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EXECUTIVE SUMMARY

Aligning Economic Development in Hampton Roads around Industry Clusters

The goal of the Industry Clusters Study Group was to determine the value of industry segment clusters as a strategic component for regional economic competitiveness. From the first meeting the Industry Clusters Study Group expressed an enthusiasm for working toward transforming our regional economy tempered with a desire to create actionable strategies rather than more academic analysis. Therefore, several threshold decisions were made during the initial meetings:

1. We agreed upon a set of Guiding Principles to focus our analysis and recommendations

2. We agreed to use the HRPDC studies as a starting point for our analysis of emerging and mature industry clusters in Hampton Roads.

3. We agreed we would identify those clusters with unique advantages in Hampton Roads but the market would pick winners and losers.

4. We agreed to focus on building the framework for cluster upgrading programs that would be utilized by all of the clusters

These four agreements framed the compilation of our report. After reviewing previous studies and discussing today’s market dynamics the group selected the following industry clusters for further study:

- Advanced Manufacturing
- Bio-Sciences
- Coastal Energy
- Cyber Security
- Military
- Modeling & Simulation
- Port & Maritime
- Tourism
- Unmanned Systems

A subset of the Study Group known as the Process Team developed a list of information we needed to know about each industry cluster, using a common set of guidelines to maintain consistency in reporting. Cluster Review Teams were formed and included a variety of individuals with a direct connection to the industry.

Each of the Industry Cluster Review teams identified strategies for growing their cluster. Their analysis, observations and recommendations can be found in the Review Team Reports. During our discussions certain themes emerged. It became apparent that there are clusters that support other clusters. Cybersecurity, Modeling & Simulation, Advanced Manufacturing, and Unmanned Vehicles are what we call horizontal clusters – ones that
cut across other clusters. This idea of horizontal perspectives also became a theme. If we are to succeed efforts and initiatives must cut horizontally across the region – i.e., not be locality specific. Our group agreed that ultimate success would be driven by the self-interest of the players. In other words cities, companies, organizations and individuals must see a personal benefit to participating in the growth of clusters.

Our major recommendations break down among three broad categories:

- Revising the regional economic development model
- Developing a cluster upgrading program
- Coordinating our efforts among self-interested parties

RECOMMENDATIONS

1) Revise the regional economic development model

We must develop and implement a plan to consciously transform our regional economy and enable it to realize its potential. If we are going to grow the clusters we have identified and studied, the economic development model in Hampton Roads needs to be revisited. For the past several decades the region’s approach to economic development has placed significant emphasis on going out and attracting firms to relocate to the region. While attracting outside investment and jobs to the region should remain a focus, significant energy and resources should be dedicated to growing our existing businesses, incubating start-ups, and commercializing research taking place at our Universities and federal facilities.

Doing so will require a realignment of resources and organizations such as the Hampton Roads Economic Development Alliance (HREDA), Old Dominion University, and the local economic development offices. We must also better understand the supply chains that support the various clusters.

2) Develop a Cluster Upgrading Program

Hampton Roads cannot advance specific clusters unless we advance the individual businesses and ecosystems within those clusters. Therefore, impacting clusters requires business-specific actions. The Process Team identified four areas of focus and specific tools that can drive individual business growth by addressing four issues:

1. Better connecting & collaborating
2. Common measurement, benchmarking & monitoring
3. Fixing things & an innovation focus
4. Access to capital

The group agreed that we should pay particular attention to emerging clusters with a focus on the horizontal clusters mentioned earlier. They include:
- Cyber Security
- Advanced Manufacturing
- Unmanned systems
- Bio-Sciences
- Coastal Energy

3) **Coordinate our recommendations with those of the other study groups with the support of the big players – Cities, Hampton Roads Business Roundtable, Hampton Roads Regional Council**

Relative to economic development, Hampton Roads has a history of “working in silos.” To succeed we must enhance our coordination and communication. Clusters work when you “connect the dots” between practitioners, users, etc. which can take place in many different ways. What we do must be supported by the key business leaders in the region. If the big players stay engaged after the report is done then this initiative has a chance of working. If not we will muddle along. The big players include the cities because they have resources and the people. Other big players include our universities and federal partners, i.e. military facilities, research labs, NASA, etc. These organizations and our major employers – Norfolk Southern, Smithfield Foods, Dollar Tree, Huntington Ingalls, Sentara Healthcare and others must recognize it is in their self-interest to get involved and stay involved.
I. INTRODUCTION:

The goal of the Industry Clusters Study Group was to determine the value of industry segment clusters as a strategic component for regional economic competitiveness.

To achieve this goal, a group of committed region-focused business and community leaders (See Appendix A), under the leadership of Jim Spore, Virginia Beach City Manager and Doug Smith, Kaufman and Canoles Consulting President, took on the charge by conducting a situation analysis; creating a baseline of facts; identifying best practices as well as any early success potential; and setting criteria for prioritizing the “next steps” for acting on group findings and recommendations.

Through the process the study group utilized valuable research and advice provided by Dr. James V. Koch, President Emeritus of Old Dominion University.

INITIAL STUDY GROUP AGREEMENTS

From the first meeting the Industry Clusters Study Group expressed an enthusiasm for working toward transforming our regional economy tempered with a desire to create actionable strategies rather than more academic analysis. Therefore, several threshold decisions were made during the initial meetings:

1) We agreed upon a set of Guiding Principles to focus our analysis and recommendations.

2) We agreed to use the HRPDC studies as a starting point for our analysis of emerging and mature industry clusters in Hampton Roads.

3) We agreed we would identify those clusters with unique advantages in Hampton Roads but the market would pick winners and losers.

4) We agreed to focus on building the framework for cluster upgrading programs that would be utilized by all of the clusters.

These four agreements framed the compilation of our report.
Guiding Principles to focus our analysis and recommendations

INDUSTRY CLUSTERS STUDY GROUP GUIDING PRINCIPLES

Regional Economic Development

I. Economic development is a collaborative process involving government at multiple levels, companies, teaching and research institutions and private sector organizations.
II. Economic strategy requires setting priorities and moving beyond long lists of separate recommendations.
III. The goal of economic strategy is to enhance productivity. This is the only way to create jobs, high income and wealth in the long run.
IV. New jobs that tie to exported goods and services from our region, versus merely a re-distribution of the local pie, have a multiplier effect and will be the target.
V. Improving productivity and innovation must be driving principles.
VI. Improving productivity demands that we mobilize the private sector and not rely on government alone.

Industry Clusters

VII. Clusters provide a framework for organizing the implementation of many public policies and public investments to achieve greater effectiveness.
VIII. Government and the private sector must collaborate to build cluster strength in the following ways:
   a. Harness efficiencies and coordination across jurisdictional boundaries.
   b. Create a private sector led cluster upgrading program with matching support for participating private sector cluster organizations.
   c. Government should listen and remove obstacles to cluster improvement.
IX. Build on the region’s existing and emerging clusters rather than chase "hot fields."
X. Must identify highly interested, self-interested, deep pocketed stakeholders.
XI. Look at horizontal clusters that cut across our three economic pillars: Port, Tourism, and Defense.
Use the HRPDC studies as a starting point for our analysis of emerging and mature industry clusters in Hampton Roads.

II. INDUSTRY CLUSTERS

PAST STUDIES OF INDUSTRY CLUSTERS

The region’s work to date on industry clusters is largely embedded in a planning process undertaken by the Hampton Roads Partnership that built upon studies conducted by the Hampton Roads Planning District Commission (HRPDC). HRPDC recognized that the economy of Hampton Roads continues to be heavily dependent upon the activities of the Department of Defense. In an effort to create a better blend of economic drivers in the region, the HRPDC has published a number of reports that scanned the region’s economic environment to identify economic clusters that could be encouraged to locate or expand in Hampton Roads and produce a variety of positive benefits for the region’s economy.

The Hampton Roads Cluster Study Report completed in 2004 identified those clusters which have the potential to further grow and develop in Hampton Roads. The results of this effort were provided to the Partnership so that it could select the final target clusters. In 2011, the HRPDC completed the Hampton Roads Regional Competitiveness Study. The Hampton Roads Regional Competitiveness Report provides a comprehensive review on literature and data concerning regional competitiveness and mechanisms for achieving productivity growth. That report identifies a host of difficulties that arise when attempting to follow growth patterns from other successful regions. Instead, evidence suggests that each region’s path to sustained growth is unique, growing organically on regional strengths and economic clusters. In reviewing both the failures and successes of development efforts across the globe it is evident that the most important aspects in achieving sustainable growth are:

1) to focus on developing a culture and environment that is based upon unique regional strengths,
2) to invest in all levels of education,
3) to encourage entrepreneurship and business growth,
   to establish an effective system of economic cluster governance.

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Identify those clusters with unique advantages in Hampton Roads but understand the market will pick winners and losers.

IDENTIFICATION OF THE CLUSTERS

The study group’s process of identifying clusters for further research included defining the pre-conditions for a meaningful cluster. Pre-conditions are those factors that are present in a cluster that may spark or add to its development. Examples include the presence of a world-class multinational company with a commitment to invest and upgrade in the area, significant research and development within a university or federal lab, workforce availability, capital investment support, and an environment that nurtures business development. The following clusters were selected for further study:

- Advanced Manufacturing
- Bio-Sciences
- Coastal Energy
- Cyber Security
- Tourism
- Military
- Modeling & Simulation
- Port & Maritime
- Unmanned Systems

We agreed not to pick winners and losers. Instead we have focused on programs and systems that could support any cluster that emerges. The dynamic of Sea Level Rise or Recurrent Flooding came up in our conversations. It was not even on our list to study, yet this could be another emerging and unique cluster opportunity for our region. If we have the right cluster upgrading programs in place we will be able to embrace Sea Level Rise or any other emerging cluster.

PROCESS TEAM

A subset of the Study Group known as the Process Team developed a list of information we needed to know about each industry cluster, using a common set of guidelines to maintain consistency in reporting. Cluster Review Teams were formed and included a variety of individuals with a direct connection to the industry. The following outcomes were addressed by each Cluster Review Team (See Appendix B for the nine Cluster Review Team reports):

1. List of key players and organizations within the cluster identified
2. Current depth of the cluster/scale of the industry described
3. Growth opportunities identified
4. Connections between new clusters and existing pillars identified and described
5. Boundary spanning clusters identified and described
6. Salary and wages produced by the cluster identified
7. Expected degree of sustainability described
8. Competitive advantages identified and described
9. Target customers and competitors identified
10. Projected growth potential from a global, national and regional perspective
11. List of what is needed to grow the cluster
12. List of obstacles to cluster growth
13. List of elements that make the cluster attractive
14. List of elements that make the cluster unique
15. Recommend measures to gauge growth in this cluster

The Process Team, led by Study Group Member Dave Richards, CEO of Concursive Corporation set up a collaboration platform, Hampton Roads Cares (https://hamptonroadscares.org/) that was used as a source for reports and data used during the process.
III. RECOMMENDATIONS

A. REVISING HAMPTON ROADS’ ECONOMIC DEVELOPMENT MODEL

We must develop and implement a plan to steadily transform our regional economy and enable it to realize its potential. If we are going to grow the clusters we have identified and studied, the economic development model in Hampton Roads needs to be revisited. For the past several decades the region’s approach to economic development has placed significant emphasis on going out and attracting firms to relocate to the region. While attracting outside investment and jobs to the region should remain a focus, significant energy and resources should be dedicated to growing our existing businesses, incubating start-ups and commercializing research taking place at our Universities and federal facilities.

Doing so will require a realignment of resources and organizations such as the Hampton Roads Economic Development Alliance (HREDA), Old Dominion University and the local economic development offices. We must also better understand the supply chains that support the various clusters.

1. HAMPTON ROADS ECONOMIC DEVELOPMENT ALLIANCE

HREDA has an opportunity to better align its efforts – both attraction and research – around the targeted industry being pursued by the localities. Their “whale hunting” approach in business attraction is an obsolete model. We must look at how the HREDA fits within our recommendations. Specifically how they focus on the industries we believe have the greatest potential for the region. A redesigned HREDA research function could be very useful as we dig deeper into these industries.

2. OLD DOMINION UNIVERSITY

Successful metropolitan areas have vibrant entrepreneurial environments with a strong and actively engaged university playing an important role. The major research institutions in Hampton Roads must step forward to be at the leading edge of support for a growing entrepreneurial community and Old Dominion University (ODU) is beginning to show significant leadership in this area. Specifically, ODU has established programs to lead the region in five categories at the heart of innovation and entrepreneurship:

a. Student Entrepreneurship: Through its new Strome Center for Entrepreneurship and a new investment in the development of their students’ entrepreneurial skills, ODU has focused on entrepreneurship as a set of skills that can be applied across professions and supplement the students’ classroom experience. ODU has also encouraged and promoted both formal programs (a planned certificate program in entrepreneurship) and extra-curricular activities such as business plan contests, entrepreneurship clubs, and startup internships.
b. **Faculty Entrepreneurship:** Through its new Entsminger Fellows Program, ODU has begun a significant culture change with faculty and graduate students increasingly encouraged to conduct research and participate in activities that spawn and support high-growth startups. New efforts are in play at ODU to: (1) create greater recognition of faculty entrepreneurs; (2) integrate entrepreneurship into the faculty's day-to-day work; and (3) increase faculty connections to outside partners.

c. **Technology Transfer:** ODU’s revitalized Technology Transfer Office has expanded its role to focus less on commercialization of individual technologies to companies outside the region and more on supporting and creating companies that will be based in the communities around the university. In addition, a revised Intellectual Property (IP) policy, streamlined licensing procedures, and greater coordination with local businesses promises to generate significant opportunity for students and faculty to commercialize the results of their research within the local area.

d. **Industry Collaboration:** Knowing that local businesses can benefit greatly from university research and innovation, ODU is seeking better ways to connect their faculty’s research and students’ education to emerging industry interests. Through its new Center for Enterprise Innovation and new staff at the Office of Research, ODU has: (1) placed greater emphasis on supporting local startup companies; (2) expanded its efforts to engage established companies that have traditionally driven the region’s economy; (3) begun opening up its facilities, faculty, and students to businesses (small and large); (4) expanded its programs to offer internships and externships; (5) begun establishing co-working, acceleration, incubation, and professional development facilities throughout the Hampton Roads region; and (6) begun planning a small venture fund that will coordinate with related activities (e.g., the newly planned 757Angels group) throughout the region.

e. **Engagement in Regional Economic Development:** Again, through its new Center for Enterprise Innovation and its new College of Continuing Education and Professional Development, ODU has explicitly recognized that local economic development is an important mission of the university. That mission includes: (1) a strong focus on the betterment of the surrounding community; (2) increased focus on innovation and entrepreneurship as key contributors to the growth and success of local communities; (3) much stronger engagement with regional economic development planning (which often starts with an assessment of a local university’s research strengths and weaknesses); and (4) encouraging students and faculty to contribute to local community development through service and projects.
3. COORDINATE LOCAL ECONOMIC DEVELOPMENT CLUSTER ACTIVITIES

Presently, each locality has a list of target industries. Those target industries do not vary much from one locality to the next. Each city has an interest in growing the clusters we have studied. Yet, no one city can adequately pursue all nine clusters. Nor can one city react to a new cluster that emerges. Each locality should agree to “own” a specific cluster. This does not mean all businesses in that cluster would be directed to that city. That city would however lead the implementation of the regional strategy related to that cluster.

The Bio-medical initiative started in Virginia Beach can be a template for other growth industry sectors around the region. Appendix C is the PowerPoint Summary of the Initiative. The Healthcare sector will represent close to 25% of U.S. GDP in 20 years according to the Brookings Institute. The Hampton Roads Region is home to many major universities, healthcare providers, and bio-medical firms. The City of Virginia Beach established a Bio Task Force under the leadership of Tom Frantz of Williams Mullen and Rony Thomas of LifeNet Health. The mission of the Bio Task Force is to develop a plan for a bio-medical and healthcare hub in the Princess Anne Commons area of Virginia Beach. The plan will encompass the research, resources, and opportunities of our existing regional assets.

Virginia Beach is planning to put land and money behind that initiative in the next several years. The Bio-medical cluster is not confined to Virginia Beach as EVMS is a focal point in the development of that cluster. Virginia Beach will have a hub, but many of the assets that are part of this cluster are throughout Hampton Roads. This is a template that other cities could use to champion other industry clusters. Someone has to do the deep dive and put land aside as well as the necessary research and capital for each of these clusters. Conversations are underway to find out how neighboring communities feel about this approach and what role HREDA could play.

Other localities could develop similar initiatives around other clusters – While the municipalities would obviously retain the right and flexibility to put resources against any development area, they would agree to act as the “champion” for one. As the champion, they would explore much deeper, agree to share best thinking with others, and convene on-going efforts with other interested parties across the region to make sure regional synergies and collaboration continue and are leveraged.

Below is a “strawman” for how the cluster ownership might align by locality:

<table>
<thead>
<tr>
<th>Virginia Beach</th>
<th>Bio-Medical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffolk</td>
<td>Cyber Security</td>
</tr>
<tr>
<td>Newport News</td>
<td>Coastal Energy</td>
</tr>
<tr>
<td>Chesapeake</td>
<td>Advanced Manufacturing</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>Port &amp; Maritime</td>
</tr>
<tr>
<td>Hampton</td>
<td>Unmanned systems</td>
</tr>
<tr>
<td>Norfolk</td>
<td>Modeling &amp; Simulation</td>
</tr>
</tbody>
</table>
B.  Replicate The NovaVis Supply Chain Model

Each of our clusters has a broad supply chain - a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer. The Process Team has undertaken a very interesting exercise designed to learn more about the regional supply chain related to Coastal Energy. Team members Chuck deCuir, Jeff Keever and Dave Richards literally started a company called NovaVis. The NovaVis experiment could be a template for preparing and leveraging the supply chain for other industry clusters. Their beta website (WWW.novavis.onsocialcloud.com) includes a short video that explains the concept and reflects the notion that most supply chains, as is the case with offshore wind, cross localities. Accordingly, they are natural mechanisms for facilitating regional collaboration. In that vein, NovaVis and the cities of Virginia Beach and Norfolk have already had preliminary discussions to work together to identify, contact and “on-board” possible offshore wind supply chain companies. The “on-board” process involves gaining a better understanding of what these companies do, educating them as to the opportunities that exist, and connecting them with appropriate resources in the everyone’s best interest.

The idea for NovaVis was generated during conversations that members of the Virginia Offshore Wind Coalition had overseas relating to offshore wind energy. The running lesson learned from those connections is that everyone is struggling with the coordination of supply chain. They used what they learned to begin approaching large companies to ask them how they manage their supply chain. As the supply chain to the US offshore energy industry has been abundantly neglected. The team asked themselves “how do you make a source of this kind of information alive and useful?” It is the connectivity of a privacy-enabled, online community and the enlightened self-interest of the participating companies that seems to be the answer. For each company or organization wanting to be involved, participating is inexpensive and easy to get started and maintaining their own presence in the community takes only a few minutes per month. Therefore, information can always be changing and moving.

If executed properly, the greatest value created (in terms of regional jobs) will be by preparing and enabling the involvement of local enterprises to capture dollars from outside the region and not lose them to regional competitors like Maryland and Louisiana.

As further note, Wetlands Watch, a Norfolk-based non-profit, and Concursive are advancing a platform around sea level rise. The NovaVis model should be analyzed for other clusters.

C. High Priority Industry Cluster Recommendations

Each of the Industry Cluster Review teams identified strategies for growing their cluster. Those recommendations can be found in the Review Team Reports (Appendix B). During our discussions it became apparent that there are clusters that support other clusters. Cybersecurity, Modeling & Simulation, Advanced Manufacturing, and Unmanned Vehicles are what we call horizontal clusters – ones that cut across other clusters. The Study Group
agreed to highlight the recommendations from some of these horizontal clusters as well as Coastal Energy and Bio-medical.

1. CYBER SECURITY

Horizontally, the cybersecurity cluster impacts the other clusters and nearly everything we do. Recently DHS and MARAD have been seeking comments on cybersecurity standards for the shipping sector from the port industry. This is a high vulnerability sector and many are totally unprepared. There is enormous global growth potential for this region in this industry alone. The most critical success factor is participation. We need buy in and participation from the following organizations:

- Local governments
  - Participation and funding from the local governments will lead the way to making this a reality
- Economic development organizations
  - Incentive packages need to be marketed and offered to start up and growing businesses
- Local businesses
  - Participation is needed to form a consortium of businesses that can completely cover all aspects of the National Institute of Standards and Technology (NIST) Cybersecurity Framework. Additionally, funding from local banks can be leveraged to establish this team by utilizing strategic partnerships of start-ups.
- Educational institutions
  - We have the workforce available now and they are currently leaving the region. We can partner with ODU’s new College of Continuing Education to initiate a program to transition our exiting military members to the commercial space and provide them with the training and certifications that are needed in the commercial world to evidence credibility, such as the Certified Information Systems Security Professional (CISSP).
- Department of Defense
  - Although this industry leg would loosen the dependency Hampton Roads has on the Federal Government, we want to ensure that Hampton Roads continues to cultivate federal dollars in the area of cybersecurity. The Consortium will work with Hampton Roads Military and Federal Facilities Alliance (HRMFFA) to continue to lobby for additional cyber based projects such as Cyber Command as well as lobby for establishing Langley AFB as the chosen location for the expansion of the Air Forces cyber reserves units.

2. ADVANCED MANUFACTURING

- Promote the region as a viable place for product assembly, for both imports and exports, especially for products that require assembly of components originating in different countries.
- Establish a regional center for advanced manufacturing with focus on specific needs or regional industry. Strengthen collaboration between industry, community colleges and four year institutions. Focus on applied and translational
research and workforce development, and develop an IP structure at regional universities conducive to engagement with industry.

- Work with regional universities to establish signature areas of excellence focused on manufacturing and provide guidance and support for going after large federal research funds and grants to establish Engineering Research Centers. (e.g. Composites, Sensors, Modeling and Simulation, Product Lifecycle Management etc.). Federal funding for National Network of Manufacturing Institutes is at the level of $70-120M over five years per institute.
- Develop close ties with other clusters to build upon each other’s strengths (e.g. sensors, robotics, unmanned-autonomous-vehicles, etc.).
- Establish a regional “R&D incubator”

3. COASTAL ENERGY

- **Team Virginia** is a loosely formed concept of being able to provide the services necessary to construct, implement and support for the Virginia offshore wind development lease block, as well as the offshore industry along much of the east coast. With the significant number of existing businesses available to participate, there is not a single coordinating organization to bring this concept to fruition, therefore this report recommends engaging a project-specific firm to coordinate Team Virginia to implementation with the Virginia Offshore Wind Technology Advancement Project (VOWTAP) from the current date through completion in late 2017. Without such coordination and management, Virginia businesses will likely be unable to fully participate in the construction and support of the VOWTAP project.

- **Becoming the Supply Chain Hub** is an opportunity for Virginia and is critical to expanding and diversifying the economy, creating new jobs and expanding the tax base. However, this will not arrive nor thrive without a coordinated effort. This report recommends engaging a firm to coordinate the development and help establish the Supply Chain Hub in Hampton Roads. The report timing could be two fold. The first step starts with an overview of coordination that would be a four to six month project, and the second step would be a plan that spans the timing of the test turbine project (VOWTAP), completion by late 2017. It could be considered to take step one, and then reconvene for step two. This report further recommends engaging a project specific firm to coordinate this recommendation. Without a consolidated approach to attracting the Supply Chain Hub, such activity will likely be scattered in areas along the east coast without a single or central hub to coordinate the major Coastal Energy projects in the Atlantic.

- **Port Readiness Survey:** While much in the detailed report addresses the many assets available in Virginia, there are certainly some deficiencies that must be identified within the port complex. In addition there is no singular repository of coordinated information. Thus, various sources and resources are scattered in many formats and locations. The lack of a composite study makes the comprehensive discussion of the assets difficult and confusing. If Virginia seeks to become the Supply Chain Hub for Coastal Energy, there must be a current and comprehensive study of the existing facilities, their capabilities and any deficiencies or shortfalls that may inhibit the attraction of these new business
opportunities. Another positive use for such a report is it becomes a very valuable regional marketing tool, therefore this report recommends engaging a project specific firm to coordinate the comprehensive Port Readiness Survey. Such a study should take between four to six months. Without this kind of survey, the efforts to attract the Supply Chain Hub to Virginia may well create unintended obstacles to these economic development goals.
Building the framework for Cluster-upgrading programs that could be utilized by all of the industry clusters

D. CLUSTER UPGRADING PROGRAM

Hampton Roads cannot advance specific clusters unless we advance the individual businesses and ecosystem within those clusters. Therefore, impacting clusters requires business-specific actions.

In support of this, the study group identified that successful ecosystems require a number of common conditions, or predicates, including: common language, common infrastructure, measurement and monitoring, trusted leadership voices, effective tools, and an open mindset and culture where everyone is welcome and encouraged to follow their enlightened self-interest.

With that in mind, the Process Team further identified a simple methodology based on four areas of focus and specific tools that can drive individual business success for those seeking growth, innovation or simply greater productivity:

1. Better connecting & collaborating
2. Common measurement, benchmarking & monitoring
3. Fixing things & an innovation focus
4. Access to capital

1. Better connecting and Collaborating

Given the current state of technology, there are few technical barriers to better connecting, communicating and collaborating. Rather, it’s more a matter of discipline and the will to make it happen.

The cluster upgrading process envisions bringing up a range of “nodes” upon which activity within and across localities can happen. Existing infrastructure will be leveraged...
wherever possible and where lacking it can be quickly addressed either by public or private resources.

NovaVis is an example of a private entity stepping in the void and working with public sector interests to respond to the need for better collaboration and activity around the emerging offshore wind cluster.

2. **Common Measurement, benchmarking & monitoring / fixing things and an innovation focus**

CoreValue Software is one tool that will address items 2 and 3 and help businesses enhance their enterprise value. By enhancing the value of many individual businesses we can enhance the regional economy. CoreValue Software has developed a suite of unique software as a service (SaaS) products to help the CEOs of private businesses build sustainable enterprise value. The CoreValue® framework and toolsets offer CEOs, business owners and their advisors the ability to dynamically assess and improve enterprise value. The results fuel higher revenues and profits.

CoreValue® identifies and quantifies the intangible value hidden within a business such as intellectual property, goodwill, market share, brand, ingenuity, relationships with vendors and more that enable it to generate revenue and profit dependably into the future. CoreValue® utilizes its best practice standards combined with industry transaction data and past financial performance to determine a company's enterprise value, potential enterprise value, the ‘value gap’ between the two and provides actionable feedback on how to improve value.

Various universities and regional economic development groups are already using CoreValue® to obtain and aggregate data on an industry level. By running hundreds of companies through the CoreValue® process, we can collect data and analyze trends and needs for the various industry clusters that have an opportunity to grow in Hampton Roads.

