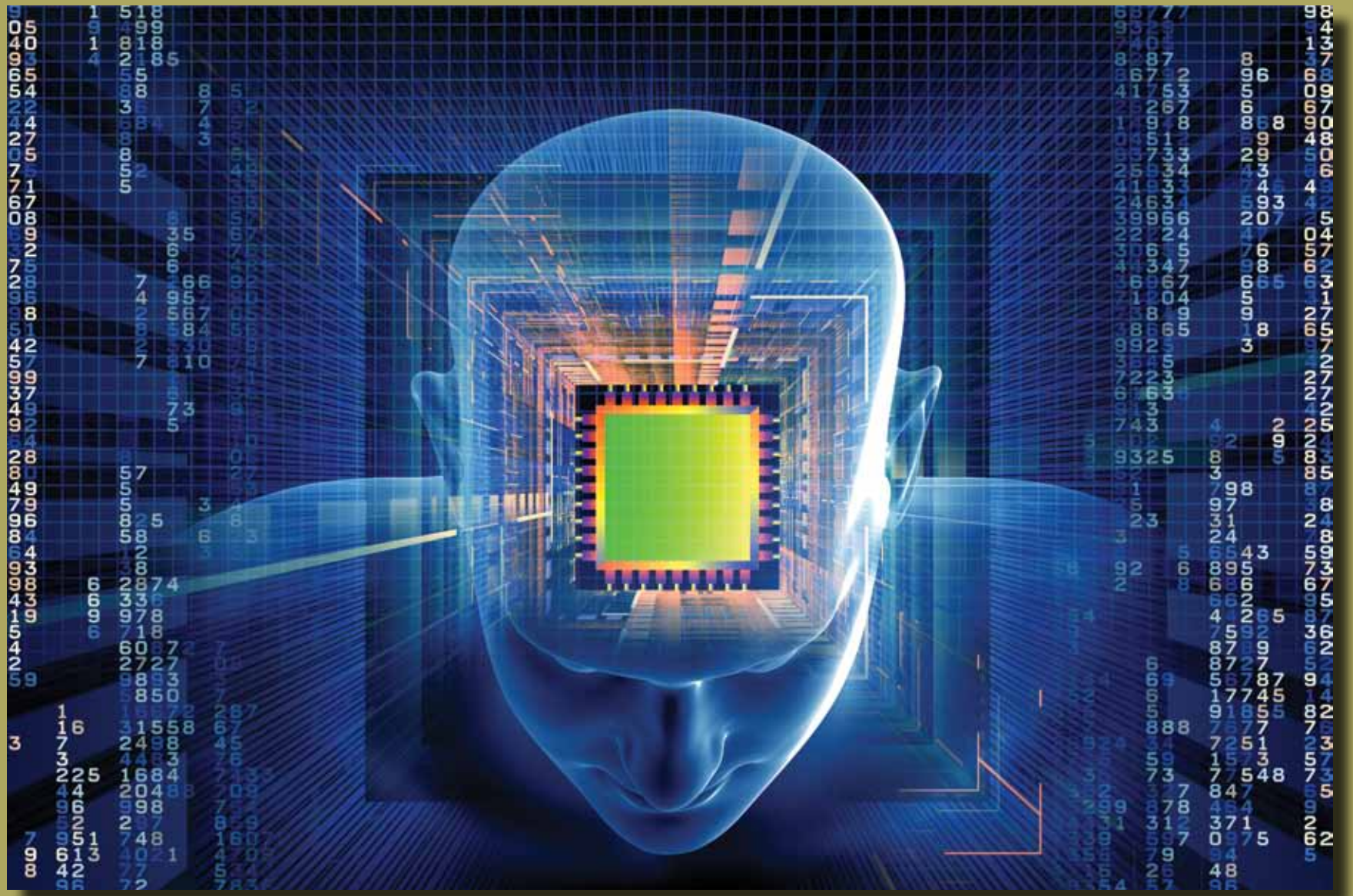
Modeling and Simulation in Hampton Roads



MODELING AND SIMULATION IN HAMPTON ROADS

This is one of the industries of the 21st century for Hampton Roads.
– CEO of a Fortune 500 firm in Northern Virginia

How big is the modeling and simulation industry in the United States and, more important, how big is it inside Hampton Roads? These are not easy questions to answer. The U.S. government, which relies upon the North American Industry Classification System (NAICS) to classify business activity in the nation, has never designated an NAICS code to represent the modeling and simulation (M&S) industry. Hence, M&S activities always are recorded as occurring as parts of activities in other industries.

