Analysis of Modeling & Simulation in Virginia

REPORT SUMMARY
The ASTA Group, LLC • November 2014

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INTRODUCTION

Virginia is known for having a strong Modeling & Simulation sector. The Commonwealth’s capabilities in M&S will, if properly leveraged, play a significant role in advancing the New Virginia Economy. M&S capabilities and use cases continue to expand and are increasingly becoming interwoven into many aspects of our daily lives.

Our goal in completing this study was two-fold. First, we wanted to develop a comprehensive picture of M&S assets across the Commonwealth, and second, we wanted to engage stakeholders to hear their perspectives on potential uses and identify opportunities to leverage those capabilities for economic growth.

Karen Jackson  
Secretary of Technology  
Commonwealth of Virginia

This 2013 study was undertaken to assess the state and economic impact of M&S within Virginia and identify projected growth areas. The study report presents a comprehensive look at M&S in the Commonwealth from multiple perspectives. Major study activities included a meta-analysis of previous studies, the identification and inventory of Commonwealth M&S assets, the conduct of an M&S asset survey and regional focus group interviews, and economic analyses of both the M&S sector and M&S workforce. Data and findings informed recommendations for growing M&S capability within the Commonwealth and framing the way forward for its assets.

Workforce and economic analyses were conducted using county and independent city economic data and tools. The meta-analysis identified past trends pertaining to M&S activities in the Commonwealth. It also provided information to inform economic and workforce analyses and provided data for the asset inventory. The regional business survey and focus group interviews provided stakeholder input and perspectives. Participating stakeholders included industry, Government, and academic users, producers and teachers of M&S.

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Study data was analyzed at both the Commonwealth level (state-wide) and regional level. Study regions, shown in the figure below, were initially drawn based on those of existing Commonwealth Technology Councils. Counties and independent cities not included in existing councils were assigned to study regions based primarily on their proximity to an existing Technology Council.
The future is optimistic for Virginia’s M&S industry. Growth is dependent upon this industry’s continued transition beyond its Department of Defense roots to a more diverse marketplace. The transition will require a business model reorientation for some businesses, a steady stream of skilled M&S workers, increased collaboration and networking to promote connections, and campaigns to promote understanding of the boundless potential of M&S.

The Commonwealth’s M&S industry has historically focused on Department of Defense customers. Federal budget constraints have prompted M&S assets to search for ways to reorient business strategies and broaden their market reach. Targeted campaigns designed to increase public awareness of M&S may pave the way for increased utilization of M&S applications and workforce across disciplines.

The diversity of M&S requires proactive business development and creative thinking about emerging market needs, workforce, product development, market identification and marketing. Companies now need visionary leaders and multi-faceted employees for sales, development and service. Workers must both understand M&S technology and be able to effectively communicate its capabilities.

Increased collaboration among Virginia’s M&S companies, learning institutions and organizations will allow the Commonwealth to leverage specific regional applications and expertise across the whole of Virginia. Inter-regional collaborative activities will also help grow individual regional capabilities. Well-publicized networking opportunities that attract the breadth of the diverse M&S community is a key to creating collaboration among M&S assets. Such collaboration will facilitate further growth within each region and across the Commonwealth.

Despite the challenge of breaking into new markets, optimism prevails that the Commonwealth’s M&S industry will continue to grow. In order for growth to occur, the Commonwealth must take an active role in creating a multi-disciplined workforce, increasing the visibility of M&S, and promoting collaboration and networking to facilitate the expansion and transition of M&S to a more diverse marketplace.
The complexity of Virginia’s M&S industry is evident given its diverse set of stakeholders, assets and industry sectors. During the course of this study, 449 M&S assets were identified across Virginia. In 2013, Commonwealth M&S assets included 325 commercial businesses, 59 laboratory/research organizations, 41 educational organizations, 19 healthcare organizations and 5 Department of Defense organizations.