3. **Access to capital**

Our group agrees that access to capital is a broader issue that will need deeper study by another group. We are assuming that the Entrepreneurship Group will have some recommendations.
IV. Conclusion

Clusters work when you “connect the dots between practitioners, users, etc. which can take place in many different ways. What we do must be supported by the key business leaders in the region. If the big players stay engaged after the report is done the preceding recommendations can work. If not, we will continue to muddle along as a region. The big players include the cities because they have resources and the people. Other big players include our universities and federal partners, i.e. military facilities, research labs, NASA etc. These organizations and our major employers – Norfolk Southern, Smithfield Foods, Dollar Tree, Huntington Ingalls, Sentara Healthcare and others must recognize it is in their self-interest to get involved and stay involved.
Appendix A

Industry Clusters Study Group Roster
## Appendix A – Industry Clusters Study Group Roster

<table>
<thead>
<tr>
<th>Scott Adams</th>
<th>Bob Armstrong, Director, Research/Business Development</th>
<th>Bill Bean, Director Technology &amp; Business Center</th>
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<tbody>
<tr>
<td>Regional President CBRE</td>
<td>EVMS</td>
<td>College of William &amp; Mary</td>
</tr>
<tr>
<td>Dan Bell</td>
<td>Joe Bouchard, Director, Government Sales</td>
<td>Chester Brazzell, former VP Human Resources</td>
</tr>
<tr>
<td>President</td>
<td>Cox Communications</td>
<td>LifeNet Health</td>
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<td>Future of Hampton Roads</td>
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<tr>
<td>Dan Combs, Vice President &amp; Dean, School of Health Professions</td>
<td>Bill Crow, President</td>
<td>Chuck deCuir, Chairman</td>
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<tr>
<td>EVMS</td>
<td>VA Ship Repair Association</td>
<td>VA Offshore Wind Coalition</td>
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<tr>
<td>Robert Fitzgerald</td>
<td>Larry “Chip” Filer, Associate Professor, Economics</td>
<td>David Harnage, Chief Operating Officer</td>
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<td>CEO and Chairman BOSH Global Services</td>
<td>ODU</td>
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<td>Karen Jackson</td>
<td>Marty Kaszubowski, Executive Director, Business Gateway</td>
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<td>Secretary of Technology</td>
<td>ODU</td>
<td>Mark Klett, President &amp; CEO</td>
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<td>Commonwealth of Virginia</td>
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<td>Klett Consulting Group</td>
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<td>David Lambert</td>
<td>Peter Leddy, Partner &amp; President OTTO Design</td>
<td>Ned Lilly, President &amp; CEO xTuple</td>
</tr>
<tr>
<td>Manager, Business Development</td>
<td></td>
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<tr>
<td>Newport News Shipbuilding</td>
<td></td>
<td>Dave Richards, CEO Concursive Corporation</td>
</tr>
<tr>
<td>Craig Quigley</td>
<td>Russell Held, VP, Economic Development VPA</td>
<td></td>
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<tr>
<td>Executive Director HRMFFA</td>
<td></td>
<td>Doug Smith, Co-Chair Deputy City Manager</td>
</tr>
<tr>
<td>Jim Ricketts, Director</td>
<td>Sandeep Samudre, President &amp; CEO Eastern VA Eye Institute</td>
<td>City of Virginia Beach</td>
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<tr>
<td>Convention &amp; Visitors Bureau</td>
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<tr>
<td>City of Virginia Beach</td>
<td></td>
<td>Tim Stiffler, President Commonwealth Lodging</td>
</tr>
<tr>
<td>John Sokolowski</td>
<td>Jim Spore, Co-Chair City Manager City of Virginia Beach</td>
<td></td>
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<tr>
<td>Executive Director VMASC</td>
<td></td>
<td>Randy Webb, President &amp; CEO Signature Financial</td>
</tr>
<tr>
<td>Mileta Tomovic</td>
<td>Bill Wasilenko, Associate Dean for Research EVMS</td>
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</tr>
<tr>
<td>Professor, Engineering Technology ODU</td>
<td></td>
<td>James V. Koch (consultant) President Emeritus ODU</td>
</tr>
<tr>
<td>Roy Whitney</td>
<td>Peter Zendzian, Managing Partner ZZ Servers</td>
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<tr>
<td>President &amp; CEO BNNT, LLC.</td>
<td></td>
<td></td>
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<tr>
<td>Donna Morris (staff)</td>
<td></td>
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<tr>
<td>Vice President for Strategic Initiatives Hampton Roads Community Foundation</td>
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</tbody>
</table>
Appendix B

Cluster Review Team Reports
1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

3. Advanced Manufacturing Industry Cluster

Cluster Team Lead: Milieta Tomovic (ODU)

Team members:
Sande Dukas (Control Company of America)
Matt Brennan (Siemens PLM)
Melanie Young (Newport News Shipbuilding)
Joseph Stark (Bauer Compressor)
Bob Fagan (CCAM)
Deborah Wright (Peninsula Workforce Dev. Center)
Bob Sharak (Opportunity, Inc.)
J.C. Brinker (ODU)
Cameron Langille (UVA)

Proposed start date: 04/15/14
Proposed end date: 07/30/14

4. Cluster Team Work Plan and Interdependencies

Objective and Outcomes

Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters

List of key players and organizations within the cluster identified (see detailed report, page 7)
1. Over 300 manufacturers in the region
2. Five universities
3. Three community colleges and an Apprentice School
4. Federal employers (Navy, Air Force, Army & Coast Guard)
5. Federal Laboratories (NASA Langley, Jefferson Lab & NIA)
6. Workforce Development Organizations (Opp-Inc. & Peninsula Council for Workforce Dev.)

Current depth of the cluster/scale of the industry described
1. Hampton Roads is home to close to 300 manufacturing companies that employ approximately 54,000 people
2. Shipbuilding and ship repair represents 57% of manufacturing employment
3. A number of companies in the region manufacture products for heavy industry, transportation, as well as consumer products. In June 2014 the manufacturing sector employed roughly 54,200 people, representing about 7.1% of total regional employment and accounts for 13% of payrolls

Growth opportunities identified
1. Tradable sector that will attract outside money to positively impact regional wealth
2. Attract first and second tier suppliers to OEMs to the region
3. Strong and diverse workforce upon which to build that includes highly trained military retirees who are critical thinkers with significant experience and solid work ethics
4. A major seaport with significant air and land connections providing opportunities to establish
assembly plans for import and export of goods
5. Cutting edge manufacturing processes and materials which can be translated into industrial applications developed by federal labs in the region
6. Innovative solutions as well as a highly trained workforce provided by area colleges and universities
7. Existing strong military sector
8. Support for translational research
9. Business-friendly (culturally diverse, with attractive tax codes and amenities)

<table>
<thead>
<tr>
<th>Connections between new clusters and existing pillars identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Modeling and Simulation allows verification of product and process in a digital environment before a single atom of raw materials is manipulated</td>
</tr>
<tr>
<td>2. Information technology allows designers to work closely with manufacturers and everyone else in the product life-cycle chain to improve the quality and performance of the product</td>
</tr>
<tr>
<td>3. Robotics applications in the manufacturing sector is yet to take full advantage of the current state of the art domain which is still expanding its boundaries</td>
</tr>
<tr>
<td>4. Sensors are necessary components of intelligent manufacturing systems</td>
</tr>
<tr>
<td>5. Port and maritime logistics is an essential component of manufacturing as products need to reach the customers in the most efficient manner</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundary spanning clusters identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Modeling and Simulation</td>
</tr>
<tr>
<td>2. Robotics/Sensors/Unmanned vehicles</td>
</tr>
<tr>
<td>3. Cyber security</td>
</tr>
<tr>
<td>4. Military/commercialization of military technology</td>
</tr>
<tr>
<td>5. Ports and maritime logistics</td>
</tr>
<tr>
<td>6. Bio-All</td>
</tr>
<tr>
<td>7. Coastal energy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Salary and wages produced by the cluster identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing jobs pay roughly $60k versus an average $43K for all occupations, a 40% premium. Total annual payroll ($1,000) is $21,935,287 (see Table 2 of the detailed report)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected degree of sustainability described</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing, knowledge and ability to make things, creates the need for innovation across many disciplines and provides opportunities for entrepreneurship and ultimately economic growth. Loss of manufacturing and associated jobs leads to precipitous decline in know-how and underlying knowledge required for innovation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Competitive advantages identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hampton Roads is home to a significant manufacturing industrial base</td>
</tr>
<tr>
<td>2. Modeling and simulation, an existing industry sector in the region, is becoming increasingly important in the manufacturing sector as it allows verification of product and process, optimal product performance, reduced cost of manufacturing, and reduced time to market. With visual presentation of simulated processes M&amp;S also provides augmented reality to assist engineers and technicians in operation and maintenance of manufacturing systems.</td>
</tr>
<tr>
<td>3. Proximity to a major east coast port – logistics is an essential component of manufacturing as products need to reach the customers in the most efficient manner.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target customers and competitors identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Target customers include the following sectors: Unmanned systems, IT, Modeling &amp; Simulation, Cybersecurity, Biotech and Coastal Energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Projected growth potential from a global, national and regional perspective.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. More goods are being produced today with fewer people than in any period in our history due to the application of automation and robotics</td>
</tr>
<tr>
<td>2. Direct employment by manufacturing companies will continue to be stable with possibility for small deviations. However, the types of skills and knowledge that will be required to work in manufacturing will be significantly different from the skills that were required in the not too distant past.</td>
</tr>
</tbody>
</table>
3. The manufacturing industry will be a major consumer of multidisciplinary innovations that will spark creation of new jobs in current and in yet to be developed industries, therefore will provide indirect support for many other jobs across different disciplines and industries.

4. Although the number of jobs on the shop floor is in overall decline, the number of opportunities created by an ever evolving manufacturing sector creates additional needs for supporting activities that integrate various technologies and create cross-disciplinary job opportunities. These new jobs will surpass the number of manual jobs that are being displaced by automation and robotics.

**List of what is needed to grow the cluster**

1. A working group of regional manufacturing and government leaders to provide leadership and direction for promoting and supporting the industry
2. Identify common threads for regional stakeholders and pursue common goals
3. Provide unified voice for manufacturing industry at the regional and state legislative level, working with the VA Manufacturers Association (VMA) and CCAM
4. Provide periodic review of the state of manufacturing the region with recommendations for future action
5. Identify ways for expanding the base by promoting and bringing major manufacturers into the region
6. Increase the visibility of manufacturing through appropriate marketing strategies
7. Promote Hampton Roads as a viable place for product assembly, for both imports and exports, especially for products that require assembly of components originating in different countries
8. Establish regional center for advanced manufacturing with focus on specific needs or regional industry (strengthen collaboration between industry, community colleges and four year institutions, with focus on applied and translational research and workforce development & develop IP structure conducive to engagement with industry)
9. With regional universities establish signature areas of excellence focused on manufacturing and provide guidance and support for going after large federal research funds and grants to establish Engineering Research Centers
10. Develop close ties with other clusters to build upon each other’s strengths
11. Establish a regional R&D incubator
12. Develop a Hampton Roads Advanced Manufacturing Research and Training Center focused on regional needs and strengths

**List of obstacles to cluster growth**

1. Lack of sufficiently large contiguous industrial space
2. The workforce lacks the numbers with appropriate qualifications required to support the future needs of industry
3. Manufacturing industry’s image is an issue for attracting young talent
4. Lower value-added activity present, rather than innovation and product development
5. Aging industry present in the region with limited R&D and focus on innovation
6. Shifting research focus
7. No incubator park exists for start-ups
8. Risk aversion
9. Federal government rules and regulations

**List of elements that make the cluster attractive**

1. 300 companies exist in the region
2. Presence of universities and federal labs engaged in research

**List of elements that make the cluster unique**

1. Integrates with unmanned systems, IT, modeling & simulation and cybersecurity and supports the region’s emerging clusters such as biotechnology and coastal energy
2. Presence of a workforce that includes know-how from transitioning military personnel
3. Presence of a strong shipbuilding industry that can attract suppliers to the area to open research labs

**Recommended measures to gauge growth in this cluster**

1. Impact:
- Number of jobs created and retained
- Number of manufacturing innovations (tracking innovation into the marketplace)
- Impact of new product or process on competitiveness (cost reduction, quality improvement)
- Number of jobs created and retained (regional and national employment rates and number of graduates from universities, community colleges and training programs who find employment in the sector)

2. Supply chain engagement & development: Work with NIST Manufacturing Extension Partnership to develop specific metrics as they conduct surveys that measure jobs created, retained, change in sales, investments leveraged, and cost savings

3. Education/workforce development:
   - Number of university students participating in research, education and training
   - Number of community/technical college students participating in research, education and training
   - Number of K-12 students and teachers participating in research, education and training
   - Number of veterans participating in research, education and training
   - Number of certification and degree programs created in collaboration with colleges, universities, and professional organizations
Advanced Manufacturing Cluster Detailed Report

Committee Members
Mileta Tomovic, Chair (Old Dominion University)
Sande Dukas (Controls Company of America)
Matt Brennan (Siemens PLM)
Melanie Young (Newport News Shipbuilding)
Joseph Stark (Bauer Compressor)
Bob Fagan (Commonwealth Center for Advanced Manufacturing)
Deborah Wright (Peninsula Workforce Development Center)
Bob Sharak (Opportunity Inc.)
Jerome Brinker (Business Gateway, Old Dominion University)
Intern: Cameron Langille (University of Virginia)

National Trends

Over one hundred years ago 50% of the US population worked in agricultural sector, and it took that many people to feed the rest of the country. Today, no more than 5% of US workforce is in the agricultural sector and those people produce enough food not just for the needs of the US but also for large segment of population outside the US. The situation is similar with the manufacturing industry. Some 50 years ago close to 50% of US population worked in industrial sector and today that number is around 10% while the production has significantly increased. Today we are producing more goods with fewer people than in any period in our history. The major cause for such change is application of automation and robotics.

Direct employment by manufacturing companies will continue to be stable with possibility for small deviations. However, types of skills and knowledge that will be required to work in manufacturing industry will be significantly different from the skills that were required in not too distant past. Hence, one cannot foresee that manufacturing by itself will be the major source of jobs in the future even if significant numbers of companies re-shore their operations. However, based on history, we can confidently say that manufacturing industry will be major consumer of multidisciplinary innovations that will spark creation of new jobs in current and in yet to be developed industries. Hence, manufacturing will provide indirect support for many other jobs across different disciplines and industries.

Although the number of jobs on the shop floor is in overall decline the number of opportunities created by ever evolving manufacturing sector create numerous additional needs for supporting activities that integrate various technologies and create cross-disciplinary job opportunities. These new jobs will surpass the number of manual jobs that are being displaced by automation and robotics. Several examples are given below.

Modeling and simulation is becoming increasingly important in the manufacturing sector as it allows verification of product and process in digital environment before a single atom of raw material is manipulated. Modeling and simulation of physical processes and products provides relatively inexpensive what-if analysis which can lead to improved and in many cases optimal product performance, reduced cost of manufacturing, and reduced time to market. With
modeling and simulation also comes the need for visual presentation of simulated processes which provides opportunity for development of augmented reality to assist engineers and technicians in operation and maintenance of manufacturing systems.

**Information technology** allows collaboration across disciplines and geographic distances. It allows designers to work closely with manufacturers and everyone else in the product life-cycle chain to improve the quality and performance of the product. As products and processes become increasingly complex the amount of information that will be collected increases exponentially. In order to take full advantage of wealth of collected data there will be a need to convert data into information and ultimately into knowledge. Hence, scientists and engineers will have ample opportunity to address issues of big data and artificial intelligence for a long time which will create new jobs. As information technology and globalization open doors for new opportunities they also create potential problems related to cyber-security as data is moved from one location to another, and from one manufacturer to another it is vulnerable to cyber-attacks through modification and alteration which can impact product and process integrity.

**Robotics** has been around for quite some time but its applications in the manufacturing sector is yet to take full advantage of the current state of the art in that domain which is still expanding its boundaries. Many factories are employing stationary robots and manipulators and few of them are using multiple robots working in tandem. As new generation of autonomous robots become safe to be used in human environment we shall see increased need and application for those systems in manufacturing domain to work in concert with humans. There are research efforts both at Old Dominion University and College of William and Mary in the area of autonomous unmanned vehicles and remote robotics that can be used in naval applications such as port security, underwater exploration, inspection and maintenance of offshore wind power systems, and harnessing sea flora for generating biofuels.

**Sensors** are necessary components of intelligent systems including manufacturing systems. In order to control manufacturing systems we need accurate and timely information about the process so that we can make appropriate corrective actions when and where needed. As accuracy of processes is increased the number and sophistication of sensors will increase. The products are becoming increasingly complex and include number of sensors themselves, which will require further research, development and manufacturing of new sensors.

**Additive manufacturing** is becoming household word and a synonym for a new manufacturing revolution. The process provides numerous opportunities for mass customization and development of parts which would not be possible to make using traditional processes. It opens up capability to create products with targeted engineered properties that are specific to particular application. The process is especially appropriate for short-run and one of a kind part manufacture which can be found in ship manufacture and repair.

**Entrepreneurship** is a natural extension of product and process development and improvement. Once individual finds way to improve process and/or product he/she will be likely to attempt to deploy that innovation to broader market and thus perpetuate development of new businesses and contribute to economic growth of the region. Additive manufacturing is a very good example of one of the more recent advancements which found its way into the market.
Logistics is essential component of manufacturing as products need to reach the customers in the most efficient manner. Proximity and/or collocation with a major port will expedite time to market and lowers overall cost. Hampton Roads has unique geographical location that can be matched by only few other localities along the eastern seaboard.

Education is essential component of preparing workforce for new emerging manufacturing industry and all technologies that are employed. As manufacturing jobs employ more complex technology, higher skilled workers will be required in traditional position (operators, maintenance, etc.) This provides opportunities for employment across many technical areas from community colleges to four year institutions. Education sector employs significant number of individuals and with future opportunities it can increase the numbers of educators. In addition to traditional training, it is expected that manufacturing industry, just like other industries, will increasingly rely on distance education and asynchronous education through virtual reality and immersive environments. This will provide opportunities for educational institutions to develop new methods and courses for instructional delivery in the new environment.

Environmental sciences are becoming increasingly intertwined with product development and manufacturing as new materials and their impact on environment is studied to prevent negative impact on environment and human health. One recent example includes studies of impact of nanoparticles on humans.

All these, and many other areas may be considered tangential to manufacturing but are becoming essential component of modern manufacturing. Some of them did not exist fifty years ago but have found a firm ground in supporting today’s manufacturing activities. These and many other areas are needed for manufacturing company to be competitive in today’s global environment. Manufacturing provides great opportunities for continued support and potential further expansion of these areas and thus for creation of new value added jobs. In order to survive in the increasingly competitive world, society will need those jobs that also have very symbiotic relationship with manufacturing. Giving up manufacturing, through off-shoring and any other means, risks losing valuable know-how and many related jobs and may lead to socio-economic decline. The essential thing that needs to be kept in mind is that manufacturing, knowledge and ability of making things, creates the need for innovation across many disciplines and provides opportunities for entrepreneurship and ultimately to economic growth. Loss of manufacturing and associated jobs leads to precipitous decline in know-how and underlying knowledge required for innovation.

State of Manufacturing Industry in Hampton Roads

Hampton Roads is home to significant manufacturing industrial base in the State of Virginia. The region has close to 300 manufacturing companies that employ approximately 54,000 people. Shipbuilding and repair represents some 57% of manufacturing employment. However, there are number of other companies that manufacture products for heavy industry, transportation industry as well as consumer products. Basic employment information is provided in Table 1 that follows.
<table>
<thead>
<tr>
<th>State and area</th>
<th>Total Employment</th>
<th>Total Employment</th>
<th>Percent of Tot Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>June 2013</td>
<td>May 2014</td>
<td>June 2014(p)</td>
</tr>
<tr>
<td>Virginia</td>
<td>3,789.6</td>
<td>3,785.3</td>
<td>3,803.8</td>
</tr>
<tr>
<td>Blacksburg-Christiansburg-Radford(2)</td>
<td>69.9</td>
<td>73.5</td>
<td>70.6</td>
</tr>
<tr>
<td>Charlottesville(2)</td>
<td>102.6</td>
<td>104.0</td>
<td>102.8</td>
</tr>
<tr>
<td>Danville(2)</td>
<td>40.0</td>
<td>39.4</td>
<td>39.1</td>
</tr>
<tr>
<td>Harrisonburg(2)</td>
<td>62.0</td>
<td>63.6</td>
<td>63.5</td>
</tr>
<tr>
<td>Lynchburg(2)</td>
<td>102.3</td>
<td>100.7</td>
<td>100.5</td>
</tr>
<tr>
<td>Richmond(1)</td>
<td>636.9</td>
<td>645.4</td>
<td>650.1</td>
</tr>
<tr>
<td>Roanoke(1)</td>
<td>158.6</td>
<td>158.5</td>
<td>158.6</td>
</tr>
<tr>
<td>Virginia Beach-Norfolk-Newport News(1)</td>
<td>762.4</td>
<td>754.6</td>
<td>764.6</td>
</tr>
<tr>
<td>Winchester(2)</td>
<td>59.3</td>
<td>60.0</td>
<td>60.3</td>
</tr>
</tbody>
</table>


Footnotes:
(1) Mining and logging is combined with construction.
(2) Data not available.
(3) Area boundaries do not reflect official OMB definitions.

[NOTE: Data are counts of jobs by place of work. Data have been revised to reflect 2013 benchmark levels. Estimates subsequent to the current benchmark are preliminary and will be revised when new information becomes available. Area definitions are based on Office of Management and Budget Bulletin No. 10-02, dated December 1, 2009, and available at www.bls.gov/lau/lauad.htm. Areas in the six New England states are Metropolitan New England City and Town Areas (NECTAs), while areas in other states are county-based. Some metropolitan areas lie in two or more states. They are listed under the state that appears first in their titles. Davenport-Moline-Rock Island, Iowa-Ill. is the exception since it is listed under Illinois for operational reasons.]
Employment figures obtained from the Bureau of Labor Statistics, previous Table, show that the Virginia Beach-Norfolk-Newport News MSA (“MSA”) has a large manufacturing sector. In June 2014, the sector employed some 54,200, representing about 7.1% of total regional employment.

Regional manufacturing is dominated by large firms, Table 2. While 69% of the 809 firms have 20 or fewer employees, and 92% have less than 500, nearly three-quarters of employment (73%) is with firms of 500 or more employees. Many of these firms are in ship building and repair, which accounts for some 57% of manufacturing employment.

Table 2: Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area
Manufacturing

<table>
<thead>
<tr>
<th>ENTERPRISE EMPLOYMENT SIZE</th>
<th>NUMBER OF FIRMS</th>
<th>NUMBER OF ESTABLISHMENTS</th>
<th>EMPLOYMENT</th>
<th>ANNUAL PAYROLL ($1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>551</td>
<td>552</td>
<td>2,947</td>
<td>104,175</td>
</tr>
<tr>
<td>20-99</td>
<td>143</td>
<td>151</td>
<td>5,324</td>
<td>231,938</td>
</tr>
<tr>
<td>100-499</td>
<td>46</td>
<td>50</td>
<td>6,375</td>
<td>299,698</td>
</tr>
<tr>
<td>500+</td>
<td>62</td>
<td>86</td>
<td>39,338</td>
<td>2,131,706</td>
</tr>
<tr>
<td>Total MFG</td>
<td>802</td>
<td>839</td>
<td>53,984</td>
<td>2,767,517</td>
</tr>
<tr>
<td>Total Emp</td>
<td>28,165</td>
<td>36,830</td>
<td>583,529</td>
<td>21,935,287</td>
</tr>
</tbody>
</table>

release date: 2/2014
SOURCE: 2011 County Business Patterns. For information on confidentiality protection, sampling error, non-sampling error, and definitions, see http://www.census.gov/econ/susb/methodology.html

 Tradable sectors like manufacturing bring in outside money, positively impacting regional wealth. Further, manufacturing jobs pay some $60K versus an average $43K for all occupations, a 40% premium. Lastly, while manufacturing represents only 7.1% of regional employment, it accounts for 13% of payrolls. Manufacturing, which brings in wealth and then circulates it throughout the region via good paying jobs, is an important contributor to regional prosperity.

Hampton Roads has the largest manufacturing base in the Commonwealth accounting for some 23% of manufacturing employment versus for 20% of overall state employment.
Major Players in HR Region

Industry
There are over 300 manufacturers in the Hampton Roads area and only a few major ones are listed below:
- Newport News Shipyard
- Norfolk Naval Shipyard
- Canon
- Stihl
- Alcoa
- Sumitomo
- Liebherr-America
- Smithfield Packaging Company
- BAE Systems
- Measurement Specialties

Universities
- Old Dominion University
- Norfolk State University
- Christopher Newport University
- Hampton University
- William and Mary

Community Colleges
- Tidewater Community College
- Thomas Nelson Community College
- Newport News Shipbuilding’s Apprentice School

Federal Employers
- Navy
- Air Force
- Army
- Coast Guard

Laboratories
- NASA Langley
- Jefferson Lab
- National Institute of Aeronautics

Workforce Development Organizations
- Opportunity Inc.
- Peninsula Workforce Development Center
Opportunities

The region has number of advantages including:

- It has over 300 manufacturing companies with approximately 54,000 employees. The region can capitalize on this fact by attracting some of the first and second tier suppliers to OEMs to this region.
- Very good and diverse workforce. Many highly technically trained military personnel retire in this region. They still have number of very productive years ahead of them and can be very effective in manufacturing sector that is looking for highly trained, critical thinkers with significant experience and high work ethics.
- Region is a major sea port with significant air and land connections. This provides opportunities for establishing assembly plants for import and export goods.
- Region is home to two major Federal Labs – Jefferson Lab and NASA Langley. Both of these two institutions are working on development of cutting edge manufacturing processes and materials which can be translated into industrial applications. Both of those institutions have facilities that are difficult to replicate and thus have established themselves as centers of excellence in their respective domains.
- Region has several institutions of higher education with significant research agenda. They can provide both innovative solutions for industry as well as highly trained workforce.
- Region is home to the largest Naval Base in the world and as such it attracts companies involved with development of sophisticated sensors and autonomous robotic systems that can find application in manufacturing domain. This represents ideal opportunity to build upon strengths of another sector and provide support for translational research.
- Region is home to one of the largest metropolitan areas (1.7 million people) with significant cultural diversity. It has very desirable geographical location with significant opportunities for outdoor activities, and hosts many cultural events which cater to diverse populations. This is very important management factor in selecting site to establish industrial presence.
- Military presence provides opportunities for building on some of its needs and strengths – sensors, autonomous unmanned vehicles and robotics, and Product Lifecycle Management.
- Hampton Roads is home to VMASC which has received significant recognition at the state level and has created solid track record with military projects.
- Bringing large company like Siemens PLM into the region provides opportunities for software development for the needs of manufacturing industry.
- The state of Virginia provides a business-friendly environment with tax codes designed to attract new business to the state.
Challenges

- **Industrial space.** There is a lack of sufficiently large contiguous space (e.g. Research Triangle in North Carolina) available for development of a number of large manufacturing facilities in HR region, except for, possibly, Suffolk area. Hence, area can consider supporting SME’s.

- **Workforce.** Although the region has good and diverse workforce it lacks the numbers with appropriate qualifications required to support the future needs of industry. As indicated by the study commissioned by Peninsula Workforce Development Center, the region will need over 11,000 qualified technicians and engineers in the next several years to fill jobs vacated due to retirement. Even if the number is off by a factor of two, it still means that significant number of qualified people will be needed to meet the needs of regional industry.

- **Industry image.** Manufacturing industry’s image is one of the major issues for attracting young talent. This problem is a national issue and is caused by the image of harsh environment and manual workplace, as well by the fact that many manufacturers have offshored their operations hence creating impression of job instability. Although ship building and repair still relies on significant manual component for manufacturing, the job stability and salaries in that industry are attracting significant number of young people. On the other hand, number of other industries located within Hampton Roads region, e.g. Canon and Stihl, represent modern type of highly automated industry. Hence, industry needs to paint a better and more comprehensive picture of the job opportunities and potential for professional and personal growth in order to attract young talent.

- **Lower value-added activity.** Many of the larger manufacturing plants in the Hampton Roads plants are assembly plants. This means that the major know-how and value added activity is at the parent company, quite a few of which are foreign companies (Stihl, Canon, Sumitomo etc.). Although manufacturing jobs pay well, it is innovation and product development that bring the most benefit to companies and their communities by spinning off new ideas and products.

- **Aging industry.** A significant group of larger manufacturing companies located in HR region are mature industries (primarily shipbuilding and repair). Those industries have limited, if any, R&D and hence very little focus on significant innovation. This has been identified by the study conducted by Thomas Nelson Community College and Peninsula Council for Workforce Development. In their report, they identified that in the next several years regional employers will have to fill several thousand technical jobs of which only 200 engineering jobs.