Nevertheless, it appears that the U.S. Department of Defense (DOD) spends almost $9 billion annually on modeling and simulation activities. Many Americans (and not just teenagers) spend almost $16 billion annually on recreationally oriented games and simulations that range from fantasy games to World War II simulations. Business firms, state and local governments, universities, medical schools and nonprofit organizations may spend as much as $25 billion annually on M&S activities. Thus, approximately $50 billion in direct expenditures may be made annually in the United States on M&S products and activities.

The Virginia Economic Development Partnership (VEDP) estimates that the Commonwealth's M&S industry employs 11,300 people in the private sector and about 2,800 in the government and military. It reports a direct economic impact of $1.7 billion on an annual basis.

Virginia M&S is concentrated in two locations – Northern Virginia (6,300 employees) and Hampton Roads (4,800). According to the VEDP, these two regions are home to 107 and 139 companies, respectively, that offer modeling and simulation capabilities in addition to other products and services. Much of this activity is defense oriented. Virginia is home to some of the largest defense contractors and thus has a significant share of the DOD's modeling and simulation budget. Most defense-oriented work involves the use of M&S tools for training and analysis purposes. Figures 1 and 2 reveal the distribution of modeling and simulation companies by region.

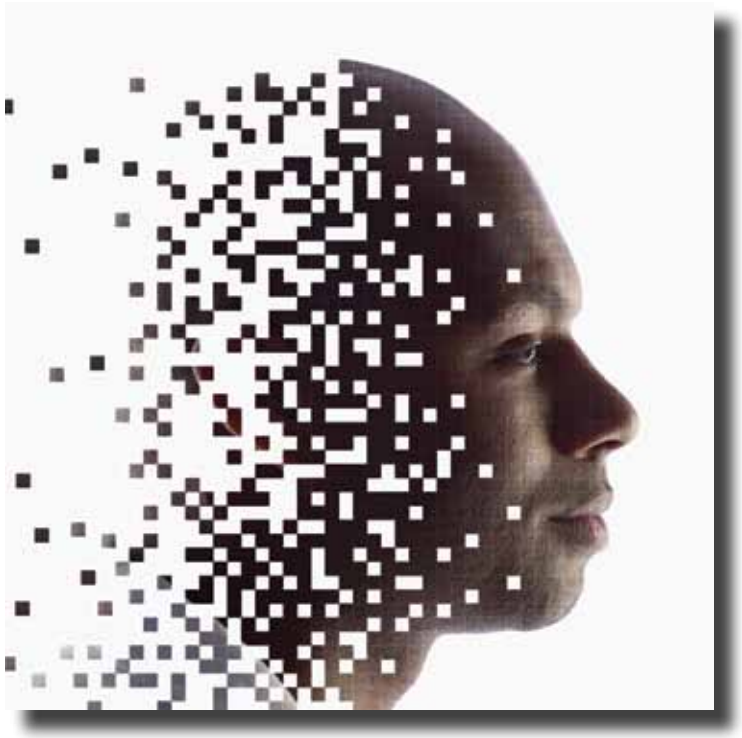


FIGURE 1

LOCATION OF MODELING AND SIMULATION FIRMS IN HAMPTON ROADS

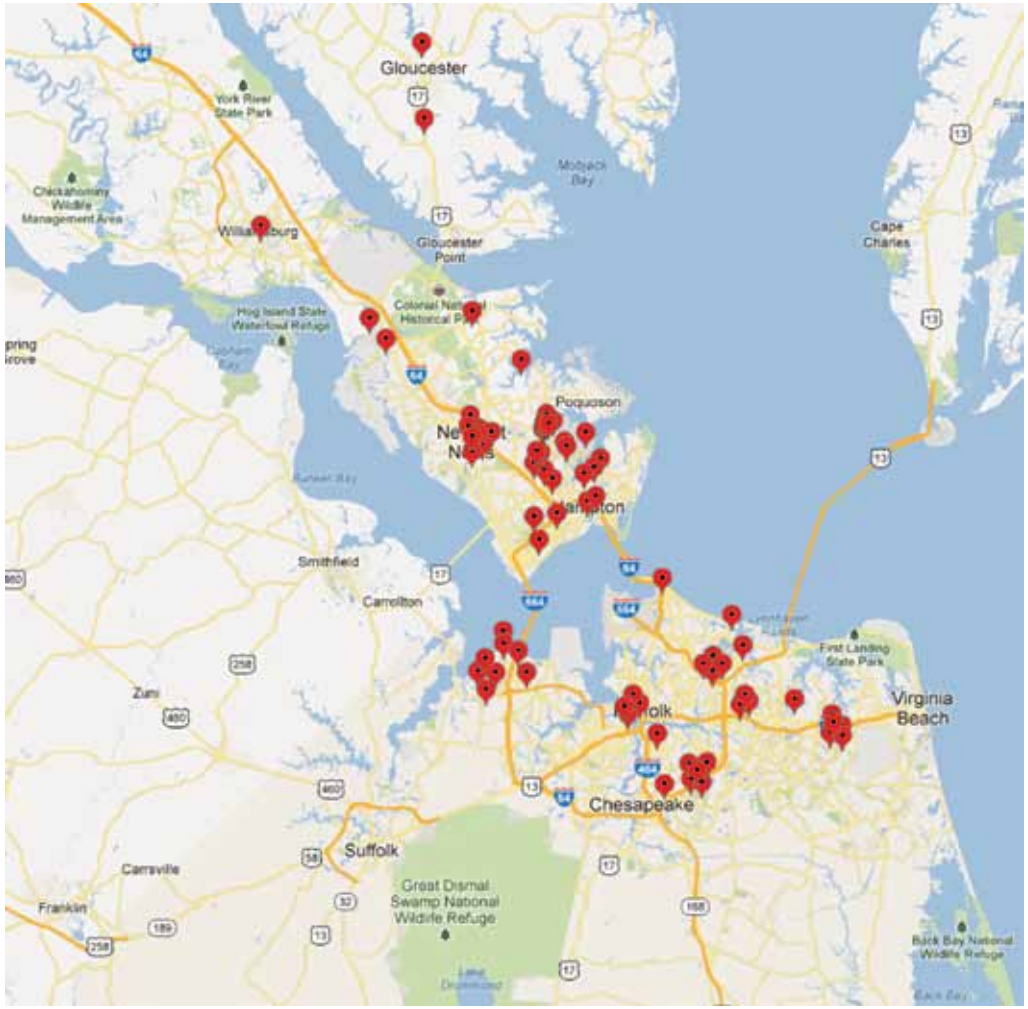
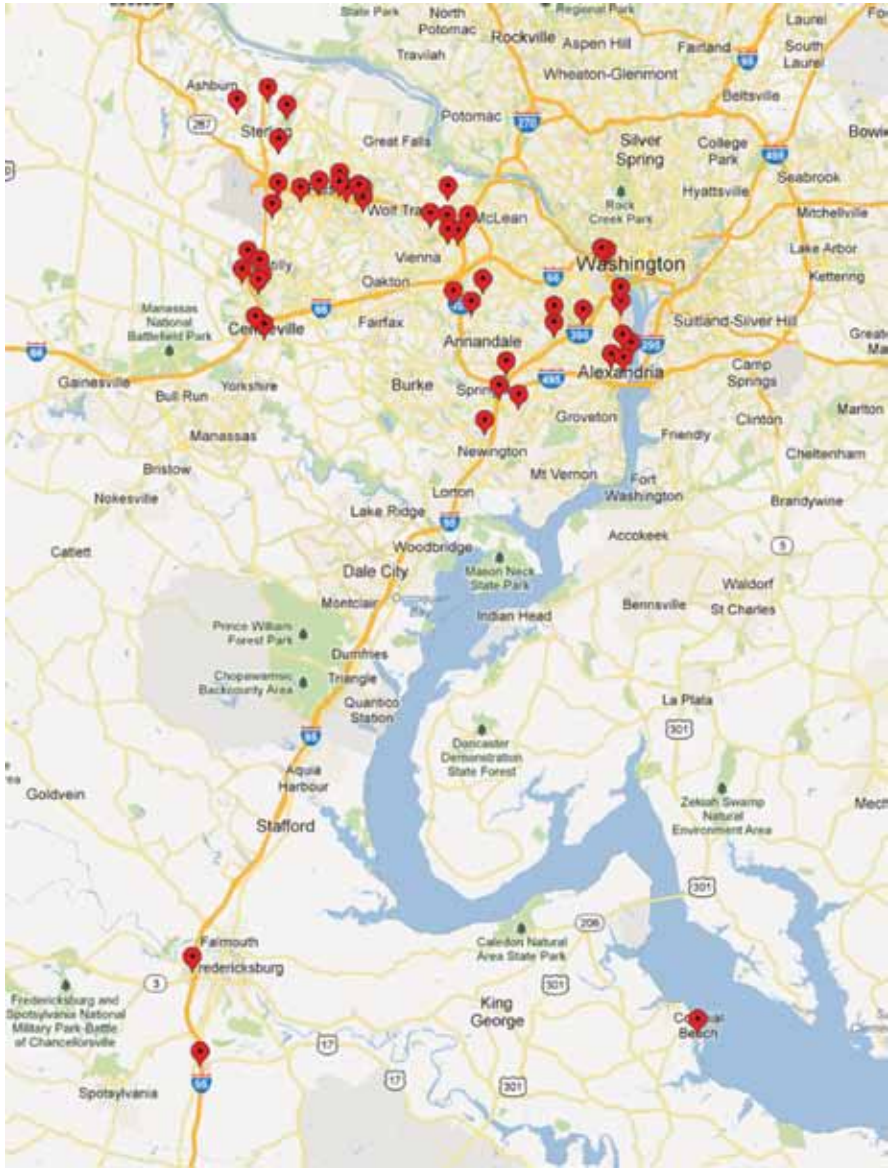


