implementation of the Mississippi Coastal Program is the primary responsibility of the Office of Coastal Resources within the Mississippi Department of Marine Resources. Mississippi has submitted program changes to the NOAA Office of Coastal Management since the last revision, but the Mississippi Coastal Program document has not been updated and re-issued, making it difficult for the regulated community to assess applicability to proposed activities.

Additionally, certain assets and proposed activities bring with them additional regulatory policies and procedures as well as questions of oversight, ownership, and liability. Marine Technology and UMS assets must be clearly classified not only by use, but also by applicable regulations and other navigational rules. These may include the International Regulations for Preventing Collisions at Sea (COLREGS), as well as International Civil Aviation Organization (ICAO) flight procedures.

POLICY AND ETHICS



Ethical Environment

In an effort to enhance the moral connectivity of remote operators, the US Army developed The Human Dimension training concept, which posits the central importance of the moral, physical and cognitive components of the soldier in order to provide a balance to the tactile tools of war. The Human Dimension highlights the pre-eminent need for a human element for ethical decision making in the face of increasingly remote methods. Not only will future UMS training and education initiatives need to teach functional knowledge and advanced technologies, programs should include ethical considerations that prepare participants to confront multi-dimensional problems.

There are also public policy and ethical issues surrounding the increased use of UMS in the Gulf of Mexico. The waters of the Gulf of Mexico are home to a variety of public and private activities including oil and gas development, commercial fishing, recreational fishing and boating, and aquaculture. The proposed assets and activities could potentially negatively impact commercial fishing operations or state-sponsored projects such as shellfish aquaculture efforts and oyster mapping efforts in the western Mississippi Sound, so that impact must be considered.

Gap:

Need for a national resource center that can be used to assist Mississippi in developing a strategy that addresses existing or needed laws. The suite of state and federal laws that relate to marine technologies and UMS testing and application are expansive. The center would be a resource for ethical considerations of UMS development and applications. The center would also serve as a base of knowledge as various types of UMS are operated together.

GOALS AND TARGETED ACTIONS

The following goals and targeted actions have been synthesized from GOTF Focus Group reports and are intended to address the gaps identified in each area of focus. 'Goals' are measureable targets with specific 'Actions' being recommended activities to achieve them. All are relatable to at least one of the Roadmap's Key Recommendations. The GOTF expects these Goals and Targeted Actions to be refined with time as the Master Plan is implemented.

Education and Workforce

Goal: Grow and retain the top STEM-performing high-school and university graduates for entrance into the Mississippi technology workforce.

- **Action:** Define career pathways and competencies in maritime technologies from K12 through graduate studies. Implement high velocity learning at every level, determine the best concepts, techniques and technologies to accelerate learning at the individual, team and organizational levels.

Goal: Expand UMS certification programs to meet unknown workforce needs through collaboration between certification provider (universities), technology domain, and potential employer (defense and non-defense industries).

- **Action:** Create a strategic plan for learning and development of UMS to guide future training and formalize training skills and standards in order to ensure a consistent level of capability.

Goal: Establish universally acceptable marine technology and UMS workforce competencies and develop training across domains of air-sea-space to meet the growing demand of cross-domain operators.

- **Action:** Build out local infrastructure and develop collaborative opportunities to strategically integrate and align the workforce with future growth and development in maritime technologies.

Goal: Overcome the dearth of multidisciplinary technical specialists in mechanics; electronics; and maintenance and repair operations within marine technology industries in the State.

- **Action:** Create a talent pipeline by accelerating the training and reskilling that allows people and technology to reach their full potential.

Engineering Capacity

Goal: Assemble and maintain data on engineering capacity and assets in the engineering sector of the Blue Economy for the entire State.

- **Action:** Catalogue organizations and assets by current capabilities, avenues for growth, and emerging needs.

Goal: Grow the pool of accredited engineers in the Mississippi workforce to keep pace with computational needs, systems calibration, platform or vehicle validation, testing and advanced development needs in marine technology industries.

- **Action:** Leverage current educational programs to produce more engineers graduating from Mississippi universities and develop recruitment strategies to attract talent to the State.

GOALS AND TARGETED ACTIONS

Advanced Development and Testing

Goal: Provide complete end-to-end support for development of new technologies and advanced capabilities in the marine technologies and UMS sectors along the Mississippi Coast through a robust process of verification and validation of novel products. The process will need to begin in the design phase; address both digital and physical product development and realization; and include complex system and network design and development across an integrated range of product platforms aimed at addressing customer needs.

- **Action:** Identify commercializable federal or university technologies and create a mechanism for pairing those technologies with entrepreneurs, small businesses, or large corporations capable of productization of those technologies.
- **Action:** Create an instrument that offsets costs associated with assessing a technology for the commercial market.
- **Action:** Develop a comprehensive test and evaluation capability for marine technologies and UMS, whether aerial, surface, or underwater.
- **Action:** Reinforce existing infrastructure and build new infrastructure that is conducive to Mississippi's intrinsic strengths in systems engineering, polymer engineering, and computational engineering.

Applications

Goal: Cultivate programs to develop new marine hardware platforms—especially unmanned and autonomous systems—with a connected architecture, specifically for data collection applications allowing interface with cloud computing capabilities enabling seamless, real-time analytics. Platforms across sea, air, and space technologies domains should be developed with common architectures allowing for seamless systems communication and data integration across the platforms.

- **Action:** Integrate hardware and software design to garner their features from the software, allowing for updates with new abilities and improved performance parameters over the life of the hardware.
- **Action:** Design hardware and software technologies with integrated cyber security components; additional research and development thrusts should be implemented to ensure systems security.
- **Action:** Develop advanced algorithms for big data analytics to provide leading-edge technologies for handling the large amounts of data garnered by new technological platforms.
- **Action:** Develop high performance, real-time analytics capabilities with dynamic sampling and critical feature selection to evaluate the performance of various combinations of feature ranking/selection algorithms, clustering algorithms, sampling methods, and learning machines.

Goal: Build capacity within the State for development of new battery technologies and novel power sources/generators for unmanned systems; advanced vehicular automation technology development; and augmented reality technologies development for integration into existing and future applications.

- **Action:** Create cross-over programs that provide both the academic and industry expertise necessary to develop, test, operate, and understand the functionality and applications of developmental systems.

Goal: Expand capabilities and expertise in marine technologies focused on fisheries management and aquaculture.

- **Action:** Develop technologies to remotely monitor fishing and help protect the marine environment by aiding in the reduction of illegal, unregulated, and unreported fishing.
- **Action:** Develop autonomous cages that follow optimal ocean and atmospheric environmental conditions for aquaculture research and industrial development.

GOALS AND TARGETED ACTIONS

Economic Development

Goal: Capitalize on Mississippi's vast potential for development of multiple sectors of maritime technology and UMS development by providing State and local economic development agencies the resources to fully comprehend the economic impact of the Blue Economy which is currently not well understood.

- **Action:** Engage a highly-qualified consultant to conduct a thorough analysis of Mississippi's ocean, maritime, and related technology industries against competitive states to identify Mississippi's advantages and its gaps (SWOT); analysis should include workforce, available incentives, venture capital and private funding sources, and state and federal resources. The study should include a comprehensive report on the Blue Economy within the State.