- **Shifting research focus.** Another challenge is the fact that universities have slowly shifted away from manufacturing curriculum due to number of reasons, including decline in federal funding for manufacturing, increased costs of laboratory equipment
required for teaching manufacturing courses and cost for lab maintenance. Due to increased visibility of manufacturing lately, universities are changing their position on supporting manufacturing but still the support is at a very slow pace and at the low level. The primary reason is a need for space and continuous support of manufacturing labs (technicians) which are part of ever shrinking base budgets. Hence, one way to address this challenge is to pool regional resources and seek state and federal funding to build Advanced Manufacturing Center of Excellence to be used by all regional stakeholders. The center should include two and four year institutions, teaching as well as research institutions. It should provide a place for workforce development and for interaction between machine operators and post-docs who can collaborate on development of new processes as well as improvement of existing process, and product development. This center should exploit the regional strengths and provide platform for translational research and serve as incubator for new ideas and off-shoot companies. Some of the cutting edge strengths include composite materials (NASA-Langley), surface engineering (Jefferson lab), additive manufacturing (Jefferson Lab and NASA), autonomous systems (NIA), welding (Newport News Shipbuilding), etc. The Center should be developed in collaboration with Commonwealth Center for Advanced Manufacturing (CCAM) in order to build upon each other strengths and to complement each other.

- **Incubator park.** Hampton Roads has no incubator park for start-ups. Innovators are not necessarily good business people with skills required to develop and deploy a business. A number of universities (e.g. Purdue University, North Carolina University etc.) have established “research parks” as incubators for start-up companies. In these cases research parks provide required infrastructure and logistics required to run small business, leaving innovators to do what they like to do the most – tinker with their ideas and making them into products.

**Future Directions - Recommendations**

- Establish working group of regional manufacturing and government leaders to provide leadership and direction for promoting and supporting manufacturing industry.
- Identify common threads for regional stakeholders and pursue common goals.
- Provide unified voice for manufacturing industry at the regional and state legislative level, work together with Virginia Manufacturer’s Association (VMA) and Commonwealth Center for Advanced Manufacturing (CCAM).
- Provide periodic review of the state of manufacturing in the Hampton Roads region with recommendation for future actions.
- Identify the ways for expanding manufacturing base by promoting and bringing major manufacturers into the region.
- Work on increasing visibility of manufacturing industry through appropriate marketing strategies.
• Promote region as a viable place for product assembly, for both imports and exports, especially for products that require assembly of components originating in different countries.

• Establish regional center for advanced manufacturing with focus on specific needs or regional industry. Strengthen collaboration between industry, community colleges and four year institutions. The focus is on applied and translational research and workforce development. Develop IP structure at regional universities conducive to engagement with industry.

• Work with regional universities to establish signature areas of excellence focused on manufacturing and provide guidance and support for going after large federal research funds and grants to establish Engineering Research Centers. (e.g. Composites, Sensors, Modeling and Simulation, Product Lifecycle Management etc.). Federal funding for National Network of Manufacturing Institutes is at the level of $70-120M over 5 years per institute.

• Develop close ties with other clusters to build upon each other strength (e.g. sensors, robotics, unmanned-autonomous-vehicles, etc.).

• Establish regional “R&D incubator”

• Develop Hampton Roads Advanced Manufacturing Research and Training Center focused on regional needs and strengths (e.g. welding, metal fabrication, composite materials, additive manufacturing, high precision manufacturing, PLM)

**Interconnection with Other Clusters**

Manufacturing cluster has natural ties to most of the other clusters:

a. Modeling and simulation
b. Robotics/Sensors/Unmanned vehicles
c. Cyber security
d. Military/commercialization of military technology
e. Ports and maritime logistics
f. Bio-All
g. Coastal energy

**References:**
4. “Report to the President on capturing domestic competitive advantage in advanced manufacturing.” Executive Office of the President, President’s Council of Advisors on Science and Technology (July 2012).
## Cluster Review Team Reports

**Industry Cluster Study Group / Bio-All Cluster Review**

### 1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

### 2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

### 3. Bio/All (Bioscience, Bio-tech, Bio-Electrics) Industry Cluster

Cluster Team Lead: Sandeep Samudre (Technisight)

| Team members:   | Chester Brazzell  
|                 | Bill Waslenko (EVMS)  
|                 | Don Combs (EVMS)  
|                 | Richard Heller (ODU)  
|                 | Bob Armstrong (EVMS) |

Proposed start date: 04/15/14
Proposed end date: 05/30/14

### 4. Cluster Team Work Plan and Interdependencies

#### Objective and Outcomes

Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters

- List of key players and organizations within the cluster identified (see Appendix A in detailed report)
  1. Novel Therapy/Product Companies (10 listed, with description and location information)
  2. Bio Imaging/Sensor Companies (6 listed, with description and location information)
  3. Clinical Trials Support Companies (2 listed, with description and location information)
  4. Informatics Companies (1 listed, with description and location information)
  5. Consulting/Support Organizations (4 listed, with description and location information)
  6. Major Academic and Federal Lab Biological Research Capabilities (8 listed)
  7. Unique Research Centers and Resources (11 listed with a brief description of their work)
  8. Technology Incubation/Commercialization Assets (6 listed with a brief description of their work)

#### Current depth of the cluster/scale of the industry described

1. Five subsectors which include:
   - Agricultural Feedstock & Chemicals
   - Drugs & Pharmaceuticals
   - Medical Devices & Equipment
   - Research, Testing & Medical Laboratories
   - Marine and Environmental
2. The region has some, but not all of the assets in place for long-term support to a Bioscience Cluster. The following assets are required to establish the industry cluster:
   - Workforce
• Basic Science/Research
• Applied Research & Development
• Development
• Technology Transfer
• New Enterprise Development
• Bioscience firm expansion
• Attraction of Biomedical Research Institutions
• Attraction of Bioscience Companies

3. Major players in the Bioscience Cluster that exist today are referenced in Inquiry #1 above (Appendix A of the detailed report), while Appendix B of the report provides a list of 18 companies formed because of the presence of, and interactions with Eastern VA Medical School.

Growth opportunities identified
1. The combination of large and small members in the Cluster permits building on the irrespective strengths. Venues and events could be a useful tool to create new communication links that move large organizations into new markets quickly and accelerate the growth of smaller ones.
2. Partnering and networking provides the opportunity for those within a cluster to:
   • distribute information on the qualifications of its members
   • share announcements of requests for federal research proposals
   • conduct SBIR workshops focused on NIH
   • connect researchers sponsored by federal agencies with companies in commercial markets developing new products and services. Opportunities for company sponsored research will create economic growth through research commercialization.
3. Match workforce needs with workforce development programs in the universities and community colleges to identify gaps and identify new programs to make information and curricula on Bioscience careers widely available in the public schools.
4. Quantify the need for incubator wet lab space and explore the feasibility of providing it as part of the incubator system.
5. Bring suppliers and end users into cluster activities (i.e., special events for the suppliers and end users – pharmaceutical companies, hospitals, doctors and medical device companies.

Connections between new clusters and existing pillars identified and described
1. Research roots found in the region’s academic organizations are the same core research organizations that serve the other industry clusters.

Boundary spanning clusters identified and described
1. Defense – Hampton VA and Portsmouth Naval Hospital as well as other various clinics primarily serve the region’s retired and active duty service members. These organizations also support defense-oriented biomedical research and development that contribute to and generate activities important to the cluster.
2. Modeling & Simulation – There is growing demand for models and simulations throughout every facet of Bioscience and Healthcare. These two clusters will be mutually beneficial to each other.
3. Sensors – Sensors are extremely important to Bioscience considering the trend towards personalized medicine and especially measurable health data, which is dependent upon sensors of various fidelity and capability.
4. Translational Research – This is an important process where bench/basic science research is translated into commercial technology that includes drug development, medical devices and various technological adaptations of basic science technology. Imperative to the success of this cluster is the need for supportive services such as Clinical Research Organizations (CRO).

Salary and wages produced by the cluster identified
1. Biosciences salaries are typically above average in the aggregate. Based on salary information from 2008, the following provides averages for specific subsectors of the cluster:
   • Drug & Pharmaceuticals - $ 93,378
   • Research, Testing, and Medical Labs - $ 80,785
- Total Biosciences - $ 77,595
- Agricultural Feedstock and Chemicals - $ 72,279
- Medical Devices and Equipment - $ 63,606
- U.S. Total Private Sector - $ 43,239

**Expected degree of sustainability described**
1. The key to sustainability is access to capital
2. State and federal grant mechanisms are important and very competitive
3. A supportive incubator and accelerator structure, where in new product and startup ideas can support business development

**Competitive advantages identified and described**
1. The presence of Eastern VA Medical School and post graduate degree granting universities with bioscience research activities (ODU and William & Mary)
   - EVMS has specific academic R&D capabilities in the areas of women’s health, diabetes, medical ModSim.
   - William & Mary’s VIMS is focused on marine science, which is critical to our region
   - ODU’s Center for Bioelectrics – Research at the Center ranges from fundamental studies of electric field and plasma effects on biological cells to applied research including medical and commercial applications.
2. Successful bioscience industries (LifeNet Health, CIRS Wellpoint)
3. Federal research facilities (NASA Langley Research Center and Jefferson Lab)
4. High performing hospital systems (Sentara, Bon Secours & Riverside) and clinics serve as collaborators, users, and customers of any locally produced Bioscience technologies
5. Geographic dispersion, while inefficient at times, does help to foster an environment of collaboration
6. The region’s need for economic diversification will help to drive the effort forward

**Target customers and competitors identified**
1. Customers – all aspects of the healthcare industry, including patients, the healthcare delivery system, and the insurance industry
2. Competitors – In VA and elsewhere are focused around academic research centers (Charlottesville, Richmond, Blacksburg, Northern VA and elsewhere around the state). The scale and scope of Bioscience is such that there is more opportunity for collaborative and complementary activities than there is for predominantly competitive behaviors. Working together, highlighting our capabilities and accomplishments will benefit the whole.

**Projected growth potential from a global, national and regional perspective.**
1. Nationally – Healthcare (included in the Bioscience Cluster) accounts for nearly 20% of the U.S. GDP (nearly $2.7 trillion). There are concerted efforts to maintain or reduce healthcare costs; however, there are ample opportunities to replace inefficient processes, treatments, techniques, devices, and tools with new, less expensive options. No matter what the healthcare or bioscience market does, there will always be a need for replacement technologies.
2. Regionally – Our need to diversify the regional economy, coupled with the ubiquitous nature of bioscience, give the Bioscience Cluster a very good chance to succeed in the region.

**List of what is needed to grow the cluster**
1. Promotion of a comprehensive Bioscience Ecosystem – a community of people, businesses, technologies, infrastructure, customers, and creators that coexist harmoniously to produce a vibrant economy. The following captures what we need to grow the Bioscience Cluster in Hampton Roads:
   - Engaged universities with active leadership
   - Entrepreneurial cultures with intensive networking across sectors and with industry
   - Available capital covering all stages of business cycle
   - Discretionary federal, state, and private R&D funding
   - Skilled workforce and talent pool
   - Specialized facilities and equipment
   - Supportive business, tax and regulatory policies
• Patience and a long-term perspective
• Accelerators that focus on Biosciences
• Pursue Virginia Bioscience funding opportunities as those highlighted in Appendix C of the detailed report

List of obstacles to cluster growth
1. Lack of capital to support research and startup activities
2. Sales/Inability to reach a broad customer base
3. Lack of product
4. Parochial, vice regional strategies
5. Failure of other supportive clusters – failure breeds failure, just as success breeds success

List of elements that make the cluster attractive
1. Focus on critical issues that are unrepresented in other Bioscience clusters, such as:
   • Patient safety issues
   • Education and Training
   • Diabetes
   • Ophthalmology
   • Food safety issues
   • Bioinformatics, Biosensors
   • Agriculture
   • Medical Modeling & Simulation
   • Marine Science
2. Appendix D in the detailed report includes a diagram depicting biotechnology as a broad field with major applications spread across a number of diverse sectors such as medical, industrial, marine and agricultural and environmental biotechnology. The diagram illustrates the opportunity we have in the region to expand our efforts into these sectors to increase the value and attractiveness of the cluster.

List of elements that make the cluster unique
1. Proximity to the Atlantic/Chesapeake Bay
2. Cluster includes one of four medical schools in the Commonwealth
3. Home to one of the most highly respected healthcare organizations in the U.S. (Sentara)
4. Strong history of regional academic collaboration
5. History of NIH grant wins
6. Natural ability to collaborate with other relevant Virginia academic, government, and industry organizations
7. Academic R&D specialties (previously referenced)

Recommended measures to gauge growth in this cluster
1. Federal bio-related R&D funding to universities
2. NIH R&D funding as the “gold standard”
3. Specialization of industry and its concentration rates
4. Private venture investments
5. University-related start-ups
6. Roadmap implementation progress
Bioscience Industry Cluster

Review Team Detailed Report

This report provides insight into the current and prospective value of a Bioscience Industry Cluster in Hampton Roads. The Bioscience Review Team¹ of the Hampton Roads Community Foundation relied upon both historical and current data to create this report.

It is important to accurately frame the need. Hampton Roads needs the following capabilities, assets, and activities to successfully foster a Bioscience Industry Cluster:

- Workforce
- Basic Science/Research
- Applied Research & Development
- Development
- Technology Transfer
- New Enterprise Development
- Bioscience firm expansion
- Attraction of biomedical research institutions
- Attraction of Bioscience Companies

When the capabilities, assets, and activities above and noted in the diagram are present and functioning harmoniously, the Hampton Roads Bioscience Cluster will have long term success.

1. List of key players and organizations within the cluster identified

Hampton Roads is home to a number of different Bioscience organizations that are natural members of the Bioscience Cluster. These organizations, which are listed in Appendix A of this document, generally fall into these categories:

- Major Academic and Federal Lab Biological Research Centers and Capabilities
- Bio-Imaging and Sensor Companies
- Unique Research Centers and Resources
- Clinical Trial Support Companies
- Novel Therapy and Product Companies
- Informatics Companies
- Technology Incubation and Commercialization Assets
- Academic and Federal Lab Technology Transfer Resources
- Consulting and Support Organizations

¹ Sandeep Samudre, Chester Brazzell, Bill Wasilenko, Don Combs, Richard Heller, Bob Armstrong
Some of the industry members, i.e. LifeNet Health and CIRS, provide over 300 jobs each. Other companies are smaller and provide employment ranging from 2-5 or greater than 50 individuals.

2. Current depth of the cluster/scale of the industry described

The biosciences industry sector may be defined as including the below four subsectors:

- Agricultural Feedstock & Chemicals
- Drugs & Pharmaceuticals
- Medical Devices & Equipment
- Research, Testing & Medical Laboratories
- Marine and Environmental

Hampton Roads has some, but not all, of the assets in place for long-term support to a Bioscience Cluster. As mentioned previously, the following assets are required to establish a Bioscience Industry Cluster:

- Workforce
- Basic Science/Research
- Applied Research & Development
- Development
- Technology Transfer
- New Enterprise Development
- Bioscience firm expansion
- Attraction of Biomedical Research Institutions
- Attraction of Bioscience Companies

Appendix A lists the major players involved in the Bioscience Cluster as it exists today. Appendix B provides a list of companies formed because of the presence of, and interactions with, Eastern Virginia Medical School.

3. Growth opportunities identified

In September of 2008, the Hampton Roads Research Partnership and Eastern Virginia Medical School contracted for a study of the region’s bioscience capabilities. The study was performed by the ANGLE Technology Group and managed for the Hampton Roads Research Partnership by Mr. Doug Dwoyer. Mr. Dwoyer has permitted the Hampton Roads Community Foundation Bioscience Group to quote and reference the study in this report. The following is excerpted from that study.

The combination of large and small members in the Cluster permits building on the irrespective strengths. Venues and events organized by the Cluster could be designed to create new communications links that would move large organizations into new markets more quickly and accelerate the growth of the smaller ones.
The widespread interest in partnering and networking presents an opportunity for the cluster to distribute information on the qualifications of its members, distribute announcements of requests for federal research proposals and conduct SBIR workshops focused on NIH.

Another type of partnering would join researchers sponsored by federal agencies with companies in commercial markets developing new products and services. New opportunities for company sponsored research could be created and real economic development could be achieved through research commercialization.

The cluster could match workforce needs with workforce development programs in the universities and community colleges to identify gaps. It could also establish new programs to make information and curricula on Bioscience careers widely available in the public schools.

The cluster could quantify the need for incubator wet lab space and explore the feasibility of providing it as part of the incubator system of the Hampton Roads Technology Council.

The cluster could be expanded to bring suppliers and end users into cluster activities. Options include special events for the suppliers and end users – pharmaceutical companies, hospitals, doctors and medical device companies.

4. Connections between new clusters and existing pillars identified and described

A special challenge for Bioscience Cluster is bringing together organizations in diverse markets that are geographically dispersed. The Bioscience Cluster has its research roots in the academic organizations located throughout the region, including Eastern Virginia Medical School, Old Dominion University, Norfolk State University, Hampton University, and the College of William & Mary. Notably, these are the same core research organizations that serve the other Clusters: Defense, Modeling and Simulation, Sensors, Robotics and Unmanned Systems, Coastal Energy, Aerospace, Port and Maritime, and Travel and Tourism Clusters.

5. Boundary spanning clusters identified and described

The Bioscience cluster interconnects with several other clusters, to include defense, modeling and simulation, sensors and translational research.

**Military Cluster:** The Hampton VA and Portsmouth Naval hospitals, as well as the various clinics, primarily serve our region’s retired and active duty service members. These organizations also support defense-oriented biomedical research and development that contribute to and generate activities important to the Cluster.

**Modeling & Simulation Cluster:** There is a growing demand for models and simulations throughout every facet of Bioscience and Healthcare. Bioscience thrives on analysis; analysis is integral to modeling and simulation. The strong Modeling and Simulation Cluster in the region has been engaged in Bioscience efforts for a number of years. These two Clusters will be mutual beneficial to each other.
**Sensors Cluster:** Sensors are extremely important to Bioscience. The trend towards personalized medicine and especially measurable health data is dependent upon sensors of various fidelity and capability. There is a definitive need for technologies developed in the Sensor Cluster within the Bioscience Cluster.

**Translational Research:** Translational research is an important process where bench/basic science research is translated into commercial technology that includes drug development, medical devices and various technological adaptations of basic science technology. Imperative to the success of this cluster is the need for supportive services such as Clinical Research Organizations (CRO’s).

**6. Salary and wages produced by the cluster identified**

Bioscience salaries are typically above average in the aggregate. Salary information from 2008 is included below.

<table>
<thead>
<tr>
<th>Category</th>
<th>Salary ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug &amp; Pharmaceuticals</td>
<td>$93,378</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>$85,274</td>
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<tr>
<td>Research, Testing, and Medical Labs</td>
<td>$80,785</td>
</tr>
<tr>
<td>Total Biosciences</td>
<td>$77,595</td>
</tr>
<tr>
<td>Professional, Scientific and Technical Services</td>
<td>$74,354</td>
</tr>
<tr>
<td>Agricultural Feedstock and Chemicals</td>
<td>$72,279</td>
</tr>
<tr>
<td>Information</td>
<td>$70,780</td>
</tr>
<tr>
<td>Medical Devices and Equipment</td>
<td>$63,606</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$54,392</td>
</tr>
<tr>
<td>Construction</td>
<td>$49,014</td>
</tr>
<tr>
<td>U.S. Total Private Sector</td>
<td>$43,239</td>
</tr>
<tr>
<td>Real Estate and Rental and Leasing</td>
<td>$43,239</td>
</tr>
<tr>
<td>Transportation and Warehousing</td>
<td>$42,969</td>
</tr>
<tr>
<td>Health Care and Social Assistance</td>
<td>$42,150</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>$26,181</td>
</tr>
</tbody>
</table>


**7. Expected degree of sustainability described**

The Bioscience Cluster typically fosters technologies and products with a considerable basic and applied research base. These types of efforts rely upon a relatively long term investment and commitment of resources. Transitional research and technology transfer are further facilitated by grants and startup funding.
The key to sustainability of the Bioscience Cluster will be access to capital. The VBHRC and CRCF state grant mechanisms, along with the various Federal grant mechanisms, will be important to this effort. Note that Federal grant mechanisms are competed nationally; every state, every regional cluster is vying for that funding.

Also important to the success of the Bioscience Cluster is a supportive incubator and accelerator structure, wherein new product and startup ideas are successfully guided and supported until they are self-supporting. Models for incubators and accelerators proposed in other cluster areas could support business development support for Bioscience Cluster activity in our region.

8. Competitive advantages identified and described

Hampton Roads has been fostering a Bioscience Cluster for a number of years. In our region, we have a medical school (EVMS), postgraduate degree granting universities with bioscience research activities (ODU, W&M), successful bioscience industries (LifeNet, CIRS, Wellpoint), and federal research activities (NASA Langley, Jefferson Labs).

The region’s unique and specific academic R&D capabilities are worth noting. EVMS has significant experience with women’s health, diabetes, medical modeling and simulation, and biomedical proteomics. ODU has extensive experience in bio-electrics and modeling and simulation, the latter which is a cluster but also a cross-cluster capability. William and Mary’s VIMS is focused on marine science, which is critical to our region. The ongoing work at these institutions serves as the core basic and applied R&D necessary for the foundation of the Bioscience Cluster.

We are also home to two high performing hospital systems (Sentara, Bon Secours) and numerous other hospitals and clinics serving a diverse population of over 1.7 million people. These healthcare organizations serve as collaborators, users, and customers of any locally produced Bioscience technologies.

Our geographic dispersion, while at times inefficient and irritating, does help to foster an environment of collaboration that will be essential to the success of the Bioscience Cluster.

Lastly, the region’s need for economic diversity will help to drive this effort forward. We as a region have a unique opportunity to leverage the technology expertise and business know how in other business sectors to add new opportunities from Bioscience for economic development in our area.

9. Target customers and competitors identified

Bioscience Cluster output serves all aspects of the healthcare industry, to include patients, the healthcare delivery system, and the insurance industry.

Our competitors in Virginia (and elsewhere) are centered around academic research centers – Charlottesville, Richmond, Blacksburg, Northern Virginia, and elsewhere across the state. We believe that the scale and scope of Bioscience is such that there is more opportunity for
collaborative and complementary activities than there is for predominantly competitive behaviors. Certainly, all of these regions compete for the same state and federal funding; however, we believe that we can guide our Cluster away from direct competitive technologies and market simply by paying attention to the rest of the state – and highlighting our capabilities and accomplishments.

10. Projected growth potential from a global, national, regional perspective

Healthcare, which is included within the Bioscience Cluster, accounts for nearly 20% of the U.S. Gross Domestic Product, nearly $2.7 trillion. There are concerted efforts to maintain or reduce healthcare costs; however, there are ample opportunities to replace inefficient processes, treatments, techniques, devices, and tools with new, ultimately cheaper things. Regardless of whether the healthcare or bioscience market grows or flattens out, there will always be a need for replacement technologies.

Regionally, our need for additional economies based upon industries other than defense, the port, and tourism – coupled with the ubiquitous nature of bioscience – give the Bioscience Cluster a very good chance to succeed in Hampton Roads.

11. What is needed to grow the cluster

In order to successfully grow a Bioscience Cluster, we have to ensure that we promote a comprehensive Bioscience Ecosystem. As ecosystem, in this context, is a community of people, businesses, technologies, infrastructure, customers, and creators that coexist harmoniously to produce a vibrant economy. They interact as a system that ultimately provides value both within and external to the ecosystem core. In Hampton Roads, we need the following to foster growth of our Bioscience Cluster:

- Engaged universities with active leadership
- Entrepreneurial cultures with intensive networking across sectors and with industry
- Available capital covering all stages of business cycle
  - Private investment, from established bioscience companies, is critical.
- Discretionary federal, state, and private R&D funding
- Skilled workforce and talent pool
- Specialized facilities and equipment
- Supportive business, tax and regulatory policies
- Patience and a long-term perspective
- Accelerators that focus on Biosciences

Appendix C includes a list of Virginia Bioscience funding opportunities from the VABIO organization. While this list is not complete, it is illustrative of the opportunities.

12. List of obstacles to cluster growth

The following are obstacles to the growth of the Bioscience Cluster in Hampton Roads:

- Lack of capital to support research and startup activities
• Sales/Inability to reach a broad customer base
• Lack of product
• Parochial, vice regional, strategies
• Failure of other supportive clusters – failure breeds failure, just as success breeds success

13. List of elements that make the cluster attractive
Focus on critical areas that are unrepresented in other Bioscience clusters, such as:

• Patient Safety issues
• Education and Training
• Diabetes
• Ophthalmology
• Food safety issues
• Biophotonics
• Bioinformatics, Biosensors
• Agriculture
• Medical Modeling & Simulation
• Marine Science

Appendix D includes a diagram depicting biotechnology as a broad field with major applications spread across a number of diverse sectors such as medical, industrial, marine, and agricultural and environmental biotechnology. There is ample opportunity in Hampton Roads to expand our efforts into these sectors, increasing the value and attractiveness of the Bioscience Cluster.

14. List of elements that make the cluster unique

• Proximity to the Atlantic/Chesapeake Bay
• Cluster includes one of four medical schools in the Commonwealth
• Home to one of the most highly respected healthcare organizations in the U.S. (Sentara)
• Strong history of regional academic collaboration
• History of NIH grant wins
• Natural ability to collaborate with other relevant Virginia academic, government, and industry organizations
• Academic R&D specialties (previously mentioned in section)

15. Recommended measures to gauge growth in this cluster
Metrics to measure impact and success of a bioscience cluster:

• Federal bio-related R&D funding to universities
• NIH R&D funding as the “gold standard”
• Specialization of industry and its concentration rates
• Private venture investments
• University-related start-ups
• Roadmap implementation progress
Appendix A

Bioscience innovation in Hampton Roads is accelerated by the synergistic collaborations and unique resources from over 20 bioscience-related companies providing diverse products and services, two acclaimed federal research laboratories and several research institutions including a growing medical school.