Of the assets identified, 96 chose to respond to the regional M&S survey. Respondents included representatives from all asset categories. Respondents reflect the varied nature of M&S in the marketplace. The majority of M&S businesses that participated in the survey could be categorized as small businesses. Thirty-seven percent of the business respondents reported annual revenue of less than $1 million, and another 24% reported $1 million to $10 million in annual revenue. More than half of the respondents reported that M&S products or services accounted for 25% or less of their annual budget. Nineteen percent of the respondents reported that M&S productions accounted for more than 50% of their total budget.

The pervasive nature of M&S requires estimating the proportion of M&S within other federally-recognized industry sectors. Using scenarios to estimate the prevalence of M&S across Virginia’s industry and employment sectors, study analyses estimated the impact of M&S on the Commonwealth’s Gross Regional Product to be $36.1 billion to $60 billion. The accompanying table presents the Gross Regional Product among the ten study regions, with highest and lowest scenario estimates included for each individual region.

Increasing the Visibility of M&S to Promote Economic Growth

M&S is a hidden capability within all regions in the Commonwealth. While Hampton Roads is recognized nationally as a hub of M&S activity, this is not necessarily true for the whole of the Commonwealth. The majority of survey and focus group participants agree that increasing the visibility of M&S capabilities and assets is a necessary step to promote growth of M&S in the Commonwealth.

An increase in M&S awareness and understanding may help overcome challenges faced by the M&S community. Respondents acknowledged that both the Government and the business community share the responsibility to promote M&S visibility.

Challenges of customer identification for product marketing and sales are two sided. On one hand, there is an oft-reported general lack of public knowledge about M&S which must be remedied. On the other hand, companies immediately need informed managers, marketers and sales and product development leaders who understand their specific M&S technology in order to communicate its capabilities with customers. These two needs make communicating and crafting effective messages difficult, but more difficult is reaching the right people who should be primed and receptive to M&S. Promoting business development and creative thinking about emerging market needs, workforce, product development and government contracts, in addition to the general effort to inform the public about the potential uses for M&S in their daily lives.

Study participants want the Commonwealth to play an active role in leading the way forward for M&S, including educating users about M&S benefits and capabilities, advocating for M&S at the National and Commonwealth level, and promoting Virginia as a leader in M&S. At all levels, Virginia’s government organizations may choose to demonstrate and publicize how they incorporate M&S into planning and decision-making. Publicizing the role of M&S in Virginia’s governance may enhance national recognition of the Commonwealth as a leader in M&S. This provide a model for local governments to follow, and foster collaboration among Government, industry and academia. Areas identified by study participants where Government may use M&S include transportation decision-making, water management and garbage collection, storm water management, and employee training. Virginia may also incorporate M&S requirements, as appropriate, into Virginia contracts and requests for proposals. This would demonstrate the potential of M&S applications and potentially promote cost-effectiveness in solutions.
At the core of this study is the question of what markets the Virginia M&S industry should transition to in order to decrease reliance on Government and Department of Defense contracts. Based on data collected, the primary markets currently served by M&S businesses are government, defense, education and training, aerospace and aviation, and engineering. At a 20,000-foot level, the answer can be gleaned for stakeholders based on the identification of other markets that are currently open to an M&S industry transition and which markets are predicted to be open in the future.

The health and medical market was identified as one undergoing rapid growth. In the future, study participants predict that the demand for epidemiological applications will increase. They also foresee increased use of cloud-based simulation and agent-based modeling in simulations. There were a number of markets identified as potentially underserved by Virginia’s M&S industry. In the accompanying figure, note the difference between those bars of emerging markets (red) that are significantly higher than current markets (green). Based on the data depiction, predicted strong agreement in growth is shown in Emergency Disaster, Utilities, Health Wellness, Natural Resources, Agriculture and Architecture. These may be the untapped markets to target for future development.