FIGURE 2

LOCATION OF MODELING AND SIMULATION FIRMS IN NORTHERN VIRGINIA



Modeling And Simulation As A Critical U.S. Industry

In a July 14, 2010, statement to the Subcommittee on Commerce, Trade and Consumer Protection of the Committee on Energy and Commerce, U.S. House of Representatives, Aneesh Chopra, the chief technology officer and associate director of the Office of Science and Technology Policy, Executive Office of the President, asserted that modeling and simulation can significantly reduce the need for physical prototypes in the manufacturing sector of the U.S. economy. This, he said, would shorten product development time, reduce costs and improve quality. Chopra, who previously was Virginia's secretary of technology, believes that M&S is capable of providing the country with a crucial manufacturing edge that will lead its manufacturing renaissance.

Previously, in June 2007, the U.S. House of Representatives approved House Resolution 487, which identified M&S as a National Critical Technology. This resolution was a result of the work of the M&S Congressional Caucus, which is headed by Hampton Roads congressman J. Randy Forbes. The resolution establishes that M&S is important to the national security. In fall 2011, the National Modeling and Simulation Coalition (NMSC) was formed. This organization grew out of the Modeling and Simulation Leadership Summit sponsored by Forbes. It focuses on bringing national attention to modeling and simulation and on helping to shape a national M&S agenda. More than 300 people attended NMSC's inaugural meeting in February 2012. There is little doubt that a variety of powerful private and public organizations are interested in the M&S field, not the least because it is seen as important to future progress by some and the source of profits by others.

A Closer Look At Modeling And Simulation In Hampton Roads

Here in Hampton Roads, the majority of modeling and simulation work is related to the military. Primary customers for this work include the Army's Training and Doctrine Command (TRADOC) at Fort Eustis, the Naval Warfare Development Command at Naval Base Norfolk and the Joint Coalition and Warfighting (JCW) arm of the Joint Staff in Suffolk. JCW embodies the now defunct Joint Forces Command (JFCOM), which used to be the primary funder of M&S-related capabilities in Hampton Roads.

A 2007 study asserted that the regional economic impact of the M&S industry on the region was $364 million. While this estimate may have been high-end, no one has argued that the economic impact of M&S on Hampton Roads is not large. The effect of M&S on cities such as Suffolk and on institutions such as Old Dominion University undeniably has been significant. As many as 10,000 jobs in our region are connected to modeling and simulation.

While military commands have been the primary M&S customers, private-sector firms have been the chief developers and providers of M&S technology. For example, the JCW and its industry partners have developed a distributed simulation system that supports the training of thousands of military personnel around the world in theater-level warfare, humanitarian missions and special-operations missions. This system is unsurpassed by any nation or military force in scale and capability and is designed to provide participants with realistic experiences and training that surely would be prohibitively expensive if participants were to be plunged into live situations around the globe. Of course, JFCOM was disestablished in 2011; however, its core M&S functions continue under JCW.