### Novel Therapy/Product Companies

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNNT</td>
<td>Company established to manufacture boron nitride nanotubes (BBNTs), BBNTs have applications in green energy, aerospace, high performance electronics, structural materials and biomedical industries.</td>
<td>Newport News</td>
</tr>
<tr>
<td>Skincare BioPharma</td>
<td>Skin care products made with multi-faceted plant-derived flavokines that provide safe and effective relief from the symptoms of viral and bacterial infections, as well as other conditions of the skin.</td>
<td>Virginia Beach</td>
</tr>
<tr>
<td>Eye RX</td>
<td>Eye RX is dedicated to developing and bringing to the commercial marketplace products that will aid vision and prevent blindness.</td>
<td>Norfolk</td>
</tr>
<tr>
<td>TechniSight Inc.</td>
<td>TechniSight is a growing life science company developing innovative therapeutics for eye diseases.</td>
<td>Norfolk</td>
</tr>
<tr>
<td>HST Global</td>
<td>Publically held biotechnology and wellness company, develops breakthroughs in supporting and treating metabolic disorders associated with cancer and other life threatening illnesses.</td>
<td>Hampton</td>
</tr>
<tr>
<td>LifeNet Health</td>
<td>Largest organ procurement and tissue banking organization with research and development focused on skin and wound allografts, cardiovascular services and regenerative medicine.</td>
<td>Virginia Beach</td>
</tr>
<tr>
<td>Light Bioscience, LLC</td>
<td>Engages in the research, development, and production of light-emitting diodes for medical and esthetic applications.</td>
<td>Virginia Beach</td>
</tr>
<tr>
<td>Provia Biologics</td>
<td>Obtains, processes and distributes biological samples (including human serum, protein extracts, DNA, and frozen, fixed, histologically processed tissue) for research.</td>
<td>Norfolk</td>
</tr>
<tr>
<td>TechniSight Inc.</td>
<td>TechniSight is a growing life science company developing innovative therapeutics for eye diseases</td>
<td>Norfolk</td>
</tr>
<tr>
<td>Soluble Systems, LLC</td>
<td>Manufactures and markets a line of advanced wound care products under the brand names of TheraSkin® and TheraGauze®.</td>
<td>Newport News</td>
</tr>
</tbody>
</table>

### Bio Imaging/Sensor Companies

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Microcontrols</td>
<td>Design and manufacture of temperature control and perfusion instruments for electrophysiology (microelectrode/patch clamping) and microscopy research, where precision and low noise are critical.</td>
<td>Norfolk</td>
</tr>
<tr>
<td>CIRS, Inc.</td>
<td>Computerized Imaging Reference Systems, Inc is recognized worldwide for tissue simulation technology and is the leader in the manufacture of phantoms and simulators for quantitative densitometry, calibration, quality control and research in the field of medical imaging and radiotherapy.</td>
<td>Norfolk</td>
</tr>
<tr>
<td>CW Optics</td>
<td>CW Optics is a technology company specializing in both hardware and software development of optical devices/systems. They are experienced in system design and development, simulation/modeling, and data management.</td>
<td>Seaford</td>
</tr>
<tr>
<td>Dilon Technologies</td>
<td>Dilon Diagnostics® delivers leading-edge molecular imaging products and services that provide advanced solutions for early and accurate cancer diagnostics.</td>
<td>Newport News</td>
</tr>
<tr>
<td>Measurement Specialties</td>
<td>Manufacturing of sensors including those for biomedical applications.</td>
<td>Hampton</td>
</tr>
<tr>
<td>Company</td>
<td>Website</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Morphix Technologies</td>
<td><a href="http://www.morphtec.com">http://www.morphtec.com</a></td>
<td>Develops products that detect hazardous chemicals and toxic products.</td>
</tr>
<tr>
<td>Beaufort, LLC</td>
<td><a href="http://www.beaufortcro.com">http://www.beaufortcro.com</a></td>
<td>Accelerates medical innovation and advances the quality of healthcare by building long-term, supportive relationships with businesses that seek high-quality, customized solutions to their regulatory, clinical research, quality management and related needs.</td>
</tr>
<tr>
<td>Insight Therapeutics</td>
<td><a href="http://www.insighttherapeutics.com">http://www.insighttherapeutics.com</a></td>
<td>Professional medical education, clinical research, and communications organization. Provides services for clients who provide products or services for the elderly. Clients include the pharmaceutical industry, academic institutions, professional organizations, health care facilities, and caregivers.</td>
</tr>
<tr>
<td>Incogen, Inc.</td>
<td><a href="http://www.incogen.com">http://www.incogen.com</a></td>
<td>Software and professional services for scientists involved in pharmaceutical, agricultural and biotechnology research.</td>
</tr>
<tr>
<td>Bionetics</td>
<td><a href="http://www.bionetics.com">www.bionetics.com</a></td>
<td>Diversified engineering and applied science company with a strong heritage of exceptional customer service to federal, state, local and commercial markets.</td>
</tr>
<tr>
<td>BioScience Consultants, LLC</td>
<td></td>
<td>Consultation for tissue and organ product development and biotechnology.</td>
</tr>
<tr>
<td>IS Biotech</td>
<td><a href="http://www.isbiotech.org/">www.isbiotech.org</a></td>
<td>International society for bioprocess technology.</td>
</tr>
<tr>
<td>Science and Technology Corp</td>
<td><a href="http://www.stcnet.com">www.stcnet.com</a></td>
<td>High technology, SBA certified company with many integrated talents and resources. Its capabilities include: Earth, space and atmospheric Sciences, remote sensing, aerospace engineering, chemical and biological lab operations and book/report and graphics publication.</td>
</tr>
</tbody>
</table>

### Major Academic and Federal Lab Biological Research Capabilities

<table>
<thead>
<tr>
<th>Institution</th>
<th>Website</th>
<th>Institution</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Virginia Medical School (EVMS)</td>
<td><a href="http://www.evms.edu">www.evms.edu</a></td>
<td>College of William and Mary (W&amp;M)</td>
<td><a href="http://www.wm.edu">www.wm.edu</a></td>
</tr>
<tr>
<td>Hampton University</td>
<td><a href="http://www.hamptonu.edu">www.hamptonu.edu</a></td>
<td>Virginia Institute of Marine Sciences (VIMS)</td>
<td><a href="http://www.vims.edu">www.vims.edu</a></td>
</tr>
<tr>
<td>Old Dominion University</td>
<td><a href="http://www.odu.edu">www.odu.edu</a></td>
<td>NASA Langley Research Center</td>
<td><a href="http://www.larc.nasa.gov">www.larc.nasa.gov</a></td>
</tr>
<tr>
<td>Norfolk State University (NSU)</td>
<td><a href="http://www.nsu.edu">www.nsu.edu</a></td>
<td>Thomas Jefferson National Accelerator Facility (laboratory)</td>
<td><a href="http://www.jlab.org">www.jlab.org</a></td>
</tr>
<tr>
<td><strong>Unique Research Centers and Resources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Applied Research Center</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.Jlab.org/ARC/">www.Jlab.org/ARC/</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State of the art research center with 27 laboratories. Houses a unique collaboration between Jefferson Lab and four VA universities: College of William and Mary, ODU, NSU and Christopher Newport University.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Eastern Virginia Eye Institute</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.EVEI.org">www.EVEI.org</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVEI is an academic ophthalmic specialty care and research center with a mission to eradicate blinding eye diseases through innovation research, education and patient care.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EVMS Translational Research Centers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.evms.edu">www.evms.edu</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and discovery in cancer and infectious diseases, diabetes and obesity, woman's and infant health and cardiovascular diseases.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hampton University Center for Advanced Medical Instrumentation (CAMI)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="science.hamptonu.edu/physics/cami/">science.hamptonu.edu/physics/cami/</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of imaging and treatment delivery/monitoring technologies. CAMI researchers receive support from both federal agencies and private sector companies.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hampton University Proton Therapy Institute</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.hamptonproton.org">www.hamptonproton.org</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer therapy and research institute applying protons as a precise, non-invasive external beam method for the selective destruction of cancer cells.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NASA Langley Research Center</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.nasa.gov/centers/langley/home/index.html">www.nasa.gov/centers/langley/home/index.html</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio-related core technologies available for potential applications in psycho-physiological response measurement, sensor and non-invasive instrument development and modeling of impacts and body stresses.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NSU McDemmond Center for Applied Research</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="https://www.nsu.edu/cset/csetgraduate/research-centers">https://www.nsu.edu/cset/csetgraduate/research-centers</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education and research center with a state of the art clean room for research on nanoparticle and materials for sensor and medical device development.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ODU Reidy Research Center for Bioelectrics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="www.odu.edu/engr/bioelectrics/">www.odu.edu/engr/bioelectrics/</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdisciplinary center studying biological and medical applications of very short pulsed power technology on processes ranging from wound healing, decontamination, cancer therapy, imaging and cardiovascular diseases.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Unique Research Centers and Resources (continued)

<table>
<thead>
<tr>
<th>Center</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thomas Jefferson Lab</strong>&lt;br&gt;National Accelerator Facility&lt;br&gt;Free Electron Laser&lt;br&gt;<a href="http://www.jlab.org/fel/">www.jlab.org/fel/</a></td>
<td>A KW class, high average power, sub-picosecond laser covering the mid-IR spectral region. Short pulses of electrons produce broadband Tera Hz light sources applicable to nanoscience and biological research.</td>
</tr>
<tr>
<td><strong>VIMS Sea Water Lab (BSL3)</strong>&lt;br&gt;<a href="http://www.vims.edu/about/facilities/seawaterlab/index.php">www.vims.edu/about/facilities/seawaterlab/index.php</a></td>
<td>Large enclosed wet labs with circulating seawater including toxics rooms and BSL3 facilities, designed for contractual use and industry collaborations.</td>
</tr>
</tbody>
</table>

### Technology Incubation / Commercialization Assets

<table>
<thead>
<tr>
<th>Center</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>College of William and Mary</strong>&lt;br&gt;Entrepreneurship Center&lt;br&gt;<a href="http://mason.wm.edu/entrepreneurship/index.php">http://mason.wm.edu/entrepreneurship/index.php</a></td>
<td>The Entrepreneurship Center, in collaboration with the Triangle Business and Innovation Center, provides entrepreneurship training and assistance under the U.S. Department of Labor's Workforce Innovation Fund.</td>
</tr>
<tr>
<td><strong>CoAST (Collaboration of Arts, Science and Technology)</strong></td>
<td>CoAST is an accelerator and creative space with a goal to develop technology companies including Biotech.</td>
</tr>
<tr>
<td><strong>Innovate! Hampton Roads</strong>&lt;br&gt;<a href="http://www.innovatehamptonroads.com">www.innovatehamptonroads.com</a></td>
<td>Innovate! Hampton Roads (IHR) provides resources for driving technology-based economic development and diversification of the regional economy.</td>
</tr>
<tr>
<td><strong>Innovation Research Park &amp; Business Gateway (ODU)</strong>&lt;br&gt;<a href="http://www.irpodu.com">www.irpodu.com</a></td>
<td>Help companies in any stage of development achieve a competitive advantage. The IRP currently consists of two 100,000 sq. ft. Class A/wet/dry lab buildings located within the 75-acre, mixed use University Village on the campus of Old Dominion University in Norfolk, Virginia.</td>
</tr>
<tr>
<td><strong>NASA Langley Technology Gateway</strong>&lt;br&gt;<a href="http://technologygateway.nasa.gov">technologygateway.nasa.gov</a></td>
<td>Provides different mechanisms for benefiting from NASA’s cutting-edge technologies such as: Space Act agreements, cooperative R&amp;D agreements (CRADAs), licenses (patents, copyrights), software usage agreements, small business contracts (SBIR/STTR), etc.</td>
</tr>
</tbody>
</table>
| Technology Hampton Roads & Technology Incubator System  
| www.hrtc.org |

This member-driven non-profit organization advocates an environment that fosters growth, education and communication within the region’s high-tech community. Its initiatives include: Providing educational programs, networking opportunities, and industry information to the region's high-tech companies and linking Hampton Roads' technology businesses with investors, legislators, educators, support organizations, and other critical resources.
## Appendix B

### Companies formed because of the presence of EVMS

Note: These companies were not formed *by* EVMS

<table>
<thead>
<tr>
<th>Name</th>
<th>EVMS faculty formed</th>
<th>License from EVMS</th>
<th>Formed with license</th>
<th>Location</th>
<th>In business in Jun-2014</th>
<th>2014 employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIRS</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Norfolk</td>
<td>yes</td>
<td>50</td>
</tr>
<tr>
<td>EyeRX</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>Norfolk</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Trinity Biomedical</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>Norfolk</td>
<td>no</td>
<td>0</td>
</tr>
<tr>
<td>Pulsar (Formed with ODU/USC faculty)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>California</td>
<td>no</td>
<td>0</td>
</tr>
<tr>
<td>GMP Endotherapeutics</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>Florida</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Exulin</td>
<td>no</td>
<td>Sub from GMP Endo</td>
<td>yes</td>
<td>Minnesota</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>RTM (Research to Market)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Norfolk</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>(Formed for inventions not pursued by EVMS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellutions</td>
<td>no</td>
<td>yes joint with ODU</td>
<td>yes</td>
<td>Georgia</td>
<td>no</td>
<td>0</td>
</tr>
<tr>
<td>DAPF (Driver Assessment Plus Franchise)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>Oklahoma</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Luksamed</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Virginia Beach</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Eair Biologics</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Norfolk</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Surgical Magnetics</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>Missouri</td>
<td>no</td>
<td>0</td>
</tr>
<tr>
<td>Provia Diagnostics</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Norfolk</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Andioceutics International</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>Norfolk</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>TechniSight</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>Chesapeake</td>
<td>yes</td>
<td>1</td>
</tr>
<tr>
<td>Theliopulse</td>
<td>no</td>
<td>yes joint with ODU</td>
<td>yes</td>
<td>California</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Nanoblate</td>
<td>no</td>
<td>yes joint with ODU</td>
<td>yes</td>
<td>California</td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Optimzm Marketing</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>Virginia Beach</td>
<td>yes</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix C

From:  http://www.vabio.org/?page=11, downloaded on 30 June 2014

Bioscience Incentives

Incentives for Bioscience Research, Commercialization and Investment in the Commonwealth

The Commonwealth of Virginia currently offers tax incentives; grants and investment programs incentivize and support emerging life science technologies and companies. In recent years Virginia Bio has worked with allies in informing and supporting public policy makers in the conception, passage and implementation of these laws.

Tax Programs

Refundable Research & Development Tax Credit

The Refundable Research & Development Refundable Tax Credit provides a credit against income tax owed up to 15% credit of first $167,000 of qualified research (20% of first $175,000 if the research was done with a Virginia University). If the Company is not profitable or otherwise owes no tax in a year, the credit is refundable in cash. The maximum credit to any one company is $35,000. There is a $5 million cap of available credits per year from 2011-2016.

1. Form RDC: Application for the Refundable R&D Tax Credit. Due April 1st.
2. Virginia Department of Taxation Information Page (VA Refundable R&D Credit)
3. Link to original legislation (SB 1326, 2011)

View a brief video explanation produced by the Virginia Society of Certified Public Accountants.

100% Capital Gains Tax Exclusion for Investors and Founders

Capital Gains Tax Exclusion provides 100% capital gains tax exclusion for founders of and investors in high technology (including life sciences) start-up companies primarily engaged in business and with principal office in Virginia. (This may be used instead of the Angel Investor Tax Credit). The Company must have had less than $3M revenue in the fiscal year prior to the investment. The exemption has been extended to June 30, 2015.

1. Virginia Secretary of Technology Information Page (Capital Gains Exclusion)
2. Link to certification form from the Secretary of Technology (Application)
3. Link to original legislation (SB 428, 2010)
4. Qualifying for the Capital Gains Exclusion: (1) When filing your taxes, fill out the appropriate tax form. The following tax forms & schedules include this exemption: Form 500 ADJ, Form 502 ADJ, Form 760 Schedule ADJ, Schedule 760PY ADJ, and Schedule 763 ADJ. OR (2) Have the business in which you are investing apply through the Secretary of Technology’s office for certification that the company is an approved technology company. And then submit the appropriate tax form.
The Virginia Angel Investor Tax Credit (Virginia Qualified Equity & Subordinated Debt Credit)

The Angel Investor Tax Credit (Virginia Qualified Equity and Subordinated Debt Credit) provides tax credit for individuals or corporations making an investment in a Virginia business in biotechnology, medical device or other similar technology, to commercialize technology developed at or in partnership with a Virginia institution of higher learning equal to 50% of qualified investment, up to $50,000. There is a $5 million cap in available credits each year.

1. Virginia Department of Taxation Information Page (VA Angel Investor Credit).
2. Link to Qualified Business Application form (Form QBA) Due December 31.
3. Link to Investor Application form (form EDC) Due April 1.
4. Link to original legislation (SB 1338, 2009)

R&D Sales Tax Exemption

The R&D Sales Tax Exemption provides 100% exemption from state sales tax on purchase of R&D supplies and equipment, and bio manufacturing production equipment.

Grant Programs

Small Business Innovation Research Matching Funds

The SBIR (Small Business Innovation Research) Matching Funds Program of CRCF (Commonwealth Research & Commercialization Fund) awards grants of up to $50,000 to Virginia-based technology companies that have won a Phase 1 SBIR Award from the National Institutes of Health (NIH). $3 million in Fiscal Years 2013 and 2014 designated for SBIR awards and for matching federal Small Business Technology Transfer (STTR) awards.

Commonwealth Research and Commercialization Fund

The Commonwealth Research Commercialization Fund (CRCF) awards grants and loans to advance targeted research and commercialization in Virginia. $9.6 million of new funding was added for Fiscal Years 2013 and 2014.

The three main subprograms are:
- Research Matching: Awards to collaborative research partners seeking outside grants but cannot identify a suitable match
- Facilities Enhancement: Awards to qualifying public or private higher education institutions and political subdivisions in Virginia to help finance facilities used for qualified research or technology commercialization
- Commercialization: Awards to encourage the commercialization of products and services in Virginia

Virginia Bioscience Health Research Corporation Grants

The Virginia Bioscience Health Research Corporation awards grants based on the following:
• Grants to collaborations involving at least two Virginia research universities and one industry partner in the bioscience field in order to accelerate translational research and commercialization.
• Grants require proportionately matched industry partner funding scaled for size of enterprise
• Letters of intent, applications and awards on ongoing basis; awards in range $200,000-$800,000.

**Investment Programs**

**Seed Stage Investment (CIT GAP Fund)**

*CIT GAP Funds* is a family of seed- and early-stage investment funds placing near-equity and equity investments in Virginia-based technology, life science, and clean-tech companies. There is $4.6 million of new funding for Fiscal Years 2013 and 2014.

*CIT Biolife Fund*
Appendix D

The below diagram was recreated from “Growing a Bioscience Industry Cluster,” Battelle Technology Partnership Practice, March 24, 2011, downloaded 30 June 2014 from http://www.nga.org/files/live/sites/NGA/files/pdf/1103JOBCREATIONHOROWITZ.PDF
Bioscience Cluster Review Team Recommendations

Final Recommendations

The Bioscience Cluster Study Group provided formatted feedback on 7 July 2014. During the September 24th meeting of the Industry Cluster Study Group, the group requested more detail to our recommendations.

Section A, below, was extracted from the draft final report relative to the Bioscience Cluster. The detailed recommendations are included in Section B.

Section A: Original Content

What is needed to grow the cluster?:

In order to successfully grow a Bioscience Cluster, we have to ensure that we promote a comprehensive Bioscience Ecosystem. As ecosystem, in this context, is a community of people, businesses, technologies, infrastructure, customers, and creators that coexist harmoniously to produce a vibrant economy. They interact as a system that ultimately provides value both within and external to the ecosystem core. In Hampton Roads, we need the following to foster growth of our Bioscience Cluster:

- Engaged universities with active leadership
- Entrepreneurial cultures with intensive networking across sectors and with industry
- Available capital covering all stages of business cycle
- Private investment, from established bioscience companies, is critical.
- Discretionary federal, state, and private R&D funding
- Skilled workforce and talent pool
- Specialized facilities and equipment
- Supportive business, tax and regulatory policies
- Patience and a long-term perspective
- Accelerators that focus on Biosciences

Section B: Detailed Recommendations

In this section, we propose several connecting recommendations that are focused on how we might jumpstart a Bioscience Cluster with a modicum of dedicated funding.

If we had $350,000+ a year, available for three to five years, how should we spend the funds?

1. Select one or two biotech areas for primary focus; these should be areas where we have a foothold or regional skills sets, such as
   a. Diabetes
   b. Human Modeling
   c. Other potential focal points:
      i. Cardiovascular disease
      ii. Medical modeling, simulation, and analysis
iii. Training & Education
iv. Systems Engineering
v. Data Analytics
vi. Population Health
vii. Bioelectrics
viii. Proteomics
ix. Cancer treatment/proton therapy

2. For each biotech area, decide on a Big Problem that we will solve.
   a. The Big Problem must have international appeal.
   b. The Big Problem must be unique or complementary to other national efforts.

3. Develop a regional approach to solving each Big Problem.

4. Create and fund a Regional Team to:
   a. Accomplish tasks 1-3, above.
   b. Actively engage all relevant state/federal grants with a heterogeneous regional team.
   c. Actively engage a Nationally Recognized Leader as a partner.
   d. Actively recruit established private companies to the region.
   e. Actively recruit relevant world-class researchers to the region.
   f. Develop strategic partnerships between regional companies/universities and Commonwealth/national private companies, Universities, and organizations.
   g. Include and leverage all regional business development and entrepreneurial activities.
   h. Actively pursue private funding from:
      i. Established bioscience and bioscience-related companies such as:
         Johnson & Johnson, Proctor & Gamble, Merck, Gilead Sciences, Amgen,
         Walmart, CVS, Biogen Idec, Actelion, Glysens, Novo Nordisk, Sanofi,
         MannKind, Briston-Myers Squibb, and AstraZeneca.
      ii. Venture Capitalist funds.
      iii. Philanthropic foundations.

5. Establish/fund a regional accelerator, and/or provide additional support to an existing accelerator, to provide resources to promising biotechnology startups.
   a. External funding/partnerships should be encouraged/actively pursued (related to 4.f.i above)
   b. Accelerator can be managed by the Regional Team with heavy Board oversight.

6. Expand our public affairs and outreach activities:
   a. Develop a cogent story representing the region’s approach to solving The Big Problem(s).
   b. Provide focused outreach to state and federal representatives and key leadership.
c. Publish our achievements, in newspapers/magazines as well as medical and trade journals.

d. Attend every relevant medical conference (clinical as well as economic development personnel should attend).

e. Actively pursue relevant speaking opportunities for our regional experts.
**Cluster Review Team Reports**

**Industry Cluster Study Group / Coastal Energy Cluster Review**

1. **Overall Outcome**
   
   The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. **Initiative Context and Expected Results**
   
   The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

3. **Coastal Energy Industry Cluster**
   
   **Cluster Team Lead:** Charles de Cuir (VA Offshore Wind Coalition)
   
   **Team members:**
   - Molly Plautz (Dominion)
   - Cathie France (Port of Virginia)
   - Bill Crow (VSRA)
   - Jeff Hammond (EnE)
   - Karen Jackson (VA Secretary of Technology)
   - Scott Chierepko (Oceaneering)
   - Jeff Keever (Keever Consulting LLC)
   
   **Proposed start date:** 04/15/14
   
   **Proposed end date:** 05/30/14

4. **Cluster Team Work Plan and Interdependencies**
   
   **Objective and Outcomes**
   
   Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.

   **List of key players and organizations within the cluster identified** (see Exhibit A of full report)
   1. Port Facilities (public & private)
   2. Engineering, Installation, Operations & Maintenance (18 identified)
   3. Transportation & Logistics (Norfolk Southern, CSX & Bay Coast Railroad)
   4. Vessels & Inner Harbor Tug/Barge Companies (13 identified)
   5. Supply Distribution/properties which can support development of an offshore wind supply chain (7 sites identified)
   6. Manufacturing, Shipbuilding & Ship Repair (16 firms listed)
   7. Virginia Coastal Energy Research Consortium (eight universities, government and industry partners)
   8. Key Associations/Organizations (VOWC, Offshore Wind Development Authority, VSRA, & VMA)
   9. Workforce (highly trained individuals transitioning from the military, community colleges, apprentice schools, technical schools, higher education centers & temporary staffing entities)
   10. Legal, Finance, Consulting & Insurance Services (16 firms listed)

   **Current depth of the cluster scale of the industry described.**
   Hampton Roads has the necessary components and infrastructure in place to be the supply chain ecosystem, similar to those in place and operated by the European Off-Shore Wind industry:
   1. Heavy-duty port infrastructure, terminal coordination
   2. Factory supplies
   3. Land and sea transport
   4. Engineering
   5. Education
6. Research & development  
7. Technology  
8. Tourism  
9. Virginia supply chain companies statewide

### Growth opportunities identified
1. Dominion Virginia Power’s (DOM) acquisition of the lease to develop the offshore wind turbine farm  
2. DOE funds to DOM to construct 12-megawatt demonstration project  
3. Coordinated vision for OSW industry by VOW and VOWDA

### Connections between new clusters and existing pillars identified and described
1. Building upon Virginia’s maritime industry and existing global supply chain  
2. Eco-tourism growth that comes with off-shore wind turbines  
3. Individuals transitioning out of the military will provide a trained, skilled workforce

### Boundary spanning clusters identified and described
1. Aerospace – UAVs used to map, for security, surveillance, operations and maintenance in the air and underwater  
2. Bio-science – critical to benthic communities, sea life, and tie into geology and geophysics  
3. Modeling & Simulation, Robotics and Sensors – can offer solutions in advance of large capital outlays  
4. Port (terminal operations) and Manufacturing support the supply chain

### Salary and wages produced by the cluster identified
1. Salaries and wages will be driven by revenue, but comparisons with Europeans suggest project revenues, jobs and expected growth.

### Expected degree of sustainability described
1. This new industry will benefit the economy well into the future with ongoing operations, maintenance, and the exploration of future and offshore energy  
2. Sustainability was well grounded in Europe. What began as a hope for sustainable clean energy has become a dynamic multigenerational economic force

### Competitive advantages identified and described (see Exhibit B of full report)
1. Water depth at the quayside and the connection to sea 5-10m (at low water)  
2. Dedicated berth >300m  
3. Operation area at quayside available for assembling/handling  
4. Own heavy lift crane and ground equipment  
5. Port operations with offshore focus  
6. Available management and staff with energy experience  
7. Unrestricted Air Draft to all major commercial port facilities

### Target customers and competitors identified
1. Customers – Refer to Inquiry #2 for this list  
2. Competitors – fellow states that have an interest in coastal and off-shore energy

### Projected growth potential from a global, national and regional perspective
1. Globally – foreign investment and growth that will support the supply chain  
2. Nationally – support system for offshore energy in the Atlantic  
3. Regionally – focus on a growth industry. While government cutbacks impact the shipbuilding industry in our region, the below water line steel for 100 turbine foundations is equal to the steel in one aircraft carrier

### List of what is needed to grow the cluster
1. Leverage state funding with private and federal funding to give Virginia a competitive advantage in attracting the coastal energy industry  
2. Support the successful completion of the advanced technology demonstration project and work with state and federal agencies to ensure advancement of the project in the competition for the follow-on funding from the DOE  
3. Support and expedite the federal process for development of the commercial energy area off the...
4. Extend the federal tax incentives for a finite period of time, as well as a federal policy mandating renewable energy use

**List of obstacles to cluster growth**

1. Instability of the federal tax incentive resulting in no guarantee the industry can rely upon for the investment necessary for these projects
2. A trained workforce will be critical to attracting the supply chain and the specific vessels to support these projects.
3. Lack of strategic risk planning
4. Regional marketing
5. Long-term stable market and regulatory framework
6. Available funding

**List of elements that make the cluster attractive**

1. Economic development
2. Economic diversification
3. Job creation
4. Increased tax base
5. Increased clean energy to the grid

**List of elements that make the cluster unique**

1. Virginia is well-positioned to become the wind energy capital of the East Coast
2. New, long term, sustainable industry that will grow the state and regional economy

**Recommended measures to gauge growth in this cluster**

1. Number of jobs
2. Number of projects
3. Training of the workforce
4. Import volume of materials and supplies
5. Number of vessels that operate out of Virginia
6. Number of towers erected
7. Volume of power generated
8. Growth in manufacturing and other facilities in the supply chain
The Industry Cluster Study Group's working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, the Study Group will develop a set of recommendations and next steps based on the findings.

June 2014
Coastal Energy Group

1. List of key players and organizations within the cluster identified.
2. Current depth of the cluster/scale of the industry described.
3. Growth opportunities identified.
4. Connections between new clusters and existing pillars identified and described.
5. Boundary spanning clusters identified and described.
6. Salary and wages produced by the cluster identified.
7. Expected degree of sustainability described.
8. Competitive advantages identified and described.
9. Target customers and competitors identified.
10. Projected growth potential from a global, national and regional perspective.
11. List of what is needed to grow the cluster.
12. List of obstacles to cluster growth.
13. List of elements that make the cluster attractive.
14. List of elements that make the cluster unique.
15. Recommended measures to gauge growth in this cluster.
1. List of key players and organizations within the cluster identified.

SEE EXHIBIT A

2. Current depth of the cluster/scale of the industry Described.

Hampton Roads already has the significant assets, socio-economic base, work force, academia, technology, and infrastructure in place to be the “Supply Chain Eco-System”.

For example, other supply chain hubs have had to build, develop, and evolve the following:

- Heavy-duty port infrastructure, terminal co-ordination.
- Factory Supplies
- Land and Sea Transport
- Engineering
- Education
- Research and Development
- Technology
- Tourism

Hampton Roads has these items as a very mature and well-grounded organization. These items are also the items put forward by the European OSW industry as the necessary components to have in place to advance the supply chain discussions.