Goal: Improve collaboration and a more seamless functioning of existing tech-focused non-profit organizations and programs along the Gulf Coast that have linking missions. Among these are NOARC as the state's lead organization for marine technology applications development, MSET as the state's lead organization for technology-based economic development along the Gulf Coast, and USM's MIST Cluster program as the state's lead program supporting the northern gulf coast region's maritime technology cluster.

- **Action:** Designate MSET as the lead project management agency to carry forward the strategic actions of the GOTF Master plan. Provide appropriate resources and funding to ensure MSET is properly staffed and able to assist in attracting both external and internal interest and resources that support development of ocean science and maritime technologies along the Gulf Coast.

- **Action:** Provide long-term funding to complement non-State resources and ensure the sustainability of the MIST Cluster program and investigate potential transfer to an independent, state-chartered, non-profit organization for long-term management.

- **Action:** Develop R&D tax credits, applied R&D seed fund, and similar programs that attract capital investment in marine-related applied research to leverage in conjunction with NOARC's development and validation capabilities. Provide long-term funding to ensure that NOARC is properly staffed and able to fulfill its mission.

Goal: Increase the focus and promote a shared vision among economic development organization for the growth of the Blue Economy in the State of Mississippi.

- **Action:** Develop a comprehensive economic development recruitment strategy targeting industry working in the Blue Economy, specifically marine technologies and UMS sectors.

- **Action:** Identify emerging markets in the Blue Economy and target markets that are synergistic to Mississippi capabilities.

- **Action:** Create focused Blue Economy marketing materials and incentives.

- **Action:** Develop a GOTF-specific business retention and expansion program.

- **Action:** Partner with the MS Gulf Coast Alliance to survey key industries and determine what policies and services will support their long-term viability and growth. Utilize survey results to identify current opportunities for growth, market constraints, and local obstacles.

- **Action:** Develop a coherent message that quality of life, workforce training, collaborative engineering spaces, and growth opportunities all exist in Mississippi.

- **Action:** Target recruitment of MRO operations for marine technologies and UMS systems for expansion into Mississippi.

GOALS AND TARGETED ACTIONS

Policy and Ethics

Goal: Position Mississippi as a leader in the development of policy and law in the marine technology and UMS domains.

- **Action:** Create a statewide resource center that can be used to assist Mississippi in developing a strategy that addresses existing or needed laws and ethical considerations for marine technologies and UMS development and applications.
- **Action:** Update the Mississippi Coastal Program to include UMS operations and activities.
- **Action:** Develop a comprehensive inventory of state, federal, and international laws and regulations governing UMS activities and operations in the Gulf of Mexico.
- **Action:** Develop a series of policy documents to support future marine technology and UMS activities in the Gulf of Mexico.

APPENDIX A: EXECUTIVE ORDER 1401

STATE OF MISSISSIPPI

Office of the Governor

EXECUTIVE ORDER 1401

WHEREAS, the Mississippi Gulf Coast has a diverse maritime industry including ports with deep water access, transportation, commercial fishing, shipbuilding, offshore drilling operations, environmental research, and aquaculture; and

WHEREAS, Mississippi is home to strategic military and government entities that provide aquatic research and environmental information such as collecting, processing, and exploiting oceanographic, meteorological, and hydrographic information; and

WHEREAS, the Chief of Naval Operations has created Task Force Ocean to advance science and ensure that the U.S. Navy maintains a competitive advantage in our ability to utilize the ocean environment; and

WHEREAS, the State of Mississippi and the Mississippi Development Authority desire to increase the maritime economy and the synergistic relationship between the military and government assets positioned along the Mississippi Gulf Coast especially as it pertains to the integration and development of unmanned maritime systems and supporting the U.S. Navy's competitive advantage:

NOW THEREFORE, I, Phil Bryant, Governor of the State of Mississippi, by virtue of the authority vested in me by the Constitution and laws of the State of Mississippi, do hereby order and direct as follows:

1. The Governor's Ocean Task Force is created to provide expertise for the development of a comprehensive economic development master plan that will focus on growing existing research and development for oceanography, unmanned maritime vehicles, technical workforce development, marine science research, and private sector activity.

2. The Governor's Ocean Task Force shall be advisory in nature and shall be composed of a Chairman and such other members that the Governor deems necessary. The members shall serve voluntarily with no compensation.

3. The Governor's Ocean Task Force shall meet periodically at the call of the Chairman to create an economic development master plan for Mississippi that shall include:

    a. Cataloging existing investments in the area of ocean technologies and unmanned maritime systems and identifying existing strengths and weaknesses with a recommended comprehensive strategy to bring the state into regional, national and international competitiveness in this area;

    b. Establishing a tangible and achievable roadmap to build capacity in maritime technology with special emphasis on national defense, energy exploration, marine resources, environmental monitoring, and aquaculture; and

    c. A strategy for working with state and federal lawmakers for the purpose of developing a vibrant economy around these technologies that includes a means for encouraging maritime technology industries to locate in the state.

APPENDIX A: EXECUTIVE ORDER 1401

BE IT FURTHER ORDERED that the Governor's Ocean Task Force shall by November 1, 2017, provide to the Governor a written economic development master plan incorporating the mandates of this Executive Order.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Great Seal of the State of Mississippi to be affixed.

DONE in the City of Jackson, on the 1st day of June in the year of our Lord, two thousand and seventeen, and of the independence of the United States of America, the two hundred and forty-first.

PHIL BRYANT
GOVERNOR

BY THE GOVERNOR

C. DELBERT HOSEMANN, JR.
SECRETARY OF STATE

APPENDIX B: FOCUS GROUP REPORTS

The following reports were compiled by each of the focus groups for their respective areas of focus. Each focus group was assigned one of the GOTF members as the focus group lead, and each group recruited other advisors and subject matter experts for support. The groups were instructed to survey the State's current assets (related to their specific areas), catalogue the capabilities and infrastructure, and identify the gaps. Each group's efforts resulted in a synopsis of the current state of their target areas and recommendations on how the state should strategically advance future development of ocean technologies and maritime assets along the gulf coast. Recommendations from all six groups were then synthesized to create the "key recommendations," as well as to identify goals and targeted actions.

EDUCATION AND WORKFORCE

Mississippi has a long history of building collaborative partnerships with government, academia, and the private sector to develop the human capital needed for high-growth, high-demand technology-based industries. These relationships are poised to continue to grow and develop with the UMS focus, partnering with educational institutions, from K12 to community colleges to universities, in areas of mutual interest and mutual benefit.

Education and Training Programs

The growing importance of the STEM subjects to the workforce is demonstrated in Mississippi's K12 schools with the existing STEM related Career and Technical Curricula and initiatives such as the Robotics and CS4MS Programs. The focus for CS4MS is to implement computer science in all schools in all grades by 2024 or sooner. Middle school implementation began this school year. High Schools are projected to provide a 4-course sequence to allow students to earn a CTE endorsement in Computer Science at any comprehensive high school, not just CTE Centers.

Existing post-secondary programs throughout the State offer fields of study and practice representing related domains to develop the human capital for UMS. Programs include physical, life and environmental sciences, engineering, earth/atmosphere/ocean sciences, mathematics, computer science, cybersecurity and other STEM related programs. The challenge is to ensure UMS-specific training is matched by training advancements that reflect the need for alternative approaches to education and training based on progressive UMS changes. Education and training programs must effectively blend theoretical and practical application, preparing UMS operators and developers with the training, education, and experience to translate complex information, patterns, and trends to make decisions.