Gaining a foothold in the market is a major obstacle to marketplace expansion. Locating the first customer in a sector is tough and will require additional business development capability for some businesses. Increased networking opportunities to meet potential customers and develop a mutual understanding of needs and capabilities will need to be driven at the regional level. Business will require a proactive plan to build collaborative, cross-disciplinary relationships among businesses, research organizations and academic institutions to yield broader, more flexible and more attractive capabilities to potential customers.
Enabling M&S Collaboration & Networking

Study participants obviously want rallying points for M&S. The data reflects that it is ubiquitous, yet presently ill-defined, relatively faceless, even unknown in some regions. This could be remedied through stronger networking and collaboration among stakeholders.

Lack of networking restricts growth enjoyed by some regions and other industries. Many study participants report the lack of M&S-based networking as a significant challenge. Regional and Commonwealth-wide, M&S networking could be improved. Depending on which region one is considering, there may be little to no communication among stakeholders to facilitate M&S networking.

Some study participants put forth the idea of identifying an industry spokesperson to promote M&S in the Commonwealth as a way to foster networking. They want a strong, dynamic figure to promote the M&S industry, draw together stakeholders and facilitate networking events.

Moreover, study participants want their leaders to promote the industry. Stakeholders want to see Virginia politicians attending events to help build awareness of M&S. Leadership and organizations must be reachable and must actively engage local stakeholders to foster M&S growth.

Study participants desire the creation of a strong, consistent message to be put forth by industry leadership. Study participants also want the Commonwealth to provide networking opportunities in order to generate enthusiasm for M&S as an industry and offer platforms for stakeholder participation. They desire the establishment of regional-level organizations to facilitate these M&S efforts.

Some participants cite a need for a common M&S industry language or lexicon in order to facilitate the use, networking and growth of M&S. The formulation of industry definition may assist stakeholders in overcoming networking challenges, as it would both provide an identification point for interested parties and enable the many diverse components to connect.

Enabling M&S collaboration will provide avenues to industry expansion and transition beyond the Department of Defense. Numerous study participants point out the challenge of a lack of collaboration in M&S.

Stronger networking will facilitate collaboration by prompting the right connections. This became evident during the course of this study, when connections were made among focus group participants themselves. For example, during two separate focus groups, connections were made between business and academia, with goals of building a targeted curriculum and providing internships for students in M&S-related programs.

Obstacles to collaboration were identified by study participants as Intellectual Property protection concerns, prohibitive fees and costs, limited funding, extensive legal frameworks of universities, barriers to data access, and a lack of communication between industry and academia.

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Virginia’s current M&S workforce is varied and strong. Using Impact Analysis for Planning (IMPLAN) and United States Bureau of Labor Statistic data, study analyses estimate the total Virginia employment for M&S core and related sectors to be 608,942 employees, which is approximately 13% of Virginia’s total employment. Based on the workforce analysis, an estimated 11,650 to 17,000 skilled employees engage directly in M&S production, research or teaching in the Commonwealth. Core sectors with the highest employment are Computer Systems Design Services, Custom Programming Services, and Management, Scientific, and Technical Consulting Services. Private Hospitals and Architectural, Engineering and Related Services are the related sectors with the highest employment.

Virginia’s M&S Workforce

Study participants report that the M&S workforce must immediately expand and diversify its skills in order to grow M&S in Virginia. The emphasis on the need for cross-disciplined employees to produce and promote M&S applications, products and services was clear. Cross-disciplined employees must have both a technical/scientific understanding of the M&S application and an understanding of the business need for clients.

Workers directly producing M&S will need hands-on experience in simulation and modeling, not just theoretical application. M&S internships, apprenticeships, projects and certifications must include technical core M&S consulting services, and hands-on experience working with products and clients. They will also need experience in the practical application of dynamic databases with reasoning logic, web services and constructive and virtual simulation integration, with collaborative environments in a mobile end-user environment. Workers will also need a strong business background to help in commercialization and business development. A significant proportion of workers will need a background that allows them to obtain and maintain security clearances, as security concerns will grow with greater digital advancements, and workers must have eligibility to work in classified environments. Employers ideally want people knowledgeable in the entire lifecycle of M&S applications or at least several aspects of it. For example, employers would like people knowledgeable in a combination of requirements definition, actual performance, programming, troubleshooting and repair, and sale of simulation.