It is important to note that this is not Hampton Roads specific. The Virginia Economic Development Partnership (VEDP) did a research study in 2010 specific to Virginia supply chain companies that would support the OSW industry. Since this report, this number has not gone down.
Virginia Supply Chain Companies (VEDP)

Industrial Controls - 14 Establishments/1,387 Employees
Motors and Generators - 16 Establishments/1,805 Employees
Turbines-Transformers - 25 Establishments/1,995 Employees
Marine Construction - 40 Establishments/475 Employees
Shipbuilding & Repair - 40 Establishments/31,250 Employees
Fabricated Structural Metal - 77 Establishments/2,160 Employees

Total Establishments: 212
Total Employment: 39,072
3. Growth opportunities identified.

The concept of Coastal and Offshore Energy is not only a significant economic driver for Virginia, the timing of the discussion is very appropriate. This appropriateness is driven by the recent developments in Offshore Wind (OSW).

On September 4, 2013 Dominion Virginia Power (DOM) bid $1.6 million to acquire the lease for 112,800 acres to develop an offshore wind turbine farm capable of generating 2,000 megawatts of electricity, enough to power 500,000 homes. The Bureau of Ocean Energy Management (BOEM) conducted the auction. DOM will proceed with the BOEM timetable for development of the commercial wind energy area while advancing its research proposals in parallel and looking for ways to lower the coast of bringing offshore wind generation to customers.

On May 7, 2014 DOM has been awarded an additional $47 million from the United States Department of Energy (DOE) to help fund the construction of a 12-megawatt demonstration project, consisting of two 6-megawatt offshore wind turbines on innovative substructures that will produce enough electricity to power up to 3,000 homes.

The Virginia Offshore Wind Coalition (VOW) and the Virginia Offshore Wind Development Authority (VOWDA) have been pivotal in crafting and coordinating the vision of this new industry.

Founded in 2009, VOW is made up of developers, manufacturers, utilities, localities, and businesses that have an interest in seeing the offshore wind industry develop in Virginia. The VOW members are active on both the development and supply chain aspects of offshore wind projects.

VOWDA was created by 2010 legislation --Title 67, Chapter 12, Code of Virginia. The mission of the Authority is to facilitate, coordinate, and support development of the offshore wind energy industry, offshore wind energy projects, and supply chain vendors.

As we see, the largest movement is in the OSW industry, this industry will lay the ground work for other coastal and offshore energy possibilities.

There are two predominant processes in play:

1. The development of scientific research, engineering, construction, installation, operations and maintenance and the life cycle aspects of the Virginia Offshore Wind Area. Specifically the installation of the turbines offshore.
2. The supply chain and its associated economic value and development.

While the two are intertwined when one considers the Virginia Offshore Wind Area, it is important to consider that in the event that the Virginia site and project is delayed, disrupted, or cancelled, the supply chain discussion continues to have great value.
The Coastal and Offshore Energy Supply Chain Hub for the Atlantic Coast

Both VOW and VOWDA are very supportive of the DOM project, and as you have seen both entities are strongly supportive of the supply chain hub concept. There have been significant discussions with VA regulatory bodies and delegates regarding the supply chain hub concept. In addition VOW has engaged European manufacturers, service suppliers, financiers, insurers, scientific research, and applied science groups through a VOW European Trade Mission in November 2013. The concept being, “What can you do to help us in skewing the learning curves in the industry?” The response was significant and valuable.

The catch phase of the supply chain discussion has been “Hampton Roads can become the Houston of the coastal and offshore energy industry.” This has been well received as an overview model. However there are large considerations that neither Houston, nor the supply chain hub of OSW in Europe, Bremerhaven, Germany had in its origination. Hampton Roads in fact has these foundation items in place.

An important aspect of this discussion is that whoever ends up being the supply chain hub for Atlantic coastal and offshore energy will have it forever. There will not be an RFP in five years for new proposals.

England knows this scenario all too well. While currently boasting the most offshore wind projects, they simply relied on Northern Europe for the supply. Now, Bremerhaven has cemented its position as the supply chain hub, and England can only play a roll. If you miss the opportunity, it’s gone for good.

One overlooked area of growth that has been recognized in Europe is eco-tourism. In the case of offshore wind, there is no shortage of tourist and locals that in coordination with other maritime tourist activities will pay additional tourism fees to be taken offshore to view the turbines.

4. Connections between new clusters and existing pillars identified and described.

The various industry clusters are very much interwoven due to the deep history of the Virginia maritime industry and the global supply chain driven by our Port. The “new clusters” will be evolutions of existing clusters and cultures. For example, as European manufactures will play a large initial role in all aspects of offshore wind energy, they will have the need to set up corresponding offices and operations in Virginia. This has already occurred with French Turbine manufacturer Alstom in Richmond.

Foreign manufacturers and service providers will engage local business for “on site” sales, management, maintenance and warranty work. This will necessarily evolve into our own companies becoming the primary manufacturing and servicing base as the industry matures. This will create an “Evolution Revolution”.

5. Boundary spanning clusters identified and described.

The joy of the Hampton Roads business community is “Boundary Spanning”. While there are “tensions” between the municipal communities, the business community regularly operates as one. Regarding Coastal Energy it is interesting that the various “clusters” all play roles in the future of coastal and offshore energy.

The Aerospace community has two great dynamics to offer. The UAVs (unmanned aerial vehicles) have a strong role in mapping, security, surveillance, operations and maintenance and
this technology translates to the undersea world and RUVs (remote underwater vehicles) as they will play a tremendous role in the significant underwater world of this industry.

The Bioscience community is critical to the benthic communities, sea life, and tie into geology and geophysics.

The Modeling & Simulation, Robotics, Sensors, and Education communities are key to any new industry or technology. The driving modeling and on site communication devices for coastal and waterborne activity can offer solutions to issues in advance of large capital outlays that could be deemed as “rolling the dice” without such communities.

The Terminal Operations, Manufacturing, Marine Construction, and Offshore Operations communities are critical and valuable asset that support the supply chain and offer real life models to the balance of the clusters.

6. Salary and wages produced by the cluster identified.

Salary and wages will be naturally driven by revenue. One of the key takeaways from our discussions with European partners was their project revenues, jobs, and expected growth. For example, an 800 Mega Watt offshore project was in excess of a €3.0 Billion investment. As comparison, the Virginia offshore wind area is expected to be a 1,200 Mega Watt project.

The current economic impact for the supply chain and operations in the German projects is 14,000 employees and €6.0 Billion in sales. This is expected to increase to 33,000 jobs and €17.9 Billion by 2018 and €22.4 Billion by 2021.

When one considers not only the offshore wind industry but all future offshore and coastal energy, these numbers are just a base.

With current cutbacks in military and government spending, coastal and offshore energy will be the future growth industry for the area.

Once again, an “Evolution Revolution”.

7. Expected degree of sustainability described.

We have an opportunity in Virginia that will allow the creation of an entire new industry that not only will benefit our economy with these new wind farms offshore, but well into the future with the ongoing operations and maintenance and the exploration of future coastal and offshore energy. This has proven to be successful in Europe and with our workforce, geographic location, and maritime infrastructure Virginia is well suited to become the Coastal and Offshore energy capital of the East Coast.

The sustainability is well grounded and founded in Europe. What began as a hope for sustainable clean energy has become a dynamic multigenerational economic force.

As technology increases, so will the benefits of these energy sources.

“Pandora’s Box is open.”
8. Competitive advantages identified and described.

SEE EXHIBIT B

9. Target customers and competitors identified

This item as it pertains to Hampton Roads and Virginia is an interesting one. From a supply chain hub, the competitors are our fellow states that have interest in coastal and offshore energy. Once again, this is where we need to get out in front of the curve. The various other states claim to have the capabilities and wherewithal to be the supply chain hub for the industry. We know that is not the case. In every example they would have to build significant facilities and infrastructure to be in the realm of being able to simply participate. However they have thrown large dollars at “marketing”. As such they have gotten the attention of global manufacturers and governments. The Virginia Offshore Wind Coalition (VOW) has been in the front of the curve and hosted a European Trade Mission in November of 2013. VOW was able to get the attention of the major manufacturers, suppliers, financial, insurance, and government groups. While the presentations were very successful, they were not all encompassing and were based on many fragmented older presentations from various factions. Virginia needs to have a consolidated report which will create the strong foundation for a regional marketing document for which there will be no peer. Who are the competitors? Let’s start with us.

As far as customers, they are all of the groups listed in Inquiry No. 2

- Heavy-duty port infrastructure, terminal co-ordination.
- Factory Supplies
- Land and Sea Transport
- Engineering
- Education
- Research and Development
- Technology
- Tourism

The key is a dedicated group who has the resources and expertise to coordinate a consolidated effort to bring these groups, whether companies, governments, or academia together for the goal of supply chain hub dominance and thus economic growth through a new industry.

10. Projected growth potential from a global, national and regional perspective.

There have been several “relative” discussions regarding construction and supply chain. Regarding construction and regional growth a conservative relative comparison is that the below water line steel for 100 turbine foundations is equal to the steel in one aircraft carrier. From a regional perspective the concepts and realities of government cutbacks makes this new industry a future growth industry in the area, maintain and advancing jobs, the tax base, and infrastructure growth. As the VOWTAP project is now reality, this kicks off the construction cycle of the offshore wind farms.

The supply chain discussion is not only a regional win, but also a national support system for offshore energy in the Atlantic. This combined with European technologies in place and the necessity that they
will have to “set up shop” in the supply chain hub area demands global attention and future foreign investment and growth.

11. What is needed to grow the cluster?

Leverage state funding with additional private and federal funding to position Virginia with a competitive advantage in attracting the coastal energy industry. Support successful completion of the advanced technology demonstration project and work with state and federal agencies to ensure advancement of the project in the competition for follow-on funding from the U.S. Department of Energy. Support and expedite the federal process for development of the commercial energy area off of the coast of Virginia and ensure compatibility with other ocean uses and avian and marine species and habitat. Additionally, the federal tax incentives need to be extended and sustained for a finite period of time, as well as a federal policy mandating renewable energy use.

12. List of obstacles to cluster growth.

Federal Tax Incentives - The federal tax incentive is unstable and not a guarantee the industry can rely upon for the investment necessary for these projects. Lack of mandates requiring renewables is an impediment moving forward as is the cost of the projects and the energy produced compared to the existing cost of power in Virginia.

Workforce - A trained workforce, attracting the supply chain and the specific vessels to support these projects are critical components to growing this opportunity for Virginia.

Lack of strategic risk planning – Another “lesson learned” from the European community is that of risk planning. Early projects managed contractual risk transfer, asset protection insurance, and financing on a “one-off” basis. This created very difficult and complicated situations as the projects advanced. The number one lesson learned from the governments and business development groups was advanced coordination and planning of all risk and contractual aspects.

Regional Marketing - We know we have the assets and the talent. We also silo ourselves against one another. No one can compete with Hampton Roads except the Hampton Roads communities. We need to market the area as one – a consolidated undeniable front without peer.

Long-term stable market and regulatory framework - A major challenge increasingly facing the offshore wind industry is regulatory risks, which can refer to un-clear or conflicting political support for offshore wind, uncertainty with grid connection, or lack of a long-term stable market and regulatory framework.

Funding is available - Power producers have so far been the main investors in offshore wind using their balance sheets. As the scale of investment grows, new entrants are becoming active in different aspects of project development. Engineering, procurement, construction, and installation companies (EPCI), wind turbine manufacturers, oil and gas companies, and corporate investors are already investing in offshore wind according to their specific strengths and capabilities. Infrastructure funds and institutional investors have already made progress in taking construction risk and enhancing the financing landscape for offshore wind.
13. List of elements that make the cluster attractive.

This has been highlighted throughout this document and will summarize: economic development, diversification of Virginia’s economy, job creation, increased tax base, and increased clean energy to the grid. Development of the offshore wind industry in the U.S. has great potential to create a large manufacturing sector that can add billions of dollars to the U.S. economy and employ tens of thousands of highly-skilled, local workers. Using simple, elegant, and proven mechanical technology, offshore wind is a leader in low-risk, large-scale energy production. With wind as the fuel, offshore wind farms produce no pollution as their blades turn with the breeze.

14. List of elements that make the cluster unique.

More than 40,000 megawatts of offshore wind energy capacity have been permitted around the globe, yet the United States accounts for barely 1 percent of that, and we have yet to generate our first watt of electricity from this abundant, carbon-free source of power. The longer we wait to begin developing this technology and creating the infrastructure and knowledge base that go along with it, the further we will fall behind the rest of the world, and the harder it will be to bring the economic development and environmental benefits to our own shores.

We have an opportunity in Virginia that will allow the creation of an entire new industry that not only will benefit our economy with these new wind farms offshore, but well into the future with the ongoing operations and maintenance of these wind farms. This has proven to be successful in Europe and with our workforce, geographic location and maritime infrastructure Virginia is well suited to become the wind energy capital of the East Coast.

15. Recommended measures to gauge growth in this cluster.

The growth of this industry would be measured in multiple ways: number of jobs, involvement in number of projects, training of the workforce, volume of the import of material and supplies for these projects, number of vessels that operate out of Virginia, number of towers erected and volume of power generated.

Success will be measured by significant long term growth in manufacturing and other facilities in Virginia at the top tier of the supply chain – turbines, foundations, cables and substations – as well as in the deeper supply chain and in installation, operations, and maintenance, and other services.

RECOMMENDATIONS FOR THE COASTAL ENERGY GROUP

Few locations in the United States have the qualities to attract an entire new industry, like Virginia, to locate in their backyard. The Coastal Energy opportunity along the eastern seaboard provides Virginia with a unique ability to bring new industry, jobs and increase the tax
base, all to expand our economy in Virginia and Hampton Roads. There are three critical components that must be addressed: Team Virginia, the Supply Chain, and Port Readiness.

**Recommendation - Team Virginia**

Team Virginia is a loosely formed concept of being able to provide the services necessary to construct, implement and support for the Virginia Off-shore Wind development lease block, as well as the Off-shore industry along much of the east coast. With the significant number of existing businesses available to participate in this concept, there is not a single coordinating organization to bring this concept to fruition, therefore this report recommends engaging a project specific firm to coordinate this Team Virginia concept to implementation with the VOWTAP project. The timing is from the current date through VOWTAP completion of late 2017. Without such coordination and management, Virginia businesses will likely be unable to fully participate in the construction and support of the VOWTAP project.

**Recommendation - Supply Chain**

The Supply Chain opportunity for Virginia is critical to expanding and diversifying the economy, creating new jobs and expanding the tax base. However, this will not arrive nor thrive without a coordinated effort to ensure this develops in Hampton Roads and this report recommends engaging a firm to coordinate the development and help establish the Supply Chain Hub in Hampton Roads. The report timing could be two fold. One, an overview of coordination that would be a 4-6 month project, and two, a project that spans the timing of the test turbine project (VOWTAP), completion in last 2017. It could be considered to take step one, and then reconvene for step two. This report further recommends engaging a project specific firm to coordinate this recommendation. Without a consolidated approach to attracting the Supply Chain Hub, such activity will likely be scattered in areas along the east coast without a single or central hub to coordinate the major Coastal Energy projects in the Atlantic.

**Recommendation - Port Readiness Survey**

While much in this report addresses the many assets available in Virginia, there are certainly some deficiencies that must be identified within the port complex. In additional there is no singular repository of coordinated information. Thus, various sources and resources are scattered in many formats and locations. The lack of a composite study makes the comprehensive discussion of the assets difficult and confusing. If Virginia seeks to become the Supply Chain Hub for Coastal Energy, there must be a current and comprehensive study of the existing facilities, their capabilities and any deficiencies or shortfalls that may inhibit the attraction of these new business opportunities. Another positive use for such a report is as a very valuable regional marketing document, therefore this report recommends engaging a project specific firm to coordinate this comprehensive Port Readiness Survey. Such study should take between 4-6 months. Without such a survey, the efforts to attract the Supply Chain Hub to Virginia may well create unintended obstacles to these economic development goals.

END
EXHIBIT A

List of key players and organizations within the cluster identified.
Coastal Energy Group

PORT FACILITIES

The Port of Virginia  http://www.portofvirginia.com/

VPA Terminals

Portsmouth Marine Terminal
Newport News Marine Terminal
Norfolk International Terminals
APM Terminals
Craney Island Marine Terminal

Cape Charles Harbor  http://www.capecharles.org/

Private Terminals

Elizabeth River Terminals (ERT)

Lambert's Point Docks (LPD)
http://www.nscrp.com/content/nscrp/en/get-to-know-norfolk-southern/about-nscrp/subsidiaries/lamberts-point-docks-inc.html

CenterPoint Intermodal Center
http://www.centerpoint-prop.com/

Ford Plant Redevelopment
http://www.katoennatie.com/locations/north-america/united-states/norfolk/
ENGINEERING, INSTALLATION AND O&M

Businesses that are already focused on the offshore energy market include:

- Crofton Industries http://www.croftondiving.com/
- Ecology and Environment, Inc. www.ene.com
- Erickson Air-Crane Incorporated www.ericksonaircrane.com
- ESS Group, Inc. www.essgroup.com
- Fugro www.fugro.com
- Global Marine Energy http://www.globalmarine-energy.com/
ENGINEERING, INSTALLATION AND O&M

ITA International, LLC ITA
http://www.ita-intl.com/about.html

Mclean Contracting
www.mcleancont.com

Moffatt & Nichol http://moffatt nichol.com/

McNeilan & Associates, LLC
converting challenges to opportunities

Real New Energy
http://www.realnewenergy.com/index.htm

Science Applications International Corporation.
www.saic.com

Tetra Tech EC, Inc. www.tetratech.com
Tidewater Inc.  http://www.tdw.com/

Timmons Group  www.timmons.com

Weeks Marine, Inc.  www.weeksmarine.com

W. F. Magann Corporation  www.wfmagann.com

Oceaneering  http://www.oceaneering.com/
TRANSPORTATION AND LOGISTICS

Transportation Infrastructure


**CSX Connections** - The below image displays the major CSX Intermodal routes from Hampton Roads to the Midwest and the Great Lakes region. For CSX services please visit [www.csxi.com](http://www.csxi.com) for an origin/destination search.

Bay Coast Railroad (BCR) [http://www.varail.com/baycoast.htm](http://www.varail.com/baycoast.htm)
VESSELS

- MAERSK LINE, LIMITED  http://www.maersklinelimited.com/
  Extensive Tug and Barge Capacity

- McAllister Towing  www.mcallistertowing.com

- McDonough Marine Service  www.mcdonoughmarine.com

- Moran Towing Corporation,  www.morantug.com

- Weeks Marine, Inc.  www.weeksmarine.com
Inner Harbor Tug and Barge Companies

T. Parker Host, Inc.  www.tparkerhost.com

C & P Tug & Barge Co.  www.cptugandbarge.com

Columbia Coastal Transport  www.columbia-coastal.com

Global Rigging and Transport, LLC  www.globalrigging.com

Hampton Roads Leasing, Inc.  www.w3marine.com

Lockwood Brothers, Inc.  www.lockwoodbros.com

The Norfolk Barge Company  www.colonnaship.com

The Norfolk Tug Company  www.norfolktug.com
SUPPLY DISTRIBUTION

Located in the middle of the Eastern Seaboard, halfway between New York City and Miami, and within a day's drive of 75% of the US population, Virginia is an ideal location for the warehousing and distribution of goods.

Development Properties
Hampton Roads has many areas which can support the development of an offshore wind supply chain. These areas could serve as industrial fabrication points for turbine and foundation components. These properties have access to waterways, from which, components could be loaded directly onto a barge and shipped either to port for storage or to sea for construction.

CSX Terminal Site (Newport News)
Ford Assembly Plant (Norfolk)
IMTT, Swan Oil and IMTT (2)
Oakland Industrial Park (Newport News)
Plant Building Located on Oakland Industrial
BASF Site (James City)
Peck Marine Deep Water Terminal
MANUFACTURING

Auxiliary Systems www.auxsysinc.com

BAE Systems Norfolk http://www.baesystems.com

Carraro Group www.carraro.com

Cobham Composites www.cobham.com

Bryan Tool & Machining www.bryantool.com

Composites One www.compositesone.com

International Marine and Industrial Applicators www.imiallc.com

Northrop Grumman Newport News
www.northropgrumman.com/shipbuilding/index.html

Skanska/Bayshore Concrete
www.usa.skanska.com

Steel America, www.steelamerica.net
World Class Shipbuilding and Ship Repair

The maritime industry in Hampton Roads has one of the greatest shipbuilding and repair capacities in the United States. The traditional role of Navy shipbuilding and repair can effectively be converted to support an offshore waterborne infrastructure. The need for high capacity offshore support ships such as jack up rigs or other installation vessels can be constructed, modified or repaired within several of the yards in the Hampton Roads area. In addition, maritime design capabilities in the local industry can solve any technical question that arises. A July 2008 report by NOAA found trends in regional marine industries that indicated Virginia had the largest variety and overall capacity for shipbuilding and repair on the East Coast.

BAE Systems Norfolk  [www.baesystems.com](http://www.baesystems.com)

Colonna’s Shipyards  [www.colonnaship.com](http://www.colonnaship.com)


Lyon Shipyards, Inc.  [www.lyonshipyard.com](http://www.lyonshipyard.com)


Technico/MHI Ship Repair & Services  [www.mhi-shiprepair.com](http://www.mhi-shiprepair.com)
DEEP KNOWLEDGE BASE

Virginia Coastal Energy Research Consortium (VCERC) was formed in 2007 by the Virginia Legislature and chartered by Governor Tim Kaine with the mission to deliver algal biodiesel and offshore wind power to the state of Virginia. The VCERC concept was first discussed in early 2006 with the General Assembly and began to gain instant support. The consortium was incorporated in Senate Bill 262 in March and began receiving state funding the following fiscal year, in July, 2007. It is governed by a board which consists of fourteen members - with representatives from each of the eight partner universities and six government and industry partners - and is headquartered at Old Dominion University in Norfolk (http://www.vcerc.org/)

Hampton University  www.hamptonu.edu

James Madison University  www.jmu.edu

Norfolk State University  www.nsu.edu

Old Dominion University  www.odu.edu

University of Virginia. www.virginia.edu

Virginia Commonwealth University  www.vcu.edu

Virginia Institute of Marine Science  www.vims.edu

Virginia Tech Advanced Research Institute  www.ari.vt.edu

KNOWLEDGE BASE
The Center for Coastal Physical Oceanography  www.ccpo.odu.edu

The Commonwealth Center for Advanced Manufacturing (CCAM)  http://www.ccam-va.com/

NASA Langley Research Center  http://www.nasa.gov/centers/langley/home/index.html

The Ship Maintenance, Repair and Operations Institute  www.eng.odu.edu/smro/

KEY ASSOCIATIONS/ORGANIZATIONS

Virginia Offshore Wind Coalition  http://www.vowcoalition.org/

Virginia Offshore Wind Development Authority  http://wind.jmu.edu/offshore/vowda/

The Virginia Ship Repair Association (VSRA)  http://www.virginiashiprepair.org/

The Virginia Maritime Association (VMA)  http://www.vamaritime.com/
WORKFORCE DEVELOPMENT

The Hampton Roads region is the home to the largest industrial military complex in the U.S. This provides the area with a talented, trained workforce that is frequently seeking new careers after military service. This workforce includes experienced maritime managers, engineers with technical and shipboard experience, and individuals with experience functioning as part of a cohesive team at sea. Such military, industrial, and educational infrastructure provides Hampton Roads with extensive training potential for new industries.

Labor Statistics from April 2014
Civilian Labor Force: 841,300
Unemployed: 47,400
Unemployment Rate: 5.7%
(Bureau of Labor Statistics)

Hampton Roads Military Background

Hampton Roads is home to just about every facet the American Military has to offer. The naval station and facilities are home to four aircraft carriers, hundreds of cruisers, destroyers, submarines and other support war vessels, and tens of thousands of enlisted troops and civilian employees. Therefore skilled labor due to the training ability of the Armed Forces has given Virginia a ripened skill force that is capable of molding into whatever role is required of them.

Each year approximately 13,000 trained and disciplined personnel exit the military. Capacity exists for retraining this workforce utilizing local technical schools, community colleges, and four year universities; such as ECPI, Norfolk State University, Tidewater Community College, Old Dominion University, and Hampton University. Many of these persons prefer to stay in the area and are available for private sector employment.

COMMUNITY COLLEGES

Tidewater Community College www.theknowledgebase.org/tidewater/csdet.php
Advanced Technology Center www.vbatc.co
Advanced Technology Institute (Va Beach) www.auto.edu
Devry University www.devry.edu
ECPI College of Technology www.ecpi.edu
Everest College www.everst.edu
Higher Education Center www.odu.edu/ao/vbhec
TEMPORARY STAFFING

Trade Team www.tradeteamusa.com

Ameri-Force http://www.ameriforce.com/

Tidewater Staffing, Inc. www.tidewaterstaffing.com

Welco Staffing www.welcostaffing.com

Other Workforce Development

TMG www.trainingmodernizationgroup.com

LEGAL, FINANCE, CONSULTING & INSURANCE SERVICES

KAUFMAN & CANOLES  Kaufman & Canoles http://www.kaufmanandcanoles.com/

Kaufman & Canoles Consulting http://www.kaufcanconsulting.com/

Keever Consulting, LLC - Origin

Origin

Cherry Bekheart  www.cbh.com

Wall, Einhorn & Chernitzer, P.C.  http://www.wec- CPA.com/

PBMares  http://www.pbmares.com/

Vandeventer Black LLP  www.vanblk.com

Troutman Sanders LLP  www.troutmansanders.com

Willcox Savage  www.willcoxsavage.com

Williams Mullen  www.williamsmullen.com

Rutherfoord, a Marsh & McLennan Agency LLC Company (MMA)  http://www.rutherfoord.com/

London & Norfolk Ltd.  www.london-norfolk ltd.com

MDP Marine Insurance, LLC  www.mdpins.com


Willis  www.willis.com

END
EXHIBIT B

Competitive advantages identified and described
PREMIER PORT FACILITIES ON THE EAST COAST

Hampton Roads Attributes

Water depth at the quayside and the connection to sea 5-10m
(at low water)

AVAILABLE

In case of locks, dimensions (width between fenders) 25–40m

AVAILABLE

Dedicated berth >300m

AVAILABLE

Operation area at quayside available for assembling/handling.

AVAILABLE

Own heavy lift crane and ground equipment

AVAILABLE

Port operations with offshore focus

AVAILABLE

Available Management and staff with energy experience

AVAILABLE

Unrestricted Air Draft to all major Commercial Port Facilities – No Bridges to pass under

AVAILABLE
Hampton Roads Harbor

The Chesapeake Bay is the largest, natural, ice-free estuary in North America. At 50’ deep, the Hampton Roads harbor can easily handle the largest container vessels afloat. This waterway also has the approval to be dredged to 55’ to handle the next generation of vessels. Hampton Roads boasts the deepest water on the U.S. East Coast, a huge competitive advantage as the size and depth requirements for vessels continue to increase.

Location- A Major Advantage

Hampton Roads is located in the mid-Atlantic region, where 70% of the U.S.’ offshore shallow water wind resources lie. These resources are easily accessible by the ports in Hampton Roads, which could export large components such as foundations, towers and turbines up and down the entire East Coast.

Connectivity:

Rail

Eleven railroads operate on over 3,600 miles of railway in Virginia, of which over 3,100 miles are Class I. The port has access to both the Norfolk Southern and CSX rail networks for both domestic and international shipments. One of the nation’s largest railroads, Norfolk Southern, is headquartered in Norfolk, Virginia.

Highway Systems

Interstate 64 is a major highway running from Hampton Roads to St. Louis, connecting junctions including I-55/I-70; I-57 in MT Vernon IL; I-65/I-71 in Louisville, KY; I-77 in Charleston, WV; I-87 in Lexington, VA and I-95 in Richmond, VA. To the east, the Chesapeake Bay Bridge Tunnel saves 90 miles to the NY/NJ corridor and provides direct access to coastal highway traffic. Improved intermodal access initiatives are underway including a four-lane interstate highway spur with overpass and tow ramps to serve NIT and the Naval Station from I-564. For more information please see the Hampton Roads Metropolitan Planning Organization (MPO) study, available at www.hrpdc.org.