The Navy supports a three-tier academic certification program for civilians and Navy officers in response to their goal of "integrating manned and unmanned systems and developing trust." The inaugural first tier certification had fifteen participants.

Several research-intensive Mississippi universities have existing certification and degree programs as well as active oceanographic, hydrographic, or unmanned systems research engineering programs.

APPENDIX B: FOCUS GROUP REPORTS

The University of Southern Mississippi houses the School of Ocean Science and Technology (SOST). Nearly all of the SOST academic and research programs are on the coast spanning from Gulf Coast Research Laboratory in Jackson County to the Division of Marine Science's oceanographers and hydrographers at Stennis Space Center. The SOST will expand into a new Marine Research Facility at the Port of Gulfport where the Ocean Engineering program will be supported along with the large research vessel Point Sur's shore operations. The SOST offers degrees ranging from undergraduate degrees in Marine Science and Ocean Engineering, to master's degrees, including one of only two Hydrographic Science degrees in the nation, and doctoral degrees. The SOST research enterprise currently manages over $90M in contracts and grants in ocean engineering, oceanography, hydrography, fisheries, aquaculture and other fields. USM also has research and education programs in Computer Science and Engineering (Coast and Hattiesburg) as well as a world-renowned Polymer Science program in Hattiesburg.

USM recently offered the nation's only university-sponsored academic certification in Unmanned Maritime Systems. This inaugural class of 15 navy-sponsored students represented a rigorous curriculum designed to give decision-making skills to the navy warfighter when using UMS as an asset in ocean surveillance. USM and the Navy are developing a set of competencies that will expand the current Tier 1 certification to more advanced Tier 2 and 3 certifications and degrees.

In USM's School of Computing, advanced algorithms for big data analytics are being developed which, once validated, can provide the leading-edge technologies for handling the large amounts of data that are anticipated to be collected, processed, and analyzed in the implementation phase of the GOTF Master Plan.

Mississippi State University (MSU) leads a wide range of research, service, and academic programs that support Mississippi's Blue Economy. The Bagley College of Engineering (BCoE) offers undergraduate, master's, and doctoral degrees that support coastal industries, including Chevron, Ingalls, and industries at Stennis Space Center, as well as federal, state, and local government. Recently, the BCoE started classes at Mississippi Gulf Coast Community College so students can earn either an electrical or a mechanical engineering degree from Mississippi State without leaving the Coast.

MSU has a plethora of significant research programs on the Coast. The Northern Gulf Institute, led by MSU and co-led by USM, has its program office and 30 employees in the MSU Science and Technology Building at Stennis Space Center. The building also houses the Associate Director of the Alliance for System Safety of UAS through Research Excellence (ASSURE) and the FAA Center of Excellence for UAS. MSU leads the Mississippi-partnership recently chosen to direct the new Department of Homeland Security Science and Technology Small Unmanned Aircraft Systems Demonstration Range Facility.

The University of Mississippi is home to the National Center for Physical Acoustics (NCPA) with a 30-year history in developing novel sensor applications for a wide variety of problems, including underwater acoustics. Interpreting the signals received from these sensors is also an active field of study, specifically sub-bottom profiling and tomographic techniques for finding sub-surface features. NCPA works closely with the Department of Physics and School of Engineering to educate graduate students in cutting edge sensor and signal processing technologies to produce the next generation of scientists and engineers. Private sector partners have always played an important role in project development at NCPA which strives to transition bench-top research into deployable solutions.

UM also has a long history of partnering with the University of Southern Mississippi in developing a variety of undersea vehicle technologies including integration of sensor platforms in vehicles, data storage, and exploration of the Gulf and beyond. Scientists from the National Center for Natural Products Research at UM have used these tools to explore undersea flora with unique potentially therapeutic compounds as a front line in novel drug development.

Both Mississippi Gulf Coast Community College and Pearl River Community College play key roles in workforce training in technical career pathways through their existing programs. New programs to specifically address technical career opportunities in maritime systems should be developed as the GOTF Master Plan is implemented.

+ **Recommendation:** Define career UMS pathways from K12 through graduate studies.

+ **Recommendation:** Leverage NAVSEA lessons learned and best practices and implement internship and apprenticeship opportunities for UMS.

Existing Skill Framework/Preliminary Workforce Analysis

Interviews with NAVO CNMOC, NRL, and the UMS Certification Program Director yielded no recognized or widely accepted set of UxS standards or skill frameworks. The lack of historical experience in training and education specific for unmanned maritime systems, as compared to other disciplines and fields of practice, makes the task of preparing the workforce to support UxS with the relevant skills difficult.

Some research suggests that the increased use and integration of remote and cyber platforms will have a dramatic impact on the approach to training and recruiting methodologies, which will need to include not only functional skills relevant to capabilities of UxS, but also the fundamentals of communication and information systems and values such as integrity, teamwork, dedication to strategic goals/mission, the ability to maintain confidentiality, and creative problem solving under pressure.

In an effort to enhance the moral connectivity of remote operators, the US Army developed The Human Dimension training concept, which posits the central importance of the moral, physical and cognitive components of the soldier in order to provide a balance to the tactile tools of war. The Human Dimension highlights the pre-eminent need for a human element for ethical decision making in the face of increasingly remote methods. Not only will future UxS training and education initiatives need to teach functional knowledge and advanced technologies, programs should include ethical considerations that prepare participants to confront multi-dimensional problems.

Preliminary workforce analysis to determine current UxS education and workforce requirements revealed an increased manpower need in support of the Navy Shipbuilding Plan. While the increased manpower is not specifically for UxS, the increased workforce includes the need for UxS personnel. Forty-one percent of the increased manpower will be in the civilian and contractor workforce, with the remaining increase in Naval Operational Oceanography (23%), enlisted personnel (26%) and officers (7%). Further analysis indicated that two-thirds of the current SSC NAVO workforce has at least a Bachelor's degree.

A robust research-based, practitioner focused skill framework can provide the foundation to recruit, train and develop a UxS workforce that closely aligns with the needs of future jobs. The framework can identify the broad range of skills discussed above, as well as the required level of education and career paths. Skillsets will drive the recruitment and enlistment criteria to more closely reflect the needs of the jobs.

+ **Recommendation:** While the UxS field is growing with many self-taught experts and practitioners, there is a need to formalize training skills and standards in order to ensure a consistent level of capability.

+ **Recommendation:** As the UxS field of practice grows, the Learning & Development (L&D) function will play a critical role for industry growth. L&D must help organizations and regions drive business. Creation of a Strategy Map for Learning and Development of the UxS will help guide the future efforts of the training function.

Gap:

Need to match the workforce demands and present state-of-the art training and education for a growing range of applications.

+ **Recommendation:** Expand local infrastructure and develop collaborative opportunities to integrate and align the workforce with UMS future growth and development.

+ **Recommendation:** To achieve what the Navy references as high velocity learning at every level, determine the best concepts, techniques and technologies to accelerate learning at the individual, team and organizational levels.

+ **Recommendation:** Create a talent pipeline that allows people and technology to reach their full potential by accelerating the training and reskilling of people. Labor productivity, talent acquisition and retention, innovation, and creativity help to solidify a UxS talent pipeline.