TRADOC contains a special M&S unit – the Training Brain Operations Center (TBOC). The Army describes this center as follows: "The TBOC

Systems Integration, Modeling and Simulation (SIMS) directorate is an award-winning standard bearer for innovative uses for modeling, simulation and gaming (MS&G). The SIMS team produces 3D visualizations, gaming scenarios, correlated terrain, and 3D models for operational, institutional, and self-development training domains, allowing multiple participants to train simultaneously in an environment based on lessons learned today. Taking serious gaming one step further, the TBOC, in association with the U.S. Army Research and Development Command (RDECOM), is developing a massive multiplayer online trainer that will allow soldiers and leaders to interact and collaborate using common scenarios in a virtual environment with other soldiers within their units and across the Army." Once again, the goal is to provide Army personnel with invaluable experiences that do not require formal "boots on the ground" in actual deployments around the world.

THE LOSS OF JFCOM

The closing of JFCOM has had a negative impact on the modeling and simulation industry in Hampton Roads. The Department of Defense claimed it would save $450 million annually by doing away with this command. It also predicted the demise of JFCOM would reduce DOD employment in Hampton Roads by about 3,000 workers.

It is difficult to tell if a reduction of this magnitude actually has occurred, though it is apparent that many M&S personnel have left the region. The core M&S functions of the DOD in Hampton Roads continue under the umbrella of the JCW. Nevertheless, it is indisputable that some private employers have disappeared as well as some DOD employees. Nevertheless, many Hampton Roads companies responded in a February 2012 survey that they are still performing various aspects of modeling and simulation work. The responding companies reported annual M&S payrolls of $94.8 million and average salaries of $85,000 for their employees. Thus, **M&S continues to provide many jobs in Hampton Roads that are attractive in terms of compensation and working conditions. Nevertheless, it remains to be seen if private-sector employers will be in it for the long run within our region.**

VMASC

Hampton Roads hosts one of the premier university research centers for modeling and simulation – the Virginia Modeling, Analysis and Simulation Center at Old Dominion University. VMASC has played a significant role in the advancement of M&S, regionally, nationally and internationally. **In many ways, VMASC has become the center node of modeling and simulation in the region. It hosts the Hampton Roads M&S consortium of industry members, whose goal is to promote the economic development of M&S in the region. VMASC generates about $8 million of annual research expenditures, which represents a four-fold return on investment in funds provided by the Commonwealth for its operation and a very gratifying return on the approximate $500,000 that ODU originally invested in M&S activities in the late 1990s.**

VMASC prefers a multidisciplinary approach to modeling and simulation and hence has the ability to address complex problems in many different economic sectors. It has major M&S research programs in defense-oriented activities, homeland security, transportation and medical/health care.

It is instructive that the medical/health care industry has begun to embrace M&S as a productivity-enhancing, cost-reducing approach to medical education, patient care and medical facility operations. An estimated $2.6 trillion is spent on health care in the United States annually, and thus the potential for productivity increases and savings is immense. **In truth, the medical/health care industry potentially is a much larger market for M&S than defense-oriented activities.**

Fortunately, the region is positioning itself to take advantage of several of its key resources in order to provide modeling and simulation capability in the medical/health care area. Old Dominion University and Eastern Virginia Medical School have partnered to develop medical/health care M&S. This partnership has existed since 2002 under the auspices of the National Center for Collaboration in Medical Modeling and Simulation (NCCMMS), a congressionally designated center for the advancement of the medical M&S field. NCCMMS recently received a $600,000 grant from the Commonwealth

to spur the transition of military M&S capability into the medical/health care field. The NCCMMS vision is attractive, namely, to make the Hampton Roads region nationally recognized as a center for medical/health care M&S innovation.

VMASC and EVMS have developed several simulations in this category. "The Virtual Operating Room" (see photo) is one such simulation. It involves the use of a surgical-skills trainer within a simulated operating room. The simulation immerses surgeons in a computer-generated operating room that includes avatars representing the attending physician, circulating nurse, anesthesiologist and others. This provides the capability for surgeons to train in a realistic environment without tying up a real operating room. It also gives users the opportunity to perform unusual surgeries that may arise only rarely, but must be familiar and practiced in order to ensure they will be capably handled in a real situation. The Virtual Operating Room provides medical schools with a greater ability to offer a consistent curriculum to all of their students. Without simulation, medical schools must rely on a variety of real patients that "walk through the door," and this seldom presents the variety or predictability of necessary patient cases that generate true medical proficiency.

Patient blood management simulation (see Figure 3) represents a second significant medical M&S application. It was developed to help train practicing surgeons and anesthesiologists in blood management techniques, but to do so more flexibly and less expensively. Blood management is an area of medicine receiving increased attention because of patient safety concerns and rising hospital operating costs.