Airports

Airports in the region serve 4.3 million passengers and 70 million pounds of cargo annually. Over 200 daily flights go through Norfolk International Airport (ORF) and Newport News/Williamsburg International Airport (PHF).
Norfolk International Airport
Is southeastern Virginia’s dominant airport serving the Greater Hampton Roads area and northeastern North Carolina. The airport is served by American, Delta, Southwest, United Express and US Airways offering 22 non-stop destinations and nearly 180 arrivals and departures daily to major cities throughout the United States. Norfolk International presently ranks 67th in the country in terms of passengers served annually. http://www.norfolkairport.com/?gclid=CN6Kpc2Op74CFcg7OgodHVIAUA

Newport News/Williamsburg International Airport
Is served by Delta Air Lines, US Airways and Frontier Airlines serving eight non-stop cities and providing connections worldwide. In February 2012, plans were announced to headquarter a new airline called PEOPLExpress at the airport, with operations planned to begin in 2013. The airport is also home to three fixed base operators, Rick Aviation, Atlantic Aviation and Orion Air Group. It recently completed a $23 million facility upgrade to include a second concourse designed for a full-service customs facility able to accommodate larger-size international jets. http://www.flyphf.com/content/

Distribution Centers in Virginia
Hampton Roads plays a vital role in supporting and facilitating the growth of distribution opportunities in Virginia and beyond. The map below is a selection of distribution centers using the Port of Virginia.
Connectivity:

Global Reach

Hampton Roads currently has weekly shipline services from all trade lanes throughout the world. The port’s shipline service breakdown is balanced, unlike many other east coast ports, providing greater flexibility for sourcing and distribution throughout the world.

By the Numbers

• 80+ foreign ports linked with direct service
• 200+ nations reached
Cluster Review Team Reports

Industry Cluster Study Group / Cyber Security Cluster Review

1. Overall Outcome
The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. Initiative Context and Expected Results
The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

3. Cyber Security Industry Cluster

<table>
<thead>
<tr>
<th>Cluster Team Lead:</th>
<th>Joe Bouchard (Cox Communications)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Denys Diaz (Monarch Bank)</td>
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<tr>
<td></td>
<td>David Harnage (ODU)</td>
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<tr>
<td></td>
<td>Rob Hegedus (Sera-Brynn)</td>
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<tr>
<td></td>
<td>Michael Klett (Klett Consulting Group, Inc.)</td>
</tr>
<tr>
<td></td>
<td>Dave Launderbaugh (Booz,Allen Hamilton)</td>
</tr>
<tr>
<td></td>
<td>Ned Lilly (xTule)</td>
</tr>
<tr>
<td></td>
<td>Shawn O'Rourke (Pro Concepts)</td>
</tr>
<tr>
<td></td>
<td>Scott Philpott (Valkyrie)</td>
</tr>
<tr>
<td></td>
<td>Mick Vollmer (TowneBank)</td>
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<tr>
<td></td>
<td>Peter Zendzian (ZZ Servers)</td>
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<table>
<thead>
<tr>
<th>Team members:</th>
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<tbody>
<tr>
<td>Governor Terry McAuliffe</td>
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<tr>
<td>Karen Jackson (Secretary of Technology, VA)</td>
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<tr>
<td>Senator Mark Warner</td>
</tr>
<tr>
<td>Development Offices)</td>
</tr>
<tr>
<td>Senator Tim Kaine</td>
</tr>
<tr>
<td>Congressman Scott Rigell</td>
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<tr>
<td>David Harnage (ODU)</td>
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<tr>
<td>Jim Shaeffer (ODU) (HRMFFA)</td>
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<tr>
<td>Craig Quigley (HRMFFA)</td>
</tr>
<tr>
<td>Bryan Stephens (HRCC)</td>
</tr>
</tbody>
</table>

| Proposed start date: | 05/15/14 |
| Proposed end date:   | 07/15/14 |

4. Cluster Team Work Plan and Interdependencies

Objective and Outcomes
Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.
The following items are addressed in detail in the attached document titled “Cybersecurity Industry Cluster White Paper.”

List of key players and organizations within the cluster identified

<table>
<thead>
<tr>
<th>Individuals</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governor Terry McAuliffe</td>
<td>Hampton Roads Community Foundation</td>
</tr>
<tr>
<td>Karen Jackson (Secretary of Technology, VA)</td>
<td>Hampton Roads Cities and Counties (Economic)</td>
</tr>
<tr>
<td>Senator Mark Warner</td>
<td>Navy Cyber Command</td>
</tr>
<tr>
<td>Development Offices)</td>
<td>Old Dominion University (Continuing Education)</td>
</tr>
<tr>
<td>Senator Tim Kaine</td>
<td>TowneBank</td>
</tr>
<tr>
<td>Congressman Scott Rigell</td>
<td>National Institute for Science &amp; Technology (NIST)</td>
</tr>
<tr>
<td>Mark Klett (Klett Consulting Group)</td>
<td>DHS Office of Cybersecurity and Communications</td>
</tr>
<tr>
<td>Rob Hegedus (Sera-Brynn)</td>
<td>National Initiative for Cybersecurity Careers &amp; Studies</td>
</tr>
<tr>
<td>Mick Vollmer (TowneBank)</td>
<td>Hampton Roads Military and Federal Facilities Alliance</td>
</tr>
<tr>
<td>David Harnage (ODU)</td>
<td>Hampton Roads Chamber of Commerce (HRCC)</td>
</tr>
<tr>
<td>Jim Shaeffer (ODU) (HRMFFA)</td>
<td></td>
</tr>
<tr>
<td>Craig Quigley (HRMFFA)</td>
<td></td>
</tr>
<tr>
<td>Bryan Stephens (HRCC)</td>
<td></td>
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</tbody>
</table>

Current depth of the cluster/scale of the industry described
1. The Federal Government spends roughly $5B on cybersecurity in which a significant percentage takes place in Hampton Roads
2. Virginia has the highest population of per capita information security professionals, per the Bureau of Labor and Statistics
3. Cyber industry more than doubles other IT sectors in growth rate

<table>
<thead>
<tr>
<th>Growth opportunities identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In 2014 worldwide information security market growth will accelerate to 8.6% and exceed $73B (Gartner Analysts)</td>
</tr>
<tr>
<td>2. There were 230 newly funded start-ups within the information security market in 2013, compared to a five-vendor, $3.5B market ten years ago.</td>
</tr>
<tr>
<td>3. As the threat continues to accelerate in capability and scale, effective solutions are needed. Targets include laptops, electronic business transaction systems with PCI data, storage devices with intellectual property, smart phones, gaming systems and other mobile devices, placing virtually all at risk.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connections between new clusters and existing pillars identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Defense and Federal Marketplace – the greatest connection in the region is the military. Despite federal budget cuts, cybersecurity spending will rise</td>
</tr>
<tr>
<td>2. Shipping, Port &amp; Maritime – The marketplace is becoming more global with the influence of the internet. Hampton Roads is positioned to be the epicenter of the global economy by connecting the port and maritime industry with cybersecurity companies</td>
</tr>
<tr>
<td>3. Public and Commercial Infrastructure – All transactions and data storage with internet connectivity has vulnerabilities to compromise and loss of service.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundary spanning clusters identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Federal spending increases in Cybersecurity indicates that there will be even more highly trained cybersecurity specialists in Hampton Roads</td>
</tr>
<tr>
<td>2. Transitioning military cyber experts will be seeking jobs in a commercial work space in which they can utilize their unparalleled experience – commercial entities will value this</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Salary and wages produced by the cluster identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Information Security Analyst labor category is one of the most lucrative positions in the country – 78,020 employees/mean hourly wage of $43.85/mean annual wage of $91,210 (BLS, 2013)</td>
</tr>
<tr>
<td>2. As mentioned above Virginia has the highest employment level in this occupation as well as the highest concentration of jobs and location quotients in this occupation (BLS, 2013)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected degree of sustainability described</th>
</tr>
</thead>
<tbody>
<tr>
<td>According to Burning Glass Technologies, a technology placement company:</td>
</tr>
<tr>
<td>1. The market for cybersecurity jobs is large and growing – 74% growth in job postings from 2007-2013</td>
</tr>
<tr>
<td>2. Demand for cybersecurity talent is outstripping supply -- cybersecurity job postings took 24% longer to fill than all IT postings and 36% longer than all job postings</td>
</tr>
<tr>
<td>3. On average, cybersecurity salaries offer a premium of over $15,000 over the salaries for IT jobs overall</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Competitive advantages identified and described</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Because of our geographic relationship with the Government and military, the trained workforce is here and the region should utilize the skills of those transitioning out of the military to keep them here in private sector jobs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target customers and competitors identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cybersecurity and Information Security Tech companies (Start-ups, Growing companies and Venture Capitalists) – with the expected growth in the industry more start-ups could occur in the region with the number doubling in the next three to five years. Incentivize those start-ups to choose Hampton Roads with the ready workforce and Tier II companies (see next point)</td>
</tr>
<tr>
<td>2. Small, medium and large businesses (not cyber centric) also need to address the growing threat of cyber-attacks. Currently the provision and expertise needed is limited and expensive so top line support may not be realistic for some businesses. A Cyber Consortium (partnership between municipalities and business development organizations pooling resources to offer services as preventative measures to reduce risk and demonstrate cost avoidance with significant cost savings).</td>
</tr>
</tbody>
</table>
This will encourage any small business with online structure or acceptance of credit cards to choose the region as their home. This kind of incentive would be unique – and attract new innovative businesses to the region.

Projected growth potential from a global, national and regional perspective
1. Technology translates to all continents and Hampton Roads can serve as headquarters for businesses who operate anywhere in the world.
2. In the last decade, the Cyber industry has grown from $3.5B to $73B with the expectation to grow faster in the coming years.

List of what is needed to grow the cluster
Participation is the critical success factor. Buy-in and participation is needed from the following organizations:
1. Local governments – participation and funding. All municipalities should become fully Cyber aware and identify best practices within government operations, schools, and the enforcement of cybercrime.
2. Economic development organizations – incentive packages need to be marketed and offered to attract start-up money grants/venture capitalists and growing businesses.
3. Local businesses – be part of a consortium that can completely cover all aspects of the NIST Cybersecurity Framework. Also funding from financial institutions can be leveraged to establish this team through strategic partnerships of start-ups.
4. Educational institutions – partner with ODU’s new College of Continuing Education to initiate a program to transition military to the commercial work space with the training and certifications needed to evidence credibility (such as the CISSP).
5. Department of Defense – continue to encourage federal dollars in the area of cybersecurity, working with HRMFFA to pursue cyber-based projects such as Cyber Command, and establish Langley AFB as the choice for the Air Force cyber reserves unit expansion.
6. Technical Training Standards – Implement a process to anticipate Jobs that will be created in the Cyber Industry in Hampton Roads. The training requirements need to be established by both industry and educators at the Universities, Community Colleges and High Schools to ensure that curriculums are adjusted to meet current and projected industry needs. This should also carry over into the transition programs with the federal, state and military personnel to ensure the best opportunities are provided for seeking to work in the cyber industry.

List of obstacles to cluster growth
The primary obstacle is timing. The industry is growing quickly.

List of elements that make the cluster attractive
1. The leveraging of existing pillars to create another economic support (reduces dependency on the federal government and sustains the trained workforce transitioning out of the military).
2. A balanced workforce of credentialed, experienced and highly educated professionals is here, and the growth potential in the industry is unrivaled.
3. The industry has a defined framework (National Cybersecurity Workforce Framework) for educating, credentialing and expanding the workforce. Military/civilian/commercial/academia all follow the same framework. Experience/education translates to all other industries.

List of elements that make the cluster unique
1. Hampton Roads needs to market an unmatched incentive – a consortium of cyber experts partnering with municipalities to offer the tools/resources/solutions that will cultivate business growth.
2. Cybersecurity will become a necessity for start-ups just like bankers, lawyers, and accountants. Hampton Roads can be the first community to offer resource to growing businesses.

Recommended measures to gauge growth in this cluster
1. Increasing Number of jobs - 74% growth in job postings from 2007-2013
2. Annual Industry Value: Commercial - $73B; Defense - $5B and growing despite sequestration.
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   3.3 Growth opportunities identified ....................................................................................... 2
   3.4 Connections between new clusters and existing pillars identified and described ............ 2
   3.5 Boundary spanning clusters identified and described ..................................................... 3
   3.6 Salary and wages produced by the cluster identified ...................................................... 3
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   3.9 Target customers and competitors identified ................................................................. 5
   3.10 Projected growth potential from a global, national and regional perspective .................. 6
   3.11 List of what is needed to grow the cluster ..................................................................... 6
   3.12 List of obstacles to cluster growth ................................................................................... 7
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   3.15 Recommended measures to gauge growth in this cluster .............................................. 7

4. Conclusion ............................................................................................................................ 8
Introduction

Whether you realize it or not, cybersecurity is impacting you at this very moment. When you go online, use your mobile device or tablet, or use a cloud-based service, you interact with various tools designed to protect your personal information. Variations of these tools are also used to protect our nation’s infrastructure. It is critical for everyone to understand cybersecurity and your role in being safe while staying connected.

The National Initiative for Cybersecurity Careers and Studies (NICCS) defines cybersecurity as: “The activity or process, ability or capability, or state whereby information and communications systems and the information contained therein are protected from and/or defended against damage, unauthorized use or modification, or exploitation.”

Cybersecurity focuses on protecting computers, mobile devices, tablets, networks, programs and data from unauthorized access or manipulation. Understanding cybersecurity is the first step to protecting your organization. Governments, military, corporations, financial institutions, hospitals and other businesses collect, analyze, store and share a great deal of confidential information across computer networks. With an increase in cyber-attacks, ongoing vigilance is necessary to protect personal information, as well as safeguard national infrastructure.

In the past, cyber-attacks have been focused on government and large businesses. Recently, more and more small and medium sized businesses have become vulnerable. As large businesses have become increasingly more cyber savvy, cyber criminals have shifted to smaller sized targets. In the world of online, real time commerce, nearly every commercial business accepts and processes confidential information. Most of these attacks can be avoided or mitigated through taking proper cybersecurity precautions. The problem is that most small and medium sized business can’t afford this support – and the hackers know it.

Our vision is to establish Hampton Roads as a recognized region of Cybersecurity excellence. The Hampton Roads Community Foundation, in partnership with local industry, government and academia, will create a Hampton Roads Cybersecurity consortium modeled after the National Institute of Science and Technology Cybersecurity Framework. A marketable consortium will be established utilizing both, commercial and government resources in order to offer small, medium and large businesses access to premium cybersecurity tools/training/analysis at a free or reduced cost. In return, the small, medium or large business would incorporate in Hampton Roads establishing the first cyber friendly business community in the country. A self-sustaining business model will allow for continual cybersecurity solutions to grow and flourish, whereby Hampton Roads is recognized as the leader in Cybersecurity.
NIST Cybersecurity Framework

The following information came from National Initiative for Cybersecurity Careers & Studies website http://niccs.us-cert.gov/training/tc/framework:

The National Cybersecurity Workforce Framework classifies the typical duties and skill requirements of cybersecurity workers. The Framework is meant to define professional requirements in cybersecurity, much as other professions, such as medicine and law, have done. The Framework organizes cybersecurity into seven high-level Categories, each comprised of several Specialty Areas.

What is the Workforce Framework?

The Workforce Framework is a national resource that categorizes, organizes, and describes cybersecurity work. The National Initiative for Cybersecurity Education (NICE) developed the Workforce Framework to provide educators, students, employers, employees, training providers and policy makers with a systematic way to for organizing the way we think and talk about cybersecurity work, and what is required of the cybersecurity workforce. When degrees, jobs, training and certifications are aligned to the Workforce Framework:

- Colleges and Training Vendors can create programs that are aligned to jobs,
- Students will graduate with knowledge and skills that employers need,
- Employers will recruit from a larger pool of more qualified candidates,
- Employees will have more defined career paths and opportunities, and
- Policy makers can set standards to evolve the field

Why was it developed?

Workers with cybersecurity skills are critical to protecting the digital infrastructures on which much of modern society is built. Industries as diverse as retail, healthcare, manufacturing, and energy all depend on the security and reliability of cyberspace. With the nation facing new and dynamic risks, threats, and vulnerabilities, a highly skilled cybersecurity workforce capable of responding to these challenges is needed now more than ever. The cybersecurity profession is maturing and growing and cybersecurity roles are becoming more distinct and defined. In the past, employers had to develop customized position descriptions to fill existing capability gaps. Some large employers followed a standard, but different employers followed different standards. This resulted in a disorganized job market.

- Colleges couldn't create programs that were aligned to jobs
- Employers had to often retrain new hires in the specific skills required
- Students didn't have clear job prospects and career opportunities
- Policy makers couldn't effectively develop programs to promote job growth
To effectively coordinate the cybersecurity job market, Colleges, Educators, Employers, Employees and Training Vendors need a standardized way to describe the work encompassed by the term “cybersecurity.” The Workforce Framework is an organized, comprehensive description of the work done by cybersecurity professionals. It is the foundation for increasing the size and capability of the US cybersecurity workforce.

**How was it developed?**

The National Cybersecurity Workforce Framework effort began in 2010. More than 20 Federal Departments and Agencies contributed to the process. The result was the development of the initial Workforce Framework in 2011.

In 2013, NICE refreshed the Workforce Framework to reflect the evolving cybersecurity field and changes in technology. The updates reflect input from across government, private industry, and academia.

The National Initiative for Cybersecurity Education (NICE) developed the National Cybersecurity Workforce Framework to categorize and define cybersecurity work. NICE is led by the Department of Homeland Security (DHS). NICE raises public awareness, enhances the recruitment, training, and retention of cybersecurity professionals, and promotes cybersecurity education. NICE’s three components and their goals are:

- **Enhance Awareness** - Raise awareness and improve the nation's ability to be safer and more secure online
- **Expand the Pipeline** - Increase the quality and quantity of the cybersecurity workforce by determining the merits of professionalization
- **Evolve the Field** - Develop and maintain and unrivaled and globally competitive national cybersecurity workforce by establishing standards and strategies for cybersecurity training and professional development

The Cybersecurity Industry Cluster will be utilizing the National Cybersecurity Workforce Framework as a backbone. Over the course of the next 6 months, the industry cluster will identify local businesses and experts that can address each and every element of the framework, so that we can ensure that we offer the total package of cybersecurity excellence. This Framework is a very rare instance in which government and industry have agreed to use it as guidance.
Below is our interpretation of the framework in which we will be utilizing as a blueprint for the effort.

Objectives and Outcomes

In addition to the vision outlined above, the Cybersecurity Industry Cluster will address each individual evaluation criteria below:

List of key players and organizations within the cluster identified

**Individuals**

Mark Klett, (Klett Consulting Group)  
Rob Hegedus, (Sera-Brynn)  
Mick Vollmer (TowneBank)  
David Harnage (ODU)  
Jim Shaeffer (ODU)  
Craig Quiqley (HRMFFA)  
Bryan K. Stephens (HRCC)  
Congressman Scott Rigell  
Senator Tim Kaine  
Senator Mark Warner  
Governor Terry McAuliffe

**Organizations**

Hampton Roads Community Foundation  
Hampton Roads Cities/Economic Development  
Navy Cyber Command  
Old Dominion University –Continuing Ed TowneBank  
National Institute for Science & Technology  
DHS Office of Cybersecurity and Communications  
National Initiative for Cybersecurity Careers & Studies  
Hampton Roads Military and Federal Facilities Alliance
Current depth of the cluster/scale of the industry described

The Federal Government spends roughly $5B on cybersecurity in which a significant percentage takes place in Hampton Roads. The largest population of per capita information security professionals is located in Virginia. The cyber industry more than doubles any other IT sector in growth rate. Even with all of these factors for success, Hampton Roads has not even scratched the surface of embracing Cybersecurity as an economic pillar. The opportunity for Hampton Roads is significant and can be the new industry the area desperately needs.

Growth opportunities identified

According to Gartner analysts, in 2014 worldwide information security market growth will accelerate to 8.6% and exceed $73 billion. Additionally, just ten years ago, the $3.5 billion information security market was dominated by just five vendors compared to 230 newly funded startups in 2013 alone!

The threat continues to accelerate in capability and scale. Cybercrime is big business and has finally reached the tipping point where consumers and regulators are demanding that businesses deploy effective solutions. We now have laptops, smart phones, wearable computers, gaming systems, other mobile devices... the list is boundless. Many of these devices are either themselves untrustworthy or are interacting with untrustworthy mobile networks. Few have the computing horsepower to perform traditional security functions of familiar desktops and laptops making them even easier targets. Every one of us is affected and now we finally realize it. Retail-related breaches, such as the recent Target breach, have hit tens of millions of consumers. Cyber security stories are now common in all mass media outlets.

Connections between new clusters and existing pillars identified and described

Defense and Federal Marketplace
The greatest connection to the Hampton Roads area is obviously the military. Despite federal budget cuts, cybersecurity spending will be going up at the Departments of Defense and Homeland Security in the fiscal year 2015 budget requests. Cybersecurity will get a $400 million boost at DoD, rising to $5.1 billion in FY15. The department refers to cybersecurity funding as “cyberspace operations.” It includes funding for defensive and offensive operations at Cyber Command (CYBERCOM) in Norfolk and other installations.

Shipping/Port
The marketplace is becoming more and more a global marketplace with the influence of the internet. Hampton Roads can serve as the headquarters for businesses who operate anywhere in the world. Technology translates all continents. Establishing Hampton Roads a
center for Cybersecurity companies, along with the Shipping Port, makes Hampton Roads at the epicenter of the global economy.

**Boundary spanning clusters identified and described**

Federal spending increases in Cybersecurity also indicates that there will be even more highly trained cybersecurity specialists in Hampton Roads. Transitioning Military cyber experts will be seeking jobs in the commercial space in which they can utilize their unparalleled experience. Start-ups will value this.

**Salary and wages produced by the cluster identified**

Per the Bureau of Labor and Statistics, the “Information Security Analyst” labor category is one of the most lucrative positions in the country.

Employment estimate and mean wage estimates for this occupation:

<table>
<thead>
<tr>
<th>Employment (1)</th>
<th>Employment RSE (3)</th>
<th>Mean hourly wage</th>
<th>Mean annual wage (2)</th>
<th>Wage RSE (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>78,020</td>
<td>2.7 %</td>
<td>$43.85</td>
<td>$91,210</td>
<td>0.6 %</td>
</tr>
</tbody>
</table>

States with the highest employment level in this occupation:

<table>
<thead>
<tr>
<th>State</th>
<th>Employment (1)</th>
<th>Employment per thousand jobs</th>
<th>Location quotient (9)</th>
<th>Hourly mean wage</th>
<th>Annual mean wage (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia</td>
<td>10,330</td>
<td>2.85</td>
<td>4.84</td>
<td>$51.13</td>
<td>$106,350</td>
</tr>
<tr>
<td>California</td>
<td>8,260</td>
<td>0.56</td>
<td>0.95</td>
<td>$49.26</td>
<td>$102,450</td>
</tr>
<tr>
<td>Texas</td>
<td>6,550</td>
<td>0.60</td>
<td>1.02</td>
<td>$42.35</td>
<td>$88,060</td>
</tr>
<tr>
<td>New York</td>
<td>5,040</td>
<td>0.58</td>
<td>0.99</td>
<td>$54.90</td>
<td>$114,190</td>
</tr>
<tr>
<td>Florida</td>
<td>3,990</td>
<td>0.46</td>
<td>0.77</td>
<td>$39.15</td>
<td>$81,440</td>
</tr>
</tbody>
</table>

States with the highest concentration of jobs and location quotients in this occupation:

<table>
<thead>
<tr>
<th>State</th>
<th>Employment (1)</th>
<th>Employment per thousand jobs</th>
<th>Location quotient (9)</th>
<th>Hourly mean wage</th>
<th>Annual mean wage (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia</td>
<td>10,330</td>
<td>2.85</td>
<td>4.84</td>
<td>$51.13</td>
<td>$106,350</td>
</tr>
<tr>
<td>Maryland</td>
<td>3,170</td>
<td>1.25</td>
<td>2.12</td>
<td>$47.84</td>
<td>$99,520</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>800</td>
<td>1.20</td>
<td>2.03</td>
<td>$47.88</td>
<td>$99,580</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1,300</td>
<td>1.13</td>
<td>1.91</td>
<td>$27.73</td>
<td>$57,670</td>
</tr>
<tr>
<td>Alabama</td>
<td>1,820</td>
<td>0.99</td>
<td>1.68</td>
<td>$37.89</td>
<td>$78,810</td>
</tr>
</tbody>
</table>
Expected degree of sustainability described

Burning Glass Technologies, a tech job placement company stated that the demand for cybersecurity jobs is large and growing, with demand outstripping supply. See the supporting facts below:

The Market for Cybersecurity Jobs is Large and Growing

- In 2013, there were 209,749 postings for cybersecurity-related jobs nationally. **Cybersecurity jobs account for nearly 10% of all IT jobs.**

- Cybersecurity postings have **grown 74%** from 2007-2013. This growth rate is over 2x faster than all IT jobs.
Competitive advantages identified and described

Hampton Roads has a huge competitive advantage to leverage the cybersecurity and information security industry growth. The largest and most obvious advantage is our already existing workforce. Virginia already has the highest percentage of trained information security personnel in the country! Because of our geographic relationship with the Government and military, the trained workforce is already here! In fact most of the trained workers transitioning out of the military eventually leave Hampton Roads because there are no jobs that utilize their skills in this region –this is a travesty. Cybersecurity job postings have increased 74% from 2007 – 2013 and represents nearly 10% of all IT jobs. This growth rate is two times faster than any other IT job! With a mean salary being as high as $92,000!

Target customers and competitors identified

The target customers would be two tiered:

I. Cybersecurity and Information Security Tech company start-ups
With the expected growth in the industry, more and more start-ups are arriving every year. In the next 3-5 years the amount of cyber based companies could double. We want to incentivize those companies to choose Hampton Roads because of our unrivaled workforce and because the draw of the Tier II companies addressed below.

II. Small, medium and large business startups (not cyber centric)

With the ever growing threat of cyber-attacks, businesses large and small are seeking assistance. Because that support and expertise is so limited and expensive most business can’t even dream about the top of the line support. The Cyber Consortium by partnering with municipalities and business development organizations, can pool resources to offer these services at free or reduced costs. This would encourage any small business with any sort of an online structure or acceptance of credit cards, or storage of confidential or sensitive material to choose Hampton Roads as their home.

This incentive is not being offered ANYWHERE IN THE COUNTRY. Hampton Roads would be the very first to offer this type of incentive and businesses would flock to the Hampton Roads marketplace.

Projected growth potential from a global, national and regional perspective

The marketplace is becoming more and more a global marketplace with the influence of the internet. Hampton Roads can serve as the headquarters for businesses who operate anywhere in the world. Technology translates all continents. Establishing Hampton Roads a center for Cybersecurity companies, along with the Shipping Port, makes Hampton Roads at the epicenter of the global economy.

In just 10 years, the industry has grown from $3.5B to $73B with the expectation to grow even faster in the upcoming years.

List of what is needed to grow the cluster

The most critical success factor is participation. We need buy in and participation from the following organizations:

a. Local governments
   Participation and funding from the local governments will lead the way to making this a reality

b. Economic development organizations
   Incentive packages need to be marketed and offered to start up and growing businesses

c. Local businesses
   Participation is needed to form a consortium of businesses that can completely cover all aspects of the NIST Cybersecurity Framework. Additionally, funding from local banks can be leveraged to establish this team by utilizing strategic partnerships of start-ups.
d. Educational institutions
We have the workforce available now and they are currently leaving. We can partner with ODU’s new College of Continuing Education to initiate a program to transition soldiers to the commercial space and provide them with the training and certifications that are needed in the commercial world to evidence credibility, such as the CISSP.

e. Department of Defense
Although this industry leg would loosen the dependency Hampton Roads has on the Federal Government, we want to ensure that Hampton Roads continues to cultivate federal dollars in the area of cybersecurity. The Consortium will work with Hampton Roads Military and Federal Facilities Alliance (HRMFFA) to continue to lobby for additional cyber based projects such as Cyber Command as well as lobby for establishing Langley AFB as the chosen location for the expansion of the Air Forces cyber reserves units.