+ **Recommendation:** Clearly define the career pathways for UxS and the competencies required along the career pathways.

ENGINEERING CAPACITY

Blue Economy in Mississippi

Efforts to quantify the Blue Economy in Mississippi must focus on identifying and understanding those organizations—federal, state, university, and private industry—that support poorly categorized ocean-based projects and programs. For example, an engineering company working on systems and sensors to understand nearshore waves is categorized under "professional engineering." All of the engineering companies in the State can be identified; however, identifying those working specifically in the maritime is a much harder task.

+ **Recommendation:** Form a diverse group of federal, state, academic, and private companies to work on furthering the Blue Economy sector as a whole. It will be important to know which organization is doing what, where they plan to go in the future, and how internal Mississippi assets can be applied to emerging needs. Sub-groups may be necessary to address specific topics, for example unmanned systems.

For a recent request submitted to the Mississippi Enterprise for Technology (MSET), a week-long task that involved prior knowledge of local efforts and a cursory internet search for companies revealed as many as 109 organizations working in the Blue Economy in the lower three counties.

+ **Recommendation:** An effort to fully compile similar information for the entire State should be initiated.

Unmanned Systems

For the purposes of the Governor's Ocean Task Force, the Engineering Capacity Work Group selected a promising sector as an example of what already exists in Mississippi and resonates with local federal, academic, and private entities—unmanned systems. This is an emerging technology that is extremely relevant to organizations in the State, such as the Navy and NOAA, which represent existing, internal markets for these systems and the information they provide.

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In understanding the engineering capacity associated with unmanned systems (UxS) in the State, not only must the system builders be considered, but also organizations that support the development/enhancement of the systems, data acquisition and handling, data analytics and product development, operations and maintenance, and communications providers. Infrastructure within the State to assist in UxS deployment, testing, evaluation, and use is also critical to document.

Existing Capacity

A catalog of Mississippi-based assets was compiled that relate to ocean-based UxS, whether the system is deployed underwater or on the water's surface, or is looking at the water from airborne or space-based platforms. Using customized "Asset Sheets," organizations were cataloged according to how they support UxS—associated with systems, services, or infrastructure. Additionally, a list of Mississippi-based suppliers supporting the industry was compiled. These Asset Sheets provide details of how each asset is supporting UxS; similar sheets were collected for organizations that are not currently supporting UxS efforts, but have the capacity to do so. The information on these sheets, combined with information gleaned from discussions with UxS users, formed the basis for the information that follows.

The review of organizations that support underwater and surface UxS systems identified the following:

- 15 Federal agencies
- 8 State agencies and universities
- 50 Private Companies

These 73 organizations provide the following types of support to UxS:

- Manufacture of space-based, airborne, and surface systems
- Operation and use of UxS to characterize coastal, national, and international waters
- Deployment and recovery of UxS in support of contracted and/or research projects
- Manufacture of ships capable of easily deploying underwater UxS
- Program/project management support
- Engineering expertise to design new UxS
- Incorporation on new sensors onboard UxS
- Research vessels and other ships available for UxS deployment
- Aircraft available for flying UxS
- Drone deployment to support environmental programs/projects
- Trainers to assist others in certification process for proper drone operation
- Expertise in the determination of drone use within commercial airspace
- Use of UxS during disaster response to re-survey shipping channels/navigation routes
- Restricted air space for the test of airborne systems
- Remote operation of underwater and surface-based UxS
- Programming of UxS for remote operation
- Manufacture of communication systems supporting UxS
- Laboratories to support post-deployment cleaning and prep of underwater/surface UxS
- Calibration of the instruments used in UxS repair and maintenance
- Manipulation of data received from UxS
- Software development to manipulate UxS data to address environmental characterizations and to prepare data for use in forecast models/predictions
- Quality assurance and metadata generation of UxS data
- Creation of databases for UxS data
- Data analysis to address various environmental issues and monitoring
- Creation of maps and other data products generated from UxS data

- Expertise in the use of UxS data collection to address various scientific, environmental, and military purposes
- Web-based access to data, maps and other data products created from or including UxS data

Based on the review, Mississippi has a large number of assets—systems manufacturers, service providers, operators, human capital, technology support, training programs, etc.—that support UxS.

Eighteen companies that currently do not support UxS, but have the capability to do so, were identified. Companies located in the State that are key participants in UxS include the following:

- BAE Systems
- Lockheed Martin
- Teledyne Marine
- Tyonek

+ **Recommendation:** Conduct a focused study on quantifying the Blue Economy in Mississippi. Results from this report indicated 73 organizations involved in one sector of the Blue Economy. A comprehensive study of the Blue Economy is needed to understand its total contribution to the Mississippi economy.

Gaps:

Based on the data collected, three gaps were identified in Mississippi's UxS capacity. It is expected that similar gaps will be determined within other sectors.

- **System maintenance and repair operations (MRO)**—in general, organizations with UxS systems had to either assign staff to the repair and/or maintenance of hardware, or send them out to the original manufacturers located out-of-state.
- **Sensor Calibration**—many of the UxS are equipped with sensors to collect environmental data. Following their use, or a certain number of uses, they must be calibrated. Although the NASA Laboratories at Stennis can provide some of this support, most return their sensors to out-of-state manufacturers for calibration.
- **Underwater/Surface System Test and Evaluation Infrastructure**—as systems progress through the development process, they must be tested, verified, and validated. Mississippi has the infrastructure for the test and evaluation of airborne systems; however, no in-water infrastructure has been established.

+ **Recommendation:** Create a program to identify and recruit companies that would further advance Mississippi's Blue Economy. A number of companies have or are looking to re-locate given the expenses associated with traditional east and west coast areas.

+ **Recommendation:** Create focused marketing materials and incentives associated with Mississippi sites. Begin efforts with existing industry (BAE Systems, Lockheed Martin, Teledyne, Tyonek) or those that fill gaps in the current capacity.

+ **Recommendation:** Leverage the existing UxS capability to expand and create new assets. There is synergistic support for the creation of a test range in the Gulf Coast area. Mississippi has distinct advantages over other locations. For example, Mississippi is home to the largest fleet of underwater UxS operated from Navy groups at Stennis, and the coastal/nearshore environment provides access to all types of scenarios for testing.

+ **Recommendation:** Create a plan to use Singing River Island as a UxS Test Range Operating Station and designate rules and regulations for using coastal Mississippi waters for UxS testing, research, and operations.

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ADVANCED DEVELOPMENT AND TESTING

Current Capabilities in Mississippi

Advanced development and testing efforts related to the Blue Economy are currently taking place throughout the State, but are often very specific to a system, such as an aircraft with sensors that look down at the ocean or a new ship launched along the coast. In some cases, an organization procures any needed equipment for development and testing, which tends to be costly. It also results in a number of individual organizations spending project monies on the same types of equipment. Another solution to the problem is to contract the use of another organization's development and test equipment. This is currently difficult for several reasons – 1., some equipment is not easily assessable (a federal asset, for example). 2. There is also a lack of understanding on the assets available in the State and how to use them. 3. And finally, and as a result 2, development and testing elements are conducted out-of-State.

+ **Recommendation:** Form a diverse group of federal, state, academic, and private companies to work on furthering the Blue Economy sector as a whole. In addition to understanding which organization is doing what, specific emphasis needs to be on the identification of internal Mississippi assets and how they can be used by others.