Study participants suggest that workers with M&S technical training should also have a background that matches customer requirements.

Virginia’s Future M&S Workforce

Study participants believe that M&S-related programs in Virginia universities and colleges need to be better aligned with workforce needs. This alignment can be informed through increased collaboration among industry and academics. More M&S apprenticeships and an emphasis on university internships to develop necessary M&S skills are recommended. Specific strategies used by stakeholders include encouraging companies to recruit interns from a nationwide pool and working with government organizations to fund internships for robotics and higher mathematics.

Study participants report that educational improvement needs to be focused on advanced physics, emerging computer technology, engineering, healthcare sciences, math and specific technical science capabilities, and math and science education to understand modeling. More geospatial modeling students and faculty, and a greater emphasis on systems dynamics thinking in higher education are also recommended.

Meeting Needs for Workforce Development

Future workforce requirements will need to be met by Virginia’s educational system through collaboration, provision of hands-on training and certification opportunities, and monetary incentives. Recommendations to increase M&S higher education output include supporting M&S training and education through expanded university degree programs and the establishment of employer/level M&S degrees in community colleges using traditional classrooms and distance learning.

Stakeholders recommend that educational institutions pair or formally collaborate with M&S industries to develop cross-disciplinary academic courses and programs. They also suggest that academic disciplines pair or formally collaborate with M&S industries to develop cross-disciplinary educational programs.

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Hampton Roads is nationally recognized as an M&S leader. For continued M&S growth, venture capital must be directed toward M&S, and a leader selected to spearhead the M&S industry. Stakeholders in the southern part of the region report that the industry is moving faster than graduates with simulation backgrounds can be produced, and young talent often migrates to Silicon Valley for higher salaries.

Region 2000 (Lynchburg) boasts M&S assets in energy, healthcare and manufacturing. There is a strong core of connected organizations and international ties, but assets see a need for more networking regionally. A critical mass of technology-oriented businesses is needed to draw a skilled workforce and new business, as is a more qualified workforce, particularly young engineers.

The Roanoke-Blacksburg Region has the critical mass to draw in M&S companies; however, study participants cite numerous hindrances to growth, including a lack of public-private collaboration, impediments to startup businesses, transportation issues, and a need for high-speed Internet access. The entrepreneurial community is stifled. Stakeholders want to connect industry and academia to benefit intellectual property (IP) and workforce development.

The Richmond Region has a strong presence in M&S in healthcare applications. The focus here is on cross-disciplined workers. Networking, startup funding and venture capital are needed. Expertise to develop a commercialization plan is also required. Market obstacles include a lack of enthusiasm for novel technologies. Products used include quantum chemistry simulations tools and audio/visual and programming services.

In the Northern Virginia Region, M&S must compete with a myriad of other focal points for attention; nonetheless, the region is recognized as a significant force for M&S. The region abounds with networking and business opportunity. The business environment is good, and local schools draw students of science and technology, which encourages workers with families to move to and stay in the area.

The Shenandoah Valley Region needs initial adopters of M&S. City governments are characterized as progressive-minded and seen as likely avenues to promote networking and development initiatives. The I-81 corridor has good infrastructure, but many rural areas still lack digital connectivity. K-12, community college and university undergraduate programs are healthy in STEM initiatives. Respondents would like a regional state university to push for greater M&S investment.

The Southern Piedmont Region is ready for M&S. The region has invested in the idea that if you build a workforce and infrastructure, business will follow. On the forefront are the Southern Virginia Higher Education Center, which is focused on education of advanced manufacturing, design and nursing, and the Riverstone Energy Center, with its research capacity. Infrastructure includes the Mid-Atlantic Broadband Cooperative. Broadband Infrastructure (100 Gbps) is headquartered in Halifax.

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