List of obstacles to cluster growth
The major obstacle is timing. This industry is booming now! The tech industries establish very quickly and if you are behind the tide you will miss the wave.

List of elements that make the cluster attractive
The potential to leverage existing industry legs to create another. This industry solves two of Hampton Roads ongoing problems:
- Dependency on the Federal Government
- Losing a trained workforce as they transition out of the military

The workforce is already here, the excellence is already here, the growth potential in the industry in un-rivaled.

List of elements that make the cluster unique
Establishing a “Center of Excellence” is simply a title. Hampton Roads needs to market an unmatched incentive. That incentive will be a consortium of cyber experts partnering with municipalities to offer unaffordable tools/resources/solutions that will cultivate business growth. As cyber threats continue to increase, business will need to protect their electronic assets. In the coming years, cybersecurity will become a necessity for startups alongside bankers, lawyers, and accountants. We want to be the first community to offer that to growing businesses.

Recommended measures to gauge growth in this cluster
The easiest way to measure industry growth is to measure it in jobs. To restate the facts obtained from Burning Glass technologies, see below the major facts in cybersecurity job growth:

- In 2013, there were 209,749 postings for cybersecurity-related jobs nationally. Cybersecurity jobs account for nearly 10% of all IT jobs.
- Cybersecurity postings have grown 74% from 2007-2013. This growth rate is over 2x faster than all IT jobs.
Cybersecurity job postings took 24% longer to fill than all IT job postings and 36% longer than all job postings.

The demand for cybersecurity talent appears to be outstripping supply. In the US, employers posted 50,000 jobs requesting CISSP, recruiting from a pool of only 60,000 CISSP holders.

On average, cybersecurity salaries offer a premium of over $15,000 over the salaries for IT jobs overall.

Conclusion
The industry growth and profitability cannot be ignored. Hampton Roads has a golden opportunity to take what we already have in the federal marketplace, transition a workforce of experts to the commercial world and establish a new economic pillar. New and growing business will be incentivized to locate in Hampton Roads to take advantage of this expertise.
Cluster Review Team Reports  

Industry Cluster Study Group / Military & Commercialization of Military Technology  
Cluster Review

1. Overall Outcome
The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. Initiative Context and Expected Results
The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.


Cluster Team Lead: Craig Quigley (HRMFFA)

Team members: Bill Crow (VSRA)

Proposed start date: 04/1/14
Proposed end date: 05/15/14

4. Cluster Team Work Plan and Interdependencies
Objective and Outcomes
Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.

List of key players and organizations within the cluster identified
a. Private and public ship repair and construction organizations
b. Private and public cyber defense organizations
c. Private and public unmanned aerial systems (UAS) organizations
d. Private and public aircraft repair organizations
e. Private businesses catering to the Special Ops presence in the region

Current depth of the cluster/scale of the industry described (Scale of 1-10 with 10 being the greatest depth)
a. Ship repair/construction – 10
b. Cyber defense – 5
c. UAS – 3
d. Aircraft repair – 2
e. Special Ops – 6

Growth opportunities identified
a. Ship repair/construction – Maintain
b. Cyber – Great growth potential
c. UAS – Enormous growth potential
d. Aircraft repair – Small growth potential
e. Special Ops – Modest growth potential
### Connections between new clusters and existing pillars identified and described
- **Ship repair/construction** – Solid; existing pillar
- **Cyber** – Solid; potential for commercialization is great
- **UAS** – Solid; public and private work being done in the region now
- **Aircraft repair** – Weak; very modest industry here now
- **Special Ops** – Solid; potential for growth

### Boundary spanning clusters identified and described

### Salary and wages produced by the cluster identified
- **Ship repair/construction** – Huge
- **Cyber** – Modest, but great growth potential
- **UAS** – Small now, but could be huge
- **Aircraft repair** – Small now, and unlikely to grow much
- **Special Ops** – Modest, with some growth potential

### Expected degree of sustainability described
- **Ship repair/construction** – Immortal
- **Cyber** – Immortal
- **UAS** – Immortal
- **Aircraft repair** – Small but immortal
- **Special Ops** – Immortal

### Competitive advantages identified and described
- **Ship repair/construction** – Existing, mature industry in the right location
- **Cyber** – Navy cyber command and Air Force ISR command in the region
- **UAS** – Chosen as FAA test site; good topography; willing governments
- **Aircraft repair** – None
- **Special Ops** – Great Navy presence here now, and can continue to grow

### Target customers and competitors identified
- **Ship repair/construction** – Navy; no competitors regionally
- **Cyber** – Government at all levels and private sector; competitors everywhere
- **UAS** – Private sector; commercial market; competitors everywhere
- **Aircraft repair** – Military and some commercial; little competition
- **Special Ops** – Navy; some competitors

### Projected growth potential from a global, national and regional perspective
- **Ship repair/construction** – Modest regional growth possible
- **Cyber** – Regional, national and global growth is possible
- **UAS** – Regional, national and global growth is possible
- **Aircraft repair** – Little chance for growth
- **Special Ops** – Regional growth is possible

### List of what is needed to grow the cluster
- **Ship repair/construction** – Steady Navy budgets; maintain quality; increase in number of Navy ships in Hampton Roads
- **Cyber** – Work force training; momentum
<table>
<thead>
<tr>
<th>List of obstacles to cluster growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ship repair/construction – Falling Navy O&amp;M,N budgets, reduction in number of Navy ships in Hampton Roads</td>
</tr>
<tr>
<td>b. Cyber – Reputation; perception</td>
</tr>
<tr>
<td>c. UAS – Nothing</td>
</tr>
<tr>
<td>d. Aircraft repair – Tremendous capital needed; start from scratch</td>
</tr>
<tr>
<td>e. Special Ops – Nothing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of elements that make the cluster attractive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ship repair/construction – Existing facilities, weather, topography</td>
</tr>
<tr>
<td>b. Cyber – Navy and Air Force presence and need</td>
</tr>
<tr>
<td>c. UAS – Blessing as FAA test site; existing facilities and intellectual capacity</td>
</tr>
<tr>
<td>d. Aircraft repair – Will always have some of this locally</td>
</tr>
<tr>
<td>e. Special Ops – Navy special ops presence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of elements that make the cluster unique</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ship repair/construction – Existing presence; Navy presence</td>
</tr>
<tr>
<td>b. Cyber – Navy and Air Force presence; proximity to Washington</td>
</tr>
<tr>
<td>c. UAS – Topography; FAA seal of approval; public/private presence</td>
</tr>
<tr>
<td>d. Aircraft repair – Nothing</td>
</tr>
<tr>
<td>e. Special Ops – Navy presence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended measures to gauge growth in this cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ship repair/construction – Total contract values</td>
</tr>
<tr>
<td>b. Cyber – Number of companies, volume of sales, number of hires</td>
</tr>
<tr>
<td>c. UAS – Number of companies, volume of sales, number of hires</td>
</tr>
<tr>
<td>d. Aircraft repair – Growth in companies and sales</td>
</tr>
<tr>
<td>e. Special Ops – Navy presence grows and number of companies/sales/employees right along with it</td>
</tr>
</tbody>
</table>
### 1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

### 2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

### 3. Modeling & Simulation Industry Cluster

<table>
<thead>
<tr>
<th>Cluster Team Lead:</th>
<th>John Sokolowski (VMASC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team members:</td>
<td>Ed Harvey (VMASC Advisory Board)</td>
</tr>
<tr>
<td></td>
<td>Bob Armstrong (EVMS)</td>
</tr>
<tr>
<td></td>
<td>Rob Lisle (Newport News Shipbuilding)</td>
</tr>
<tr>
<td>Proposed start date:</td>
<td>04/15/14</td>
</tr>
<tr>
<td>Proposed end date:</td>
<td>05/30/14</td>
</tr>
</tbody>
</table>

### 4. Cluster Team Work Plan and Interdependencies

**Objective and Outcomes**

- Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.
- List of key players and organizations within the cluster identified
  2. MYMIC ([http://www.mymic.net/](http://www.mymic.net/))
  4. Virginia Modeling, Analysis and Simulation Center (VMASC) at Old Dominion University ([http://www.vmasc.odu.edu/](http://www.vmasc.odu.edu/))
  5. Eastern VA Medical School National Center for Collaboration in Medical Modeling and Simulation ([http://www.evms.edu/research/centers_institutes_departments/national_center_for_collaboration_in_medical_model/](http://www.evms.edu/research/centers_institutes_departments/national_center_for_collaboration_in_medical_model/))

- Current depth of the cluster/scale of the industry described
  1. Primary M&S companies are those that generate greater than fifty percent of their revenue from Modeling and Simulation work. These primary companies have the greatest potential to grow the M&S effort within the region.
  2. Secondary companies are difficult to characterize because their M&S work is part of a much larger effort that supports non M&S related business and there is no formal industry classification for the M&S work.

- Growth opportunities identified
  1. M&S technology can be applied to just about any domain, from manufacturing to healthcare to finance. This requires identifying industry problems that can benefit from M&S.
  2. Old Dominion University’s modeling and simulation academic programs are producing students with the skills to develop models and simulations for most purposes and to develop new approaches to modeling that will be unique products for this field.

- Connections between new clusters and existing pillars identified and described
  1. M&S can complement any of the industry sectors.
Boundary spanning clusters identified and described
1. M&S can complement any of the industry sectors

Salary and wages produced by the cluster identified
1. The average salary range of Modeling and Simulation jobs statewide is $102,000 and roughly $78,000 to $80,000 in Hampton Roads, 22% lower than Modeling and Simulation salaries for job postings nationwide ([www.indeed.com](http://www.indeed.com))

Expected degree of sustainability described
1. A strong foundation upon which to build the cluster exists in the region and is beginning to grow as M&S is applied outside the defense domain (i.e., medical M&S through companies like SimIS, Inc. and education through AT&LT and game-based learning to enhance training through MYMIC)

Competitive advantages identified and described
1. Old Dominion University was the first to offer the Ph.D. in Modeling and Simulation in 2000 and also first in establishing an academic department and undergraduate engineering program within the discipline.
2. The National Center for Collaboration in Medical Modeling and Simulation (NCCMMS) at EVMS is a research center dedicated to improving patient care by advancing the quality and quantity of medical modeling and simulation-based training and education available to students and practitioners by developing new standards and technologies through active collaboration with industry and academic partners.
3. The College of William and Mary has led teams to study coastal wind-driven water levels, transportation, and next generation virtual environments using M&S.
4. The Hampton Roads MODSIM Initiative promotes the use, application, and promotion of modeling, simulation, visualization, game-based learning, and systems dynamics as tools for enhancing and enriching science, technology, engineering, and mathematics (STEM) education and training with the goal of creating a workforce for the 21st Century.
5. The support of federal research and development centers such as Jefferson Lab and NASA Langley Research Center positions the region for growth.

Target customers and competitors identified
1. Customers cover a broad spectrum, but in the region the four primary entities (listed in Appendix A) produced M&S products in the domains of healthcare, defense, homeland security, transportation, and education.

Projected growth potential from a global, national and regional perspective.
1. Growth opportunities are significant because of the need to use this technology in just about any domain.
2. The primary companies that generate greater than 50% of their revenue from M&S work have the greatest growth potential within the region.

List of what is needed to grow the cluster
1. An entrepreneurial ecosystem that supports ODU’s M&S graduates with the necessary tools to start their own companies
2. A mechanism to identify industry problems that could benefit from M&S (possibly a forum to present and vet those problems would facilitate interest in exploring M&S solutions)

List of obstacles to cluster growth
1. The challenge in shifting the paradigm from developing modeling and simulation solutions for defense to that of developing them for commercial applications, as the process is very different.
2. The lack of funding for product development, particularly the bridge funding needed for smaller companies

List of elements that make the cluster attractive
1. The competitive advantages (also considered assets) listed above make the cluster attractive
2. The application of M&S can increase efficiency and lower costs for business and government

List of elements that make the cluster unique
1. The region has a technical workforce, capable of developing simulation products to address all types of problems in an unlimited set of domains
**Recommended measures to gauge growth in this cluster**

1. Output
2. GRP
3. Employment
4. Average Annual Salary
The modeling and simulation cluster team reviewed the scope of the modeling and simulation (M&S) activity within Hampton Roads. This effort consisted of reviewing previous M&S studies for the region plus personal knowledge of the members of the cluster committee. What follows is a summary of that review.

To understand the modeling and simulation cluster within Hampton Roads requires us to separate this effort into two main categories, organizations whose primary effort is modeling and simulation and those organizations involved with M&S from a secondary perspective. The differentiation is based on the level of revenue from M&S work. Primary M&S companies are those that generate greater than fifty percent of their revenue from modeling and simulation work. This distinction is important because it is these primary companies that have the greatest potential to grow the M&S effort within the region.

We have identified four primary entities in the region. They are listed in Appendix A to this report. They produced M&S products in the domains of healthcare, defense, homeland security, transportation, and education.

Characterizing the secondary companies from an M&S perspective is much more difficult because the M&S work is part of a much larger effort that supports non-M&S related business and because of a lack of formal industry classification for the M&S work. What is clear is that the workforce in Hampton Roads has the technical expertise to both develop models and simulations and to employ M&S in a secondary role for engineering and analytical purposes.

Growth opportunities in M&S are significant because of the need to use of this technology in just about any domain from manufacturing to healthcare to finance. But there are two barriers to this growth. The first barrier requires a paradigm shift from developing modeling and simulation solutions for defense to that of developing them for commercial applications. The process is much different. In the defense area, companies respond to requests for proposal to develop simulations. The government pays for the development and then utilizes the product. In the commercial world, most companies will not pay for development of a product. They are looking for a solution to a problem and the solution provider must have that solution already developed with the ability to market and sell it to address the problem. This way of doing business is foreign to those who have been in the defense industry. Changing this mindset to a commercial one is the first hurdle that has to be overcome. The commercial approach also involves understanding the problems faced by companies in a target domain. An M&S company cannot be "everything to everybody." They must be selective on the domains they target, develop solutions to problems in those domains and then expand once the original domains are covered.

The second barrier to commercial M&S growth is funding for product development. Some larger companies may be able to invest internal funds to develop solutions to market. Other smaller companies will probably need access to bridge funding for this development. The availability of this bridge funding is crucial to growing this industry in Hampton Roads. One item that goes along with this funding is a mechanism to identify industry problems that could benefit from M&S. Having a forum to present and vet those problems would facilitate interest in exploring M&S solutions.
One example of a company following this strategy is Advanced Training and Learning Technology (AT&LT). They identified a need in the educational area for remedial math tutoring, developed a simulation that provides this training, and is actively marketing the simulation to clients who must solve this problem. This effort is clearly outside the defense domain but serves as an example of how to move the M&S cluster forward in Hampton Roads.

A contributing factor to the growth potential is the graduates from Old Dominion University’s (ODU) modeling and simulation academic programs. These students leave with the skills to develop models and simulations for most purposes and to develop new approaches to modeling that will be unique products for this field. Arming a percentage of these students with the tools to start their own companies is an important addition to growing this cluster within the area. ODU is taking steps in this direction.

What makes Hampton Roads unique from an M&S cluster perspective is the technical workforce capable of developing simulation products to address all types of problems in an unlimited set of domains. This is especially true in the development of simulations for training and educational purposes. Providing the financial encouragement to entrepreneurs to take on this challenge is something the region should seriously consider if it wants to grow a sector that can complement defense, port, and tourism sources of jobs and revenue.

Appendix A

List of Primary Modeling and Simulation Entities in Hampton Roads

Advanced Training and Learning Technology (AT&LT)
MYMIC
SiMiS
Virginia Modeling, Analysis and Simulation Center (VMASC) at Old Dominion University
## 1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

## 2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

## 3. Port and Maritime Logistics Industry Cluster

<table>
<thead>
<tr>
<th>Cluster Team Lead:</th>
<th>Russell Held (VPA)-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team members:</td>
<td>Chip Filer (ODU)-</td>
</tr>
<tr>
<td></td>
<td>Len Fleisig (Willcox &amp; Savage)-</td>
</tr>
<tr>
<td></td>
<td>Bob Harbour (CenterPoint)-</td>
</tr>
<tr>
<td>Proposed start date:</td>
<td>04/15/14</td>
</tr>
<tr>
<td>Proposed end date:</td>
<td>05/30/14</td>
</tr>
</tbody>
</table>

## 4. Cluster Team Work Plan and Interdependencies

**Objective and Outcomes**

Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.

**List of key players and organizations within the cluster identified** (see Attachment 1 of detailed report)

1. Hampton Roads is home to logistics leaders like Norfolk Southern, Maersk Line Ltd., A.P. Moeller Terminals, CMA-CGM and Zim Lines
2. Other private terminals (Kinder Morgan, Purdue AgriBusiness and Norfolk Southern’s Coal Pier 6)
3. 10 shipping agencies representing more than 170 shipping lines calling on Hampton Roads
4. 15 Non-Vessel Operating Common Carriers
5. 14 Towing & Barge companies
6. Over 65 warehouse operators
7. Over 25 Freight Forwarders and Custom House Brokers
8. Distribution centers and manufacturing operations that include Wal-Mart, Target, Cost Plus World Market and QVC
9. Manufacturers include Stihl, Canon, International Paper and Green Mountain Coffee Roasters

**Current depth of the cluster/scale of the industry described** (based on 2013 performance indicators)

1. Total cargo in Short Tons (Thousands) – 73,501.44
2. General Cargo in Short Tons (Thousands) – 17,091.62
3. Container Cargo in Short Tons (Thousands) – 16,786.75
4. Breakbulk Cargo in Short Tons (Thousands) – 336.06
5. Total Cargo Dollar Value (Millions) – 66,945.91
6. Coal Loadings in Short Tons (Thousands) – 51,084.84
7. TEUs – 2,223,532 (13% of East Coast Market Share)
8. Ranked #4 in Top U.S. Ports in Total Cargo in Thousands of Short Tons
9. Ranked #4 in Top U.S. Ports in Total Cargo Thousands of Metric Tons
10. Ranked #6 in Top U.S. Ports in Cargo value
## Growth opportunities identified
1. Improvements to international logistics infrastructure like the Panama Canal Expansion
2. Hampton Roads is ideally situated based on population centers and 2040 cargo forecasts that reflect continued world trade growth
3. Management of general purpose Foreign Trade Zone sites through Alternate Site Framework, providing users better and quicker access to benefits
4. Manufacturing reshoring and expansion opportunities
5. Coastal energy exploration, production, and logistics

## Connections between new clusters and existing pillars identified and described
1. Coastal energy
2. Robotics/underwater/unmanned vehicles
3. Modeling & Simulation

## Boundary spanning clusters identified and described
1. The Port & Maritime Logistics Cluster crosses over, enhances and/or benefits from all of the emerging clusters under review

## Salary and wages produced by the cluster identified
(see Attachment 2 of detailed report)
1. VPA operations directly contribute $1.4 billion in earnings (2006)
2. Including indirect and induced effects, VPA operations generated over $4 billion in earnings (2006)
3. The economic impact on Hampton Roads relative to earnings generated by the coal export industry is $55 million (2011)
4. Including indirect and induced effects coals shipments in Hampton Roads generated more than $200 million in earnings (2011)

## Expected degree of sustainability described
1. The port remains an economic driver of the regional economy
2. Committed to environmental, land-use and financial sustainability

## Competitive advantages identified and described
1. Natural deep water, easily accessible, ice and obstruction free harbor
2. Within a day’s drive of two-thirds of the U.S. population
3. Hampton Roads is positioned well for continued growth because of previous port infrastructure investment such as the 50 ft. channel and the Virginia International Gateway Terminal in Portsmouth, and landside infrastructure development such as Norfolk Southern Heartland Corridor and the CSX National Gateway.
4. The attraction of local distribution centers and manufacturers has created a local customer base for international trade.
5. The universities and community colleges provide valuable port, maritime and logistics education and training.

## Target customers and competitors identified
1. Customers – See Inquiry #1
2. Competitors – East Coast, U.S. and World Ports
   a. Regional – Wilmington, DE and Baltimore, MD
   b. East Coast – New York, NY, Charleston, SC and Savannah, GA
   c. Distribution – New Jersey

## Projected growth potential from a global, national and regional perspective.
1. World and U.S. trade are projected to grow between 4% and 5% annually
2. Ideally situated based on population centers and 2040 cargo forecasts
3. Trends in world trade include bigger container vessels, the expansion of the Panama Canal and market growth via the Suez Canal (good for Hampton Roads)
4. The region is positioned well for continued growth because of previous port infrastructure investment and the potential to expand capacity as mentioned in Inquiry # 8 above

## List of what is needed to grow the cluster
1. Starting the Congressionally authorized 55-foot channel project
2. Dredging the Southern Branch of the Elizabeth River to 45 feet.
3. Expansion of the Virginia International Gateway Terminal
4. Development of a marine terminal on Craney Island
5. Road, rail and barge projects
6. Continued development of maritime & logistics related educational and training opportunities to build the necessary workforce

**List of obstacles to cluster growth**  
1. Highway congestion  
2. Potential lack of infrastructure funding

**List of elements that make the cluster attractive**  
1. Virginia Port Tax Credits (Port Volume Increase Tax Credit, Barge and Rail Usage Tax Credit, and International Trade Facility Tax Credit)  
2. Port of Virginia Economic & Infrastructure Development Zone Cash Grant  
3. Statewide footprint with local terminals linked to the Port of Richmond and Virginia’s Inland Port

**List of elements that make the cluster unique**  
1. Location  
2. Deep water  
3. Inland logistics infrastructure

**Recommended measures to gauge growth in this cluster**  
1. Jobs created (direct and indirect)  
2. Salaries/wages (direct and indirect)  
3. Contribution to or percentage of GRP
Port & Maritime Logistics Cluster Review Team Detailed Report

The strategic mid-Atlantic location, deep water, streamlined transportation infrastructure, and capacity for growth offered by Virginia’s port are well known among shippers and ocean carriers the world over. The natural advantages of our port have historically served as a magnet for investment, attracting new industries and commerce to Hampton Roads. Today, the world’s largest shipping lines link Virginia’s sheltered ice-free harbors to destinations around the globe. Hampton Roads encompasses 25 square miles of easily accessible waterways and is located just 18 miles from the open sea, offering ships carrying the heaviest cargoes the ease of sailing in and out of the 50-foot-deep, obstruction free channels.

Virginia’s Hampton Roads consistently ranks as one of the leading ports in the United States for foreign waterborne commerce. In terms of general cargo volume (containerized, breakbulk and bulk cargo), our port is the second largest port on the U.S. East Coast behind the Port of New York/New Jersey, handling over 50 million tons of cargo annually. In terms of containers, our port is third largest on the U.S. East Coast, behind the ports of New York/New Jersey and Savannah handling 2.3 million TEU’s per year.

In addition to the advantages offered by the easy access to the open sea, Virginia’s ports are served by one of the nation’s most efficient inland transportation networks. Cargo is transported with speed and efficiency by 30 miles of on-dock rail. Numerous national and regional trucking companies and two of the nation’s largest railroads, CSX and Norfolk Southern, enable service to two-thirds of the U.S. population within 24 hours.

The Hampton Roads’ Port & Maritime Logistics Cluster is made up of a multitude of diverse companies and disciplines. Hampton Roads is home to the headquarters of logistics leaders like Norfolk Southern, Maersk Line Ltd., and A. P. Moeller Terminals, as well as U.S. headquarters for international ocean carriers CMA-CGM and Zim Lines. In addition to headquarters, the Hampton Roads Port & Maritime Logistics Cluster includes 10 Ship Agencies representing more than 170 shipping lines calling on Hampton Roads, 15 Non-Vessel Operating Common Carriers, 14 Towing & Barge companies, over 65 warehouse operators and over 25 Freight Forwarders and Custom House Brokers. The Virginia Maritime Association has compiled a list of more than 100 different types of companies offering logistics and accessorial services in Hampton Roads. (Attachment 1)

This Cluster also includes the shippers that invest in their own distribution centers and manufacturing operations. Major distribution centers in Hampton Roads include Wal-Mart, Target, Cost Plus World Market and QVC. Manufacturers include Stihl, Canon, International Paper and Green Mountain Coffee Roasters. In addition to natural advantages and an efficient cargo transportation system these manufacturers also take advantage of a robust Foreign Trade Zone program. In recent years, manufacturers and distribution centers have both been drawn to the area and expanded in the area by taking advantage of Virginia Port Tax Credits and the Port of Virginia Economic & Infrastructure Development Zone Grant.

An economic impact study of this entire Cluster does not exist, however two segment studies demonstrate the enormous impact of the Port & Maritime Logistics Cluster.
1. A 2008 study by the William & Mary Mason School of Business on economic and fiscal impacts of the Virginia Port Authority operation on Hampton Roads for calendar year 2006 concluded that VPA operations directly contribute to $5.5 billion in goods and services, $1.4 billion in earnings and 39,589 jobs. Including indirect and induced effects, the VPA operations generated over $12 billion in goods and services, $4 billion in earnings and over 100,000 jobs. (Attachment 2)

2. A 2012 study by Old Dominion University’s Regional Studies Institute concluded that in 2011 the export coal industry’s economic impact on Hampton Roads contributed directly to $518 million in goods and services, $55 million in earnings and nearly 1,100 jobs. Including the indirect and induced effects, in 2011 coal shipments in Hampton Roads generated more than $900 million in goods and services, more than $200 million in earnings and almost 4,200 jobs. (Attachment 3)

World and U.S. trade are projected to grow between 4% and 5% annually. Trends in world trade, including bigger container vessels, the expansion of the Panama Canal and market growth via the Suez Canal favor Hampton Roads. The Port and Maritime Logistics cluster in Hampton Roads is positioned well for continued growth because of previous port infrastructure investment such as the fifty foot channel and the A.P. Moeller Terminal in Portsmouth, and landside infrastructure development such as the Norfolk Southern Heartland Corridor and the CSX National Gateway. The attraction of distribution centers and manufacturers has created a local customer base for international trade and the Universities and Community Colleges are responding with port, maritime and logistics education and training.

However, continued growth requires further infrastructure development including:

- Starting the Congressionally authorized 55-foot channel project.
- Dredging the Southern Branch of the Elizabeth River to 45 feet.
- Expansion of the APM Terminal.
- Development of a marine terminal on Craney Island.
- Road and rail projects.
- Continued development of maritime & logistics related educational and training opportunities to build the necessary workforce.

In conclusion, the Port & Maritime Logistics Cluster is today a major economic driver for Hampton Roads because of natural advantages and the vision of leadership to develop the infrastructure to handle growing world trade. Continued focus on infrastructure development is necessary to ensure continued growth. Possibly the most compelling reason for the process team to consider is that the Port & Maritime Logistics Cluster crosses over, enhances and/or benefits from all of the emerging clusters under review.
## Accessorial Services

Firms providing the following services are listed under VMA Professional Services, Membership Section.