Proposed efforts to bring an incubator/accelerator focused on the development and test of new ideas in the Blue Economy have not been successful. As a result, ideas for new sensors and systems cannot be prototyped, modeled, or tested. In most areas where these sensors and systems are being successfully developed (San Diego/Massachusetts/Florida), there is a dedicated space supporting students, entrepreneurs, and hi-tech companies where not only can the equipment needed for prototyping and testing can be shared, but receive education on developing the business aspects of their technology.

+ **Recommendation:** Create an incubator/accelerator that is customized to support the hi-tech aspects of the Blue Economy. Ensure the infrastructure is conducive to Mississippi strengths, such as advanced materials and additive manufacturing. Accessibility by students of Mississippi universities is essential for furthering the productive development of small companies based on new and fresh ideas.

Up-and-Coming Programs

There are various types of Mississippi-based organizations that are currently working on, or have proposed, efforts that will drive the success of the Blue Economy in terms of technology advancement, reduced costs, increased accuracy and understanding, and efficiency. Some of these are federal research laboratories, some are private companies with internal research and development efforts, and others are start-ups. Recent efforts in federal programs such as DARPA, ONR, and NRL, as well as larger companies such as Huntington Ingalls and Shell, are focused on not only the development of new techniques or new applications of existing techniques, but the integration, interchangeability, and extensibility of systems to provide customized solutions to a number of scenarios. Challenges for these programs are all relatively consistent and are:

- Interoperability
- Autonomy
- Integration
- Communications
- Training
- Propulsion and Power
- Manned-Unmanned Issues

For example, long-term Navy goals are focused on Manned-Unmanned (MUM) Teaming, where actions and reactions of all types of fleet forces can be optimized based on the specifics of a scenario to be addressed. This strategy requires much forethought during system design, with attention to open architectures in hardware and software components, interface standards, and even materials used. Intricacies of how systems will work together and developing rules of engagement are still a work-in-progress. A number of Mississippi assets exist that can be applied to the challenges facing programs like this.

+ **Recommendation:** Create programs that provide the expertise necessary to develop, test, operate, and understand the functionality of these systems and their use. In the case of the Navy's MUM Teaming goals, Mississippi has two universities, each with specific and relevant expertise of their own. Leveraging the curricula at the University of Southern Mississippi in underwater systems and Mississippi State University in aerial systems to form a cross-over educational experience would create globally unique program and position the State as a leader in the field.

+ **Recommendation:** Leverage current activities on Singing River Island to develop a comprehensive test and evaluation capability for UMS, whether aerial, surface, or underwater. Dedicate a building to house standardized tools, equipment, software, control stations, and other elements needed to fully support the deployment and assessment of these systems in a very-well-understood environment and within proximity to a variety of operational scenarios.

+ **Recommendation:** Using the previous two recommendations, position Mississippi as a leader for developing policy, rules of engagement, and operating procedures for interoperable UMS, including the use of multiple systems and multiple types of systems.

+ **Recommendation:** Create a mechanism or group to identify other examples of where Mississippi-based programs of excellence can be leveraged for the expansion of the State's Blue Economy. This might include shipbuilding, oil and gas, ocean monitoring/observing/forecasting, and others.

Current Shortfalls

In the Engineering Capacity Section of this document, 73 organizations were identified that currently provide some type of direct support to UMS. The shortfalls identified in that Section are also relevant here, with emphasis on the need for an MRO capability. Adding this to the recommendations in the previous section will then provide a complete end-to-end support for UMS along the Mississippi coast.

+ **Recommendation:** Identify private entities that provide MRO services to aerial and underwater UMS and facilitate/expand their offices in Mississippi.

+ **Recommendation:** Create a program to identify and recruit companies that would further advance Mississippi's Blue Economy. A number of companies have or are looking to re-locate given the expenses associated with traditional east and west coast areas.

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APPLICATIONS

To position the State of Mississippi as a leader in maritime technologies and ocean-based unmanned systems applications, the GOTF will develop a comprehensive assessment strategy and development plan for applications for maritime technologies and ocean-based unmanned systems within the State. The following focus areas have been identified as key drivers for success in this field:

Technology, Systems, and Systems Integration

Mississippi has significant assets for supporting aerial and spaced based remote sensing applications, as well as unmanned aerial, surface, and submersible vehicles. This includes government, industry and university assets and expertise related to multi and hyperspectral, LIDAR, synthetic aperture radar (SAR) and other similar remote sensing sensor systems, image processing, data storage and processing, and decision support tools development and validation. The State and its federal partners have also established both land and sea UAV flight zones.

+ **Recommendation:** Expand and enhance current –and establish new– aerial, surface, and subsea unmanned vehicle test ranges and their supporting infrastructure.

+ **Recommendation:** Develop and implement a methodology for identifying existing assets, expertise, and investments as well as tracking new developments for cataloging and reporting.

Modern technology hardware is being designed as open and extensible platforms capable of acquiring accurate data almost anytime and anywhere. These hardware platforms have enormous application potential. The market for data about the physical world and about action occurring within the world is virtually limitless. Modern technology hardware is oft primarily associated with data collection. The market for applications that transform that data into usable information holds the potential for tremendous economic growth.

+ **Recommendation:** The focus on assets and expertise for the development of new technological hardware —especially unmanned and autonomous systems—should be primarily on design of data collection platforms with a "connected" architecture, allowing interface with cloud computing capabilities.

+ **Recommendation:** Attention on existing and developmental assets and capabilities should be focused on the integration between hardware and software so that data collected can be uploaded to the cloud, analyzed, and presented seamlessly in a usable format. Integrating the hardware and software systems designs will enable devices to garner their features from the software, allowing for updates with new abilities and improved performance parameters over the life of the hardware.

+ **Recommendation:** Effort should be made to ensure that hardware platforms across sea, air, and space technologies are developed with common architectures allowing for seamless systems communication and data integration across the platforms.

+ **Recommendation:** Prioritize the design of hardware and software technologies with integrated cyber security components. Additional research and development thrusts should be implemented to ensure systems security.

Target Agencies and Industries for Support

Mississippi has a robust ecosystem of existing industry and governmental agencies operating in the fields of marine and ocean sciences and technologies. To support this base, accelerate tech-based innovation, and grow the high-tech economy, a concerted effort should be undertaken to identify needed support and capabilities.

+ **Recommendation:** Conduct regular systematic reviews of agencies and report on:
  - Technology Road Maps
  - SBIR/STTR and similar technology development solicitations topic areas
  - Federal labs mission statements and associated research focus areas.

+ **Recommendation:** Conduct regular systematic reviews of marine related industries and report on:
  - Technology Road Maps where available
  - Conferences related to applied technologies
  - Trade journals and other publications
  - Industry research groups.

+ **Recommendation:** Conduct interviews with key agency and industry leaders and technologists to better understand and verify problems and opportunities that may be addressed by technology applications development through state, federal, and industry joint partnerships.

Creation of operational programs within the state to help address identified critical needs of target agencies and industries related to marine technology applications should be considered. Existing models in the high-performance materials (Mississippi Polymer Institute) and automotive industries (CAVS-E) have been implemented and have shown great success.

+ **Recommendation:** Establish joint agency/industry/state-university applied research development programs.

+ **Recommendation:** Support tech-based incubator programs and extension services aiding tech-startups and industry applied research projects.

+ **Recommendation:** Conduct regular conferences and meetings among agency/industry/state-university research and development organizations.

+ **Recommendation:** Explore R&D tax credits, applied R&D seed fund, and similar programs that may attract capital investment in marine-related applied research.

Process for Verification and Validation of Novel Technologies for Operational Prototype

To bring new technologies and advanced capabilities to fruition within the State, public and private partnerships can address identified applications themes in the marine and ocean sciences sectors through a robust process of verification and validation of novel products. The process will need to begin in the design phase; address both digital and physical product development and realization; and include complex system and network design and development across an integrated range of product platforms.

+ **Recommendation:** Establish a product innovation, development, and pilot production facility (such as USM's Accelerator) on the Gulf Coast to facilitate new product design and prototyping.

+ **Recommendation:** Expand existing and establish new physical environment test ranges in the gulf coast region.

+ **Recommendation:** Develop a digital proving ground of ultra-high resolution, precisely characterized geospatial information/data based on the physical test ranges for use in future systems prototype development and performance verification testing.

+ **Recommendation:** Utilize a collaborative research framework that leverages collective resources to accelerate development of new system prototypes.

+ **Recommendation:** Orchestrate a collective integration of expertise across university, industry, government, and non-profit (NOARC, MSET, etc.) where stakeholders all participate and all benefit from results.

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Valuation of Data Acquired through Applications

The rapid proliferation of connected devices, sensors, and (Internet of) things has ushered in the era of big data, which holds tremendous potential for problem solving and applications development in various fields.

+ **Recommendation:** Identify university, state, and federal resources focused on development of advanced algorithms for big data analytics to provide leading-edge technologies for handling the large amounts of data garnered by new technological platforms.

+ **Recommendation:** Focus resources on developing a methodology for high performance, real-time analytics with dynamic sampling and critical feature selection to evaluate the performance of various combinations of feature ranking/selection algorithms, clustering algorithms, sampling methods, and learning machines.

+ **Recommendation:** Conduct a comprehensive literature review by an interdisciplinary team that may lead to the finding of algorithms suitable for specific tasks. Subsequently, software development teams made up of university, industry, and federal partners may be composed to undertake customized development projects capitalizing on the published algorithms and open-source software and leading to additional education and R&D opportunities to Mississippi communities.

Applications for Existing Industry

Several maritime-based industries within the State use remotely operated and autonomous unmanned systems, and other robotic instrumentation and sensors. The defense industry uses autonomous unmanned and remotely operated technology regularly. Other industries, such as oil and gas; ports and transportation; commercial fishing; and aquaculture have recently started to utilize autonomous and remotely operated systems. Many industries are looking to expand their investments in these technologies.

Remotely operated vehicles (ROVs) are regularly used by the oil and gas industry. Examples include mapping of pipelines or inspecting wells and equipment. Autonomous underwater vehicles (AUVs) are being used for bathymetric data and sub bottom profiling. The use of waver gliders has been on the rise as battery life and propulsion systems improve. There is potential for unmanned surface vehicles (USVs) to replace surface ships as relays for tethered ROVs and AUVs.

+ **Recommendation:** Assess capacity within the State for development of new battery technologies and novel power sources/generators for unmanned systems.

+ **Recommendation:** Position or develop assets and infrastructure along the coast to encourage greater adoption of USVs for commercial applications, and subsequently implement incentives and recruiting strategies to grow the USV production capacity within the State.

Ports, harbors, and maritime transportation have benefited from unmanned technology and sensor development. Technology that can benefit ports and harbors includes unmanned systems for detecting, tracking, and assessing threats. Vehicle automation can advance maritime transportation to complete operations in environments that are geopolitically or environmentally hazardous.

+ **Recommendation:** Assess capacity within the State for advanced vehicular automation technology development.

+ **Recommendation:** Develop a test range for verifying capabilities of ocean-based autonomous vehicles.

The commercial fishing industry has recently started to utilize remotely operated technology. Fishermen often leverage the use of vessel monitoring systems mandated for compliance and enforcement in federal fisheries for safety and data collection. Fish trackers and unmanned aerial systems operated from vessels that help target schools of fish and look for potential bycatch issues are used by commercial fleets.

+ **Recommendation:** Assess capacity within the State to develop technologies aiding selective fishing practices that help reduce bycatch and environmental impacts related to the commercial fishing industry.

+ **Recommendation:** Examine growth opportunities that include the ability to remotely monitor fishing and help protect the marine environment by aiding in the reduction of illegal, unregulated, and unreported fishing.

Robotic equipment in aquaculture can both increase production and reduce diver intervention for routine maintenance. Augmented reality technologies for diver operations can aid communication and improve efficiency underwater.

+ **Recommendation:** Assess capacity within the State to develop autonomous cages that follow optimal ocean and atmospheric environmental conditions for aquaculture research and industrial development.

+ **Recommendation:** Determine existing capabilities related to augmented reality technologies and examine the potential for integration into existing and future applications.

The Departments of Defense (DoD) and Homeland Security (DHS) increasingly utilize unmanned systems. The U.S. Navy operates the largest fleet of unmanned systems in the country from Stennis Space Center. The DHS Science and Technology Directorate recently selected Mississippi as the new base of operations for small unmanned aircraft systems.

+ **Recommendation:** Leverage existing and develop new assets and capabilities in parallel with the directives generated by the Navy's Task Force Ocean.

+ **Recommendation:** Leverage existing and develop new assets and capabilities in parallel with the directives generated by DHS's expanding need for drone technologies.

Identification of Relevant Ocean Applications

Commercial Industry

- Commercial Exploration
  - Offshore Drilling
  - Survey and Seabed Mapping
  - Pipeline/Cabling/Inspection
- Marine Fisheries
  - Commercial and recreational fishing
  - Commercial shellfish production/Mariculture – Offshore and Onshore
- Commercial shipping and Port and Harbor operations
  - Ocean weather monitoring and prediction
  - Security, Detection, and Inspection
  - Navigation and Accident Investigation
- Coastal Restoration and Recovery
  - Environmental engineering
  - Coastal wetland plant production

Scientific Research

- Seabed Mapping and Imaging
- Oceanographic Studies
- Environmental Research and Monitoring
- Pharmaceutical Research

Defense

- ISR (Intelligence, Surveillance, and Reconnaissance)
- Mine Countermeasures
- Anti-Submarine Warfare
- Defense logistics and Port and Harbor operations
  - Ocean weather monitoring and prediction
  - Security, Detection, and Inspection
  - Navigation and Accident Investigation

Miscellaneous

- Search and Rescue
- Marine Salvage and Debris Removal
- Marine Archaeology

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ECONOMIC DEVELOPMENT

Mississippi is home to 15 ports situated along waterways throughout the state, including two deep-draft ocean ports along the Mississippi Gulf Coast in Gulfport and Pascagoula, making Mississippi a major competitor in ocean, maritime and marine-related technology industries. Beyond the coastline, an array of suppliers and technology companies support the maritime industry.

Business Retention and Expansion Program

A thorough and comprehensive business retention and expansion strategy will protect and grow Mississippi's existing ocean and maritime industries. Robust data on marine industry sectors needs to be gathered using state of the art survey tools and methods. Industry surveys must include sectors not traditionally thought of as maritime specific. The initial target company list should consist of major players within the ocean/maritime industry, in addition to blue technology companies, and focus on the Navy's Task Force Ocean Focus Areas: Sensing and observation; modeling and prediction; application and decision aids; human capital and technical workforce.