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<tr>
<th>Services</th>
</tr>
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<tbody>
<tr>
<td>Accountants-Certified Public</td>
</tr>
<tr>
<td>Agriculture</td>
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<tr>
<td>Architecture, Planning and Interior Design</td>
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<tr>
<td>Asset Management</td>
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<td>Banks/Investment and Mortgage Loans</td>
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<tr>
<td>Cargo Inspection</td>
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<td>Cargo Transfer Station</td>
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<tr>
<td>Cement</td>
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<tr>
<td>Cement/Sand/Gravel/Fertilizer</td>
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<tr>
<td>Charity</td>
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<td>Classification Society</td>
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<tr>
<td>Coal Terminals</td>
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<tr>
<td>Coal/Coal Inspection; Analysis; Sampling</td>
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<tr>
<td>Cold Storage/Refrigeration</td>
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<td>Commercial Development and Property Management</td>
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<td>Commercial Tire Sales</td>
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<tr>
<td>Commodities</td>
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<td>Communications/Media</td>
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<tr>
<td>Consultants</td>
</tr>
<tr>
<td>Container Sales and Trading</td>
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<tr>
<td>Container/Chassis Repair</td>
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<td>Contractors and Construction Supplies/Equipment</td>
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<td>Defense Contractor</td>
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<td>Depot Services/Container and Chassis Rental, Repair, Sales and Storage</td>
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<td>Diesel Engine and Generator Repair</td>
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<tr>
<td>Dredging (Harbor, etc.)</td>
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<tr>
<td>Educational Institute</td>
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<tr>
<td>Electronic Sales/Service</td>
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<tr>
<td>Employee Benefits Consultants</td>
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<tr>
<td>Employment Services</td>
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<tr>
<td>Engineers/Environmental Engineers/Scientists and Planners</td>
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<td>Engineers/Naval Architects/Surveyors and Appraisers</td>
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<td>Environmental Services: Pollution Control/Tank and Steam Cleaning/Exterminators</td>
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<td>Export Packing and Logistics</td>
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<td>Exporters and Importers</td>
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<td>Fire Protection and Safety</td>
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<td>Fleet Management</td>
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<td>Freight Forwarders and Customhouse Brokers</td>
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<td>Fumigation</td>
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<td>Global Security Solutions</td>
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<td>Government Affairs</td>
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<td>Government-City, State, Federal Health Services</td>
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<td>Heating and Air Conditioning</td>
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<td>Hotels and Clubs</td>
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<td>Hydraulics Repair, Sales and Services</td>
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<td>Insurance Services and/or Insurance Counselors</td>
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<td>Limousine/Car Services</td>
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<td>Line Handling</td>
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<td>Logistics Consulting</td>
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<td>Manufacturer and Distributor</td>
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<td>Marine and Industrial Suppliers/Ship Chandlers</td>
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<td>Marine Fuels and Lubricants</td>
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<td>Marine Repair and Service</td>
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<td>Marine Surveyors</td>
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<td>Marine Surveyors/Lloyd's Agency Manager</td>
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<td>Meeting and Convention Services</td>
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<td>Motor Freight Lines/Intermodal</td>
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<td>Nautical Charts/Navigation</td>
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<tr>
<td>Navigation Equipment Manufacturer</td>
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<tr>
<td>Sales and Service</td>
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<td>Non Vessel Operating Common Carrier/NVOCC</td>
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<tr>
<td>Oil Terminal, Refinery</td>
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<td>On-Site Hydraulic Hose Repair, On-Site Pressure Test</td>
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<tr>
<td>Pilotage</td>
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<tr>
<td>Port and Industrial Development Organizations</td>
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<tr>
<td>Printing and/or Marketing Services</td>
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<tr>
<td>Propeller Inspection, Repair and Modifications</td>
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<td>Public Relations</td>
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<td>Railroads</td>
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<td>Real Estate</td>
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<td>Refuse and Recycling Collection</td>
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<tr>
<td>River Restoration</td>
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<tr>
<td>Sales/Retail</td>
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<tr>
<td>Seamen's House</td>
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<tr>
<td>Shipbuilding, Ship Repair and Maintenance, Drydocks</td>
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<tr>
<td>Steamship Owners, Agents, Operators</td>
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<td>Stevedores</td>
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<td>STS Crane Repair and Refinements</td>
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<td>Telecommunications</td>
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<td>Terminal Operators</td>
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<td>Trade Association</td>
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<tr>
<td>Training/Education/Research</td>
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<td>Underwater Hull Services</td>
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<td>Underwater Ship Husbands Services</td>
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<td>US Customs Software (AMS, ISF) and Training</td>
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<tr>
<td>Warehouse</td>
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<td>Waste Disposal</td>
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<tr>
<td>Yacht Repair and Storage</td>
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Virginia Maritime Association’s Ports of Virginia Annual 2014
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<thead>
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<th>Port operations</th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
<th>Total</th>
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<tr>
<td>Revenues/Sales</td>
<td>$1,617.8</td>
<td>$587.8</td>
<td>$1,410.7</td>
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<tr>
<td>Employee Compensation</td>
<td>$458.4</td>
<td>$233.1</td>
<td>$636.2</td>
<td>$1,327.7</td>
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<td>Employment</td>
<td>8,227</td>
<td>5,336</td>
<td>15,325</td>
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<tr>
<td>Va made exports</td>
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<tr>
<td>Revenues/Sales</td>
<td>$2,102.6</td>
<td>$754.2</td>
<td>$1,377.2</td>
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<tr>
<td>Employee Compensation</td>
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<td>$215.6</td>
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<td>4,733</td>
<td>12,340</td>
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<td>Va sold imports</td>
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<tr>
<td>Revenues/Sales</td>
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<td>$550.4</td>
<td>$2,055.5</td>
<td>$4,470.0</td>
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<tr>
<td>Employee Compensation</td>
<td>$667.3</td>
<td>$173.0</td>
<td>$829.6</td>
<td>$1,670.0</td>
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<td>Employment</td>
<td>24,120</td>
<td>3,928</td>
<td>18,991</td>
<td>47,040</td>
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<td>Total</td>
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<tr>
<td>Revenue/sales</td>
<td>$5,584.4</td>
<td>$1,892.4</td>
<td>$4,843.5</td>
<td>$12,320.3</td>
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<td>$621.6</td>
<td>$2,006.8</td>
<td>$4,112.1</td>
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<td>Employment</td>
<td>39,589</td>
<td>13,998</td>
<td>46,657</td>
<td>100,244</td>
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William & Mary Mason School of Business – The Fiscal Year 2006 Virginia Economic and Fiscal Impacts of Virginia Port Authority Operations report
### TABLE 5

**ESTIMATED ECONOMIC IMPACT OF COAL SHIPMENTS ON HAMPTON ROADS IN 2011**

<table>
<thead>
<tr>
<th></th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Induced Impact</th>
<th>Total Economic Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (in millions)</td>
<td>$518.8</td>
<td>$207.0</td>
<td>$117.8</td>
<td>$903.6</td>
</tr>
<tr>
<td>Earnings (in millions)</td>
<td>$55.3</td>
<td>$95.8</td>
<td>$52.1</td>
<td>$203.1</td>
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<tr>
<td>Employment</td>
<td>1,089 jobs</td>
<td>1,456 jobs</td>
<td>1,645 jobs</td>
<td>4,190 jobs</td>
</tr>
</tbody>
</table>

Old Dominion University’s Regional Studies Institute – The State of the Region Hampton Roads 2013
Cluster Review Team Reports

Industry Cluster Study Group / Tourism Cluster Review

1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

3. Tourism Industry Cluster

Cluster Team Lead: Tim Stiffler (Commonwealth Lodging)

Team members:
- Jim Ricketts (Va Beach CVB)
- Vinod Agarwal (ODU)
- Peter Leddy (OTTO Design)
- Tony Difilippo (Norfolk CVB)
- Dave Iwans (DIA)

Proposed start date: 04/15/14
Proposed end date: 05/30/14

4. Cluster Team Work Plan and Interdependencies

Objective and Outcomes

Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters

1. List of key players and organizations within the cluster identified
   - Economic Development
   - Convention and Visitors Bureau’s
   - Hotel/Motel and Restaurant Associations
   - Coastal Virginia Tourism Alliance
   - Suppliers/Vendors
   - Large area hotel and restaurant management companies

2. Current depth of the cluster/scale of the industry described
   - 2nd largest driver of economy (Virginia Beach)
   - 9% of local jobs/income
   - Pillar of local economy
   - One in eight people employed in the private sector (nationally) are in travel/tourism
   - Travel is a top 10 employer in 48 states

3. Growth opportunities identified
   - Move up the tourism “food chain” by attracting better hotel franchises, restaurants, entertainment venues, etc.
   - Look at transformation in Las Vegas over the past 15 years (from gambling to family entertainment destination)
4. Connections between new clusters and existing pillars identified and described
- Supports growth of local business and population (hotels, restaurants, etc.)
- Port, ocean, waterways promote growth of region and attract visitors
- Support provided by hotels and restaurants often taken for granted
- Quality lodging and food outlets are a major contributor to local quality of life

5. Boundary spanning clusters identified and described
- Supports all industries in the area
- Recruiting efforts/quality of life/ability to attract and retain top tier job candidates
- Quality of life issues impact 50% of all CEO’s relocation/expansion decisions
- 22% of corporate executives cite quality of life concerns as primary reason to relocate a facility, ahead of labor market, infrastructure and healthcare costs

6. Salary and wages produced by the cluster identified
- Mid-low wages for many in industry. Entry level jobs
- Provides employment opportunities for lower income/education level population to get into workforce with few skills
- Entry/Gateway to career development
- Perception as low paying industry. However, many well-paying middle and upper management jobs
- 53% of jobs are middle class wage or higher

7. Expected degree of sustainability described
- Very long term and growing
- Projected 5% growth over the next 10 years
- As local economy/employment grows, so will the need for quality hotels, restaurants and entertainment venues
- New travel industry jobs created 29% faster than the rest of the economy
- International travel expected to grow another 40% from 2010 to 2020

8. Competitive advantages identified and described
- Economic vitality of port and port related industries creates demand for travel/tourism services
- History of the area is a major draw to tourists
- Oceanfront with interstate access
- Diversity of product; new and improving supply of better hotel flags; national restaurant chains, etc.
- 2/3 of national population is nearby and within one day’s driving distance
- 70% of visitors drive to this market-area accessible by road, air and sea

9. Target customers and competitors identified
- “Drive to” markets are the biggest feeders
- Increase market share by offering more attractions and things to do

**Competitors**
- Ocean City
- Myrtle Beach
- Savannah (Port City)
- Charleston (Port City)
- Florida resort markets

10. Projected growth potential from a global, national and regional perspective.
- Unlimited. 5% annual growth anticipated going forward
- Just a function of commitment to provide resources such as roads, accessibility, airport support, professional sports.
- International travel is growing at an incredible rate and will figure prominently in future growth.
- China/Brazil

11. List of what is needed to grow the cluster
- Better transportation is a must. Both inter-modal and interstate access
- Regional identity and cooperation- Area needs to speak/market with one voice
- Lodging and restaurant product needs to continue to improve to remain competitive
12. **List of obstacles to cluster growth**
- Competition from other tourist destinations
- Historical reputation for lower tier tourism offerings
- Transportation and accessibility
- Tunnel/Interstate access must improve
- Airport has few direct flights to/from key cities, this has a large negative impact on corporate/business travel

13. **List of elements that make the cluster attractive**
- Very large employer and job producer
- Positive impact on “Quality of Life”
- Local climate/temperature is very desirable
- Museum/Cultural/Historical offerings are unique
- Geographical location- large “drive-to” market for national population
- ODU - Division I football
- Diversity of Attractions- beach, cultural, arts, history

14. **List of elements that make the cluster unique**
- Existing ocean/leisure reputation already established
- World’s largest naval base
- History and cultural background are a unique compliment to seaside lifestyle, not just a seasonal resort area
- Ocean/water/port

15. **Recommended measures to gauge growth in this cluster**
- Number of new jobs created
- Major source of gross revenue for the area
- Tax revenue to support local community
- Smith Travel Research data to track demand for area lodging
- Increasing average length of stay is a big indicator of success
1. Overall Outcome

The Industry Cluster Study Group working goal is to determine the value of industry clusters as a strategic component for regional economic competitiveness. Starting with a baseline of facts, derived from a SWOT analysis, three clusters with early success potential (the highest probability) for the region will be identified. The Study Group will develop a set of recommendations and next steps based on the findings.

2. Initiative Context and Expected Results

The Industry Cluster Study Group set up an overall Process Team and a Cluster Review Team for nine industry clusters identified as either a New Market Cluster (emerging) or Existing (regional economic pillars), based on earlier regional studies and meeting presentations and discussion. The Process Team developed a framework for study groups to follow to better define outcomes and maintain consistency.

3. Unmanned Systems Industry Cluster

<table>
<thead>
<tr>
<th>Cluster Team Lead:</th>
<th>Robert Fitzgerald (Bosh Global Systems)</th>
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<tbody>
<tr>
<td>Team members:</td>
<td></td>
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<tr>
<td></td>
<td>Dave Harnage (ODU)</td>
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<tr>
<td></td>
<td>John Sokolowski (VMASC)</td>
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<td>Paul Robinson (Aerotech)</td>
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<td>Craig Quigley (HRMFFA)</td>
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<td></td>
<td>Karen Jackson (VA/Secretary of Technology)</td>
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<td></td>
<td>Roy Whitney (Jefferson Lab)</td>
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<tr>
<td>Proposed start date:</td>
<td>04/15/14</td>
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<tr>
<td>Proposed end date:</td>
<td>05/30/14</td>
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</table>

4. Cluster Team Work Plan and Interdependencies

Objective and Outcomes

Comprehensive cluster evaluation. Product of the cluster team will be used by the Industry Cluster Study Group to rank clusters.

List of key players and organizations within the cluster identified

- Joint Base Langley Eustis Facilities/UAS Activity Work Group
- Mid-Atlantic Aviation Partnership (MAAP) – FAA test Site (VA, MD, NJ)
- Association of Unmanned Vehicle Systems International (AUVSI) – Hampton Roads Chapter
- National Institute of Aerospace
- NASA Langley
- Virginia Institute of Marine Science (VIMS)

Current depth of the cluster scale of the industry described

**Unmanned Aircraft Systems**

- Post-embryonic
- 50+ small businesses between Williamsburg and the NC state line
- Dozens of industry-related companies scattered throughout Hampton Roads
- Related industries include: airframe manufacturing, auto-pilot, sensors, modeling and simulation, operations and maintenance, cyber technology, training, information technologies

**Unmanned Ground Systems**

- Limited UGS industry in this region
- Unaffected by FAA regulations

**Unmanned Maritime (Surface & Sub-Surface)**

- Several Hampton Roads companies in this industry sector
- Unaffected by FAA regulations
**Growth opportunities identified**

- Once the FAA opens the NAS to UAS operations (initial permissions for small UAS under 400’ expected by 2016), target market sectors will include (besides Amazon.com book delivery): Agriculture, Public Safety, Oil & Gas, Energy, Search & Rescue, security & surveillance, real estate, entertainment, advertising & marketing, fishing …
- Building an environment for technical cross-pollination and integration between system types (air, ground, surface, and sub-surface) could create synergies, sparking innovation, regional connectivity, and eventually leading to commercialization
- Leveraging our natural environment, Hampton Roads could establish itself as America’s center for port and maritime research and applications for unmanned systems
- Private public partnerships between industry and ODU, NASA Langley, Jefferson Labs, and other public entities unique to Hampton Roads could accelerate the development of Unmanned System capabilities in both the government and private sectors

**Connections between new clusters and existing pillars identified and described**

- Unmanned Systems can cut across and create synergies with multiple pillars and cluster boundaries such as: cybersecurity, modeling and simulation and advanced manufacturing and materials
- The potential synergy of cooperative unmanned air, ground, and maritime systems could prove to be substantial in areas such as: port management support and security, post disaster response and recovery, power grid monitoring, Geographic Information System (GIS) mapping and modeling of facility and campus security

**Boundary spanning clusters identified and described**

- See Connections between new clusters and existing pillars above

**Salary and wages produced by the cluster identified**

- Getting a job count and assessment of salaries & wages is difficult (especially by domain) because this industry is still new and fragmented and does not show up on the radar; however, Bureau of Labor Statistics tracks this data which available on the BLS website at the following link: [http://www.bls.gov/oes/2013/may/oes173024.htm#st](http://www.bls.gov/oes/2013/may/oes173024.htm#st)
- Anywhere from manufacturing & assembly (min wage) to research, development and engineering (6-figures+)

**Expected degree of sustainability described**

- Consider this the next iteration of flight – in the same way manned flight worried some and intrigued others a century ago, studies indicate UAS technology will eventually become part of the national/global fabric
- This industry is preparing to emerge from the Federal government sector with fairly mature technologies and practices
- As the NAS is open, expect a frenzy of activity from small-medium businesses and entrepreneurs for the first couple of years
- Once the dust settles, sizable sustainable market sectors will reveal themselves, which will attract more capital investment and large business activity

**Competitive advantages identified and described**

- Virginia selected by the FAA to lead one of six UAS test sites around the country to prepare the way for UAS operations in the NAS – this Middle Atlantic Aviation Partnership (MAAP) gives Virginia a significant advantage over other states and regions
- Although UAS flights over urban or densely populated areas will likely not be part of the initial offering, Hampton Roads has distinct advantages over many other areas
  - Technology-friendly: a wealth of related technology centers: Jefferson labs, NASA Langley, NIA to name a few
- Infrastructure: the ability to host & house entrepreneurs, and businesses of all sizes
- Room to fly: uncluttered skies within an hour’s drive west and maritime access to the east
- Hosting one of the largest ports in the world adjacent to the largest US Naval Base and shipyard presents Hampton Roads a unique environment to build, develop and rest unmanned air, ground, and maritime systems to support operations and security in multiple related areas

**Target customers and competitors identified**
- Target market sectors will include (besides Amazon.com book delivery): Agriculture, Public Safety, Oil & Gas, Energy, Search & Rescue, security & surveillance, real estate, entertainment, advertising & marketing, fishing …
- Five other FAA-selected test sites around the country are racing to establish a lead in flying UAS in the NAS
- The FAA just announced a waiver to allow certain motion picture-related companies the permission to fly UAVs to produce movies – a first for the FAA and this industry

**Projected growth potential from a global, national and regional perspective**
- Studies show this industry building an $8B+ market within the first few years of authorized flight in the NAS, exceeding the US DOD market value soon afterwards
- Other nations are already embracing this technology – unhampered by the FAA and are hungry to share in the innovation that is sure to come eventually from the US

**List of what is needed to grow the cluster**
- Actively and purposefully invest in UAS development infrastructure in Hampton Roads and southeastern VA
- Leverage pent-up need in several markets to apply pressure on FAA to open the NAS as soon as feasible
- Engage the MAAP to embrace Hampton Roads as the region’s (Eastern Seaboard) center for small UAS commercial application and integration
- Build and market a business-friendly environment where UAS-centric entrepreneurs and small companies can come to fly, develop, test, and collaborate amongst themselves and the many technology centers unique to this area.

**List of obstacles to cluster growth**
- Regional cooperation – until the various municipalities begin to work cooperatively to recognize the potential and attract the members of this industry cluster, Hampton Roads will be unable to capitalize on the unique benefits and inherent competitive advantages of the area
- Funding – most of the companies in this industry either large DOD contractors (not the initial target) or small to embryonic with little to no discretionary capital
- Regulatory – unmanned aircraft will not be able to fly over or near Hampton Roads until the FAA changes its regulations

**List of elements that make the cluster attractive**
- The chance to participate in (or lead) the creation of new markets for a fairly mature industry that will soon explore and expand into new commercial and civil sectors
- The potential to fundamentally change the way other industries perform their functions, such as:
  - Precision Agriculture: digitizing farms, improving productivity, reducing costs associated with pesticides and other product applications by narrowing areas requiring such applications (in lieu of crop dusting entire farms), expediting analysis of crop disease and infestation, limiting impact of excessive chemical spraying by providing means of more
targeted diagnosis and application.

- Energy: More efficient means of inspections of power lines, pipelines, underwater drilling rigs, etc.
- Telecommunications: More efficient means of inspections of cell towers, radio towers, etc.
- Civil Engineering: More efficient means of inspections of roads, bridges, tunnels, etc.
- Public Safety: Readily available and more economic means of overhead 24x7 imagery for disaster response, search and rescue, criminal suspect pursuit, area/facility security and surveillance

### List of elements that make the cluster unique

- One of a very few emerging technologies today that has real, tangible benefit in the short term and significant growth potential in the future
- Combining the benefits and capabilities of any of the components – air, ground, and maritime – unmanned systems can offer substantial economic and technological value in several areas:
  - Combining integrated aerial, surface and sub-surface monitoring and sensing of port operations
  - Using UAS to deliver real time aerial images of hazardous areas to unmanned ground or maritime systems to penetrate, monitor and explore dangerous or contaminated post-disaster environments
  - Cost of imagery overflights are estimated to be a fraction of existing (manned flight) options

### Recommended measures to gauge growth in this cluster

- Number of new UAS-related business started in or moving to the Hampton Roads area
- Number of UAS-related business staying in Hampton Roads year to year
- Number of UAS-related jobs created or remaining in Hampton Roads year to year
Appendix C

Virginia Beach Bio Task Force Update
Bio Task Force

> The mission of the Bio Task Force is to develop a plan for a bio-medical and healthcare hub in the Princess Anne Commons area of Virginia Beach.

> The plan should encompass the research, resources, and opportunities of our existing regional assets.

> Leadership

  – Chair
  • Tom Frantz, Williams Mullen

  – Vice Chair
  • Rony Thomas, LifeNet Health
Bio Task Force Members

> Bon Secours
  – Mr. Michael Kerner
> College of William & Mary
  – Mr. Taylor Reveley
> Eastern Virginia Medical School
  – Dr. Jerry Nadler
  – Dr. Richard Homan
> Eden Capital
  – Paul Hirschbiel
> Hampton University
  – Dr. William Harvey
  – Mr. Keith Gregory
> Jefferson Lab
  – Mr. Drew Weisenberger
> MCV Hospital
  – Mr. John Duval
> Norfolk State University
  – Mr. Eddie Moore, Jr.
> Old Dominion University
  – Dr. John Broderick
> Operation Smile
  – Dr. Bill Magee
> Riverside Health System
  – Mr. William Downey
> Sentara Healthcare
  – Mr. David Bernd
  – Mr. Joseph Butz
  – Dr. Carl Hartman
  – Mr. Thomas Thames
> Tidewater Community College
  – Dr. Edna Baehre-Kolovani
> Virginia Biotech Park
  – Ms. Carrie Roth

Bio Task Force: Advisory Committee

> College of William & Mary
  – Ms. Julie Summs
> Eastern Virginia Medical School
  – Dr. William Wasilenko
> Health Diagnostic Laboratory, Inc.
  – Ms. Tonya Mallory
  – Mr. Robert Bohannon
  – Ms. Anna McKean
> Healthcare Services of Hampton Roads, Inc.
  – Ms. Linda Bright
> Jefferson Lab
  – Dr. Robert McKeown
> Kaufman & Canoles
  – Ms. Ann Crenshaw
> LifeNet Health
  – Mr. Gordon Berkstresser
> National Center for Collaboration in Medical Modeling & Simulation
  – Mr. Bob Armstrong
> Naval Medical Center Portsmouth
  – Rear Admiral Elaine Wagner
> Old Dominion University
  – Dr. Morris Foster
> Sentara Healthcare
  – Mr. Robert Broermann
> The Aegis Technologies, Inc.
  – Mr. Richard Severingham
> University of Virginia
  – Mr. Pat Hogan
  – Dr. Thomas Skalak
> Virginia Biotech Association
  – Mr. Jeffrey Gallagher
> Virginia Commonwealth University
  – Dr. Mike Rao
> Virginia Modeling, Analysis, & Simulation Center (VMASC)
  – Dr. John Sokolowski
> Virginia Oncology Associates
  – Dr. Edward George
Setting the Stage . . .

A Region in Need of a New Direction

PROBLEM: Reliance on Department of Defense
> Over the next ten years, sequestration will cut $600 billion from the defense budget.
> Some studies estimate that 40% of Hampton Roads’ GRP is military/defense-based.

SOLUTION? Rapid Growth in Bioscience Industry
> Healthcare sector will be close to 25% of U.S. GDP in 20 years according to Brookings.
> Region is home to many major universities, healthcare providers, and bio-medical firms.
Guiding Principles

> Establish our region as the center for advanced bio-tech and healthcare research and industry "on the East Coast"
  – Establish a hub in Virginia Beach’s Princess Anne Commons.
  – Physical location of hub participants will be region-wide.

> Must be additive to the regional economy by growing and/or attracting:
  – 1) Companies that derive the majority of revenues from outside of region.
  – 2) Research opportunities that can attract substantial funding from external sources.

Guiding Principles (continued…)

> Must drive substantial job creation in the region, focused specifically on higher-income jobs.
> Progress should be measurable and reportable annually.
> Use existing regional assets and resources in hub development when appropriate.
> All institutions of higher education, hospitals and large healthcare enterprises in the region will be asked to partner in achieving the mission.
> Regional governmental authorities and private entities will work together.
  – Obtain state and federal funding for hub development and attract required private equity investment.
Facility Logix selected to perform an in-depth market analysis and provide recommendations for next steps.

Company has completed over 20 strategy, incubator, and innovation feasibility study proposals in places including:

- State of Maryland
- Prince William County, Virginia
- Eastern North Carolina
- Somerset, New Jersey
- Orlando, Florida
- Loveland, Colorado

Key Regional Resources

- **Colleges & Universities**
  - Eastern Virginia Medical School
  - College of William & Mary
  - Hampton University
  - Old Dominion University
  - Norfolk State University
  - Medical College of Virginia
  - Tidewater Community College
  - University of Richmond
  - University of Virginia
  - Virginia Commonwealth University

- **Healthcare Providers**
  - Bon Secours Health System
  - Chesapeake Regional Medical Group
  - Children’s Hospital of the King’s Daughters (CHKD)
  - HCA Virginia
  - Sentara Healthcare
  - Naval Medical Center Portsmouth
  - Riverside Health System

- **Major Companies**
  - LifeNet Health
  - Operation Smile
  - Health Diagnostic Laboratories, Inc.
Areas of Focus

> **Diabetes & Related Complications**
>  – Rates are reaching epidemic proportions
>  – Many Virginia locations have some of the highest rates of diabetes in the country
>  – Expertise at institutions like EVMS provide opportunity for an integrated clinical program with academic collaboration

> **Cardiovascular Disease**
>  – Sentara’s Heart Hospital among the best in the nation
>  – Often results due to complications from diabetes and pre-diabetes

Goal

> **Capitalize on our areas of expertise, to be affirmed and defined by Facility Logix.**
> **Attract companies from the following sectors:**
>  – Big Data
>  – Analytics
>  – Centers of Excellence in Treatment and Research
>  – Life Sciences

> **Attract private equity to assist in the process.**
Princess Anne Commons

> The City of Virginia Beach has offered up to 1,500 acres for a Bio-Medical and Healthcare park in the Princess Anne Commons corridor of Virginia Beach.

> Phase I will begin with the construction of “Princess Anne Corporate Park” North and South on approximately 155 acres.

> Area already has a significant cluster of bio-medical companies and universities.
Potential Organization
Public and Private Financing Required

CCAM Model

> A Virginia nonstock corporation & a 501 (c) (3)
> Organized as a member organization and has multiple tiers of membership
  – Commensurate rights, benefits and obligations at each level.
  – Members consist of public and private entities.
> Engages in various types of research:
  – Generic research
  – Directed research
  – Third party research
  – Translational research
Our Financial Advantage

> Cost of doing business in our region is significantly lower than other bio-med hubs (San Diego, Boston, etc.)

> Virginia offers a variety of incentives at the state and local level.

  – Localities like Virginia Beach may offer grants if company meets certain capital investment or employment requirements

  – State level grants available, including:
    • Refundable Research & Development Tax Credit
    • Angel Investor Tax Credit
    • R&D Sales Tax Exemption
    • Virginia Bioscience Health Research Corp. Grants

> New incentive programs could be developed.

Next Steps
Next Steps

> **September 25, 2014**
  – Joint meeting of the Bio Task Force and Advisory Committee at The Westin

> **September-October, 2014**
  – Facility Logix will conduct stakeholder interviews as they perform their market assessment

> **October 23, 2014**
  – Bio Task Force meeting
  – Working draft of market assessment will be presented by Facility Logix

> **December 2014**
  – Plan will be presented to Mayor Sessoms

Questions?