+ **Recommendation:** Develop a GOTF-specific business retention and expansion program:

  - Partner with the Gulf Alliance to survey key industries and determine what policies and services will support their long-term viability and growth.
  - Utilize survey results to identify current opportunities for growth, market constraints, and local obstacles. Throughout the process, the team will gather valuable insight into expansion opportunities, skill gaps, and competitive advantages that can be used in conjunction with real-life data.
  - Examples of survey topics: permitting, both state and local; employment issues; utility issues; serving as a liaison to local, state and federal officials; workforce issues; advocating on issues important to local industries and small businesses in the areas of transportation, regulations, and policy matters; identifying sites and buildings available for expanding business and industry; and coordination with existing businesses and industries to continue improving the business environment.

Emerging Markets

There are a number of emerging markets associated with the blue economy and blue-tech sectors. Examples of these include the increased use of unmanned systems for ocean sensing and forecasting, including handling of increasingly large datasets and their real-time interpretation; transportation; floating ports; and defense-related support. Enormous capacity exists in local federal, state, and private organizations to support unmanned systems development and testing, evaluation, utilization, and maintenance. To be successful, continuous understanding of advances in select, Mississippi-relevant markets is needed. Coordination of efforts across all types of organizations to strategically push these markets forward is essential to effectively capitalize on developing opportunities.

+ **Recommendation:** Identify emerging markets in the blue economy, specifically those markets that are synergistic to Mississippi capabilities.

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The Blue Economy is encumbered by a lack of reporting mechanisms—NAICS and SIC codes do not adequately separate organizations working in the Blue Economy. Therefore, a clear understanding of which engineering companies support maritime engineering, for example, is not going to be easily determined unless direct connections are made and maintained. The utilization of networking organizations (Innovate MS, MSET, MIST Cluster, etc.) to understand the capabilities of their members and their technological capabilities is essential to identifying Mississippi-based companies best able to address emerging opportunities. An organization such as this should also understand the actions of similar organizations across the nation and internationally.

+ **Recommendation:** Create, or designate an existing, networking organization to facilitate interaction among blue economy/blue-tech companies in the State and remain current with ever-changing technologies.

Efforts to identify and foster the development of emerging blue economy and blue-tech markets need to be further developed and supported. Technology incubators and accelerators provide physical environments where early-stage companies can be co-located with subject matter experts and where innovative thinkers can collaborate. The process of technology commercialization requires knowledge and understanding of the applications and market for the innovation. In Mississippi, there is a wealth of technology being developed and used; however, there is little to support entrepreneurs in terms of funding (angel and venture), or for verification, validation, and modification of an invention. The process should encourage partnering among government, industry, higher education, non-profit and private sector entities to stimulate a strong network of technology and innovation.

+ **Recommendation:** Create mechanisms to support and fund emerging markets, specifically using technology business incubators and accelerators.

Competitive Advantage

Understanding the State's current market position as compared to other states in the blue economy sector is essential to gaining and maintaining a competitive advantage.

+ **Recommendation:** Conduct an initial self-analysis of Mississippi's ocean, maritime, and related technology industries against competitive states to identify Mississippi's advantages and its gaps (SWOT).

+ **Recommendation:** Benchmark Mississippi against the states of Florida, Virginia, North Carolina, California, Washington, Massachusetts, and Maryland—all of which constitute a heavy Navy base and technology footprint, similar to Mississippi. This comparison would give Mississippi an opportunity review programs and resources that are publicly available against the State's offerings.

  - Analysis should include workforce, available incentives, venture capital and private funding sources, state and federal resources.

+ **Recommendation:** Upon finalization of the strategic plan, implementation should include funding sources to hire a consultant to conduct an industry survey of these items against identified competitive states.

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Research and development, both university and industrial, can create major advantages for the state. Research partnerships between university and industry provide additional value.

+ **Recommendation:** Create a catalog of current and potential partnerships to identify the impacts of those partnerships. This should include R&D dollars, employment, and potential expansion opportunities or new locations into the State.

+ **Recommendation:** Identify tax credit or incentive programs specifically tied to research and development and catalog against competing states.

+ **Recommendation:** Identify existing or create R&D tax credits specifically for university and industry partnerships.

Testing

Mississippi has a unique position in evaluation and testing of unmanned platforms including air, land, and marine—both surface and subsurface in all environments. The South Mississippi Training Complex, thanks to a huge military presence in Mississippi, is already ahead of other areas, especially being the FAA's Center of Excellence for unmanned integration into National Airspace. Mississippi State has now been granted a Certificate of Authorization (COA) for unmanned access to the Warning and Restricted Training areas over the Gulf of Mexico, which provides unlimited test access for ocean-based programs as well as air-to-surface testing.

+ **Recommendation:** Create, or designate an existing organization to manage and expand current test ranges; develop new ranges, and market the capabilities offered to national and international markets.

Cluster Branding and Sales Plan

A well-structured and consistent communication strategy is a key component to the implementation of the Oceans Task Force final plan. For a cluster management organization to stand out as a point of reference and be recognized for its unique assets, it must be well-branded and marketed. The marketing and branding strategy is a comprehensive process that begins with gathering and analyzing data, understanding assets and clearly defining a strategic mission. After this process is completed, the Governor's Ocean Task Force can begin to develop a communication and branding strategy and identify tools to reach the target audience.

+ **Recommendation:** Develop a cluster branding and sales plan focused on attracting both external and internal interest and resources that will support the strategic development of ocean science and maritime technologies along the Coast.

+ **Recommendation:** Add subject matter experts in cluster branding and marketing to this effort. At a baseline, the strategy should include the following elements:

  - Clearly define roles and responsibilities of various agencies and organizations throughout the state.
  - Develop a branding process that will be based on final vision of the study. This includes brand name, theme and consistent messaging.
  - Develop a communications plan using multiple types of media (website, social media, print) that is targeted to sectors identified in the final plan.
  - Integrate branding and marketing into the existing economic development infrastructure.
  - Develop an implementation and coordination plan for ongoing sales activities.
  - Identify events and activities that will provide for continuous dialogue from stakeholders, both internally and externally, creating a broad recognition and acceptance of the brand.

+ **Recommendation:** Leverage the extant SBA supported Marine Industries Science & Technology Cluster (MIST Cluster) as a baseline starting point for further cluster branding and development under an independent non-profit organizational structure.

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POLICY AND ETHICS

Mississippi has a unique opportunity to become the leader in testing and advancing the nation's next generation of Unmanned Maritime Systems. While there are numerous unmanned systems efforts ongoing in the United States, there is a lack of focus on underwater systems development. Mississippi is uniquely positioned to fill this void; however, as with any innovative technology there are legal and regulatory barriers that must be addressed to achieve desired goals.

The legal and policy framework governing UMS activities is complex. On the federal level, more than 20 agencies administer over 140 laws affecting ocean waters and resources. In Mississippi, three state agencies (Mississippi Department of Marine Resources, Mississippi Secretary of State Office, and Mississippi Department of Environmental Quality) and associated Commissions implement a variety of coastal management and permitting programs. UMS activities occur in both state (0–3 nautical miles offshore) and federal waters (3–200 nautical miles offshore). Additional complexities emerge as UMS seek interoperability across platforms and domains.

Consider, for instance, the complexity surrounding the necessary environmental reviews for the Range. A review under the federal National Environmental Policy Act (NEPA) is required for any major federal action significantly affecting the quality of the environment. The NEPA review, which may include the preparation of an Environmental Assessment or Environmental Impact Statement, is handled by the federal agency controlling the project. Where multiple federal agencies are involved -- for example, where a project needs permits from different agencies -- the regulations require that a Lead Agency be designated to prepare and issue the NEPA document. Federal agencies are permitted to hire contractors to prepare the required environmental documents, but the documents must be reviewed and issued by the Lead Agency. Several federal agencies are in a position to be designated the lead agency, including the Navy, the U.S. Army Corps of Engineers, or the U.S. Coast Guard.

On the state level, the Mississippi Coastal Program has not been formally revised since 1988. The Mississippi Coastal Program was legislatively mandated in Section 57-15-6 of the Mississippi Code and approved by NOAA under the provisions of the Coastal Zone Management Act (CZMA) on September 29, 1980. Implementation of the Mississippi Coastal Program is the primary responsibility of the Office of Coastal Resources within the Mississippi Department of Marine Resources. Mississippi has submitted program changes to the NOAA Office of Coastal Management since the last revision, but the Mississippi Coastal Program document has not been updated and re-issued, making it difficult for the regulated community to assess applicability to proposed activities.

Furthermore, the legal status of UMS is unclear under both federal and international law. Unlike UAVs, which the Department of Defense has classified as aircraft, UMS classification remains uncertain. Clear guidance has yet to be developed regarding which UMS should be considered vessels and additionally in the military context, warships and weapons. The classification of an UMS will impact how that UMS is treated under federal and international law with respect to navigational rights such as innocent passage, collision regulations, and liability.

+ **Recommendation:** Update the Mississippi Coastal Program to include UMS operations and activities.

There are also public policy and ethical issues surrounding the increased use of UMS in the Gulf of Mexico. Ethics, as used within this master plan, refers to standards of right and wrong in terms of the obligations that UMS developers and operators have to their employers, funders, partners, and the wider society. UMS activities may lead

to collaborations between military, scientific, and private industry partners involving classified or confidential information, such as trade secrets or propriety data. Surveillance activities can raise privacy concerns. The waters of the Gulf of Mexico are home to a variety of public and private activities including oil and gas development, commercial fishing, recreational fishing and boating, and aquaculture. Proponents of UMS activities must consider the competing uses of ocean space and the navigate a variety of user needs and demands.

UMS activities should be undertaken in adherence to a maritime industry codes of conducts and best practices, in additional to applicable legal requirements. The UK Marine Industry Alliance, for example, developed an industry code of conduct for maritime autonomous systems. The U.S. Coast Guard's Navigation Safety Advisory Council Resolution 16-0 provides best practices for UMS. Certification and other educational programs for UMS should provide training on industry codes of conduct, best practices, and other ethical consideration related to scientific integrity, data management, and privacy requirements.

Gap:

The suite of state and federal laws that relate to Unmanned Maritime Systems development, testing and application are expansive. There is currently no national center focusing on the legal, policy, and ethical issues surrounding the use of UMS, thereby limiting the resources that are available to assist Mississippi in developing a strategy that addresses existing or needed laws. There is a significant need for legal research and outreach activities to inform UMS policy development on the state, federal, and international levels. UMS legal research and outreach would also directly support the development of the UMS in industry by increasing stakeholder awareness of the existing legal framework governing their activities, facilitating stakeholder engagement, and informing law and policy reform efforts on the state and federal level.

+ **Recommendation:** Provide funding support to establish the "Mississippi Unmanned Maritime System Policy Center" within the Mississippi Law Research Institute (MLRI) at the University of Mississippi School of Law. MLRI, established under Miss. Code Ann. § 57-55-5, is the official advisory law revision, research, and reform agency of the state of Mississippi. MLRI's Ocean, Coastal, Natural Resources, and Environmental Research Group is a nationally recognized resource for ocean and coastal law, and is well-positioned to draw upon the diverse law and policy expertise of faculty and programs at the University of Mississippi, including the National Center for Remote Sensing, Air, and Space Law.

+ **Recommendation:** Develop a comprehensive inventory of state, federal, and international laws and regulations governing UMS activities and operations in the Gulf of Mexico.

+ **Recommendation:** Develop a series of policy documents to support future UMS activities in the Gulf of Mexico.

APPENDIX C: SUPPORTING COMPANIES, AGENCIES, AND ORGANIZATIONS

COMPANIES CURRENTLY SUPPORTING UMS

A2Research

AeroTec LLC

Aurora Flight Sciences

Chevron

Datastar

Debris Tech

Drone Assist, Inc.

Dungan Engineering

Eaton Aerospace

EMC, Inc.

Entergy

Environmental Management Services

Fugro Marine Geoservices

Geocent

General Dynamics Information Tech

Information Management Resources Inc.

Innovative Imaging & Research

Insitu (Boeing subsidiary)

Kopis Mobile

Leidos

Lockheed Martin Space Systems

Mississippi Enterprise for Technology (MSET)

Necessity Systems LLC

Northrop Grumman

NVision Solutions

Orion Engineering

PAE (Pacific Architects & Engineers)

Pelagic Research Services

Power Dynamics

Qrisq Analytics

Riverside Technology Inc

SaiTech

Sinhatech

Stark Aerospace

Vencore Services & Solutions

VT Halter Marine

COMPANIES THAT COULD SUPPORT UMS

Acquisition Logistics Engineering

Anchor QEA

BAE Systems

Clear Point Engineering

Compton Engineering

Cuevas Machine Co

David Evans & Associates

Digital Engineering & Imaging

Engineering Services

GE Aviation

General Atomics

Harrison Hydrographic and Oceanographic

Heinrich & Associates

High Tech

Huntington Ingalls

Hyperion Technology Group

International Welding & Fabrication

LogLinear Group

Mississippi Aerospace

OpTech/Teledyne

Pickering Firm

Pitmann Engineering

Precision Products

Professional Services Corporation International (PSCI)

Raytheon

Seymour Engineering

Skylla Engineering

Tenax Aerospace

Tyonek

STATE AGENCIES CURRENTLY SUPPORTING UMS

Hancock County Port & Harbor Commission

Harrison County Development Commission

Jackson County Economic Development Foundation

Mississippi State University

National Oceans & Applications Research Center (NOARC)

Pearl River Community College

University of Mississippi

University of Southern Mississippi (USM)

FEDERAL AGENCIES CURRENTLY SUPPORTING UMS

Camp Shelby Joint Forces Training Center

Naval Meteorology and Oceanography Command

Naval Oceanographic Office

Naval Oceanography Operations Command

Navy Special Operations

Keesler Air Force Base

National Aeronautics and Space Administration

NOAA's National Data Buoy Center

NOAA's National Center for Environmental Information

NOAA's Navigation Response Team-1

NOAA National Marine Fisheries Service

Naval Research Laboratory - Stennis

FEDERAL AGENCIES THAT COULD SUPPORT UMS

Joint Airborne Lidar Bathymetry Technical Center of Excellence

National Guard, Combat Readiness Training Center

Naval Air Station Meridian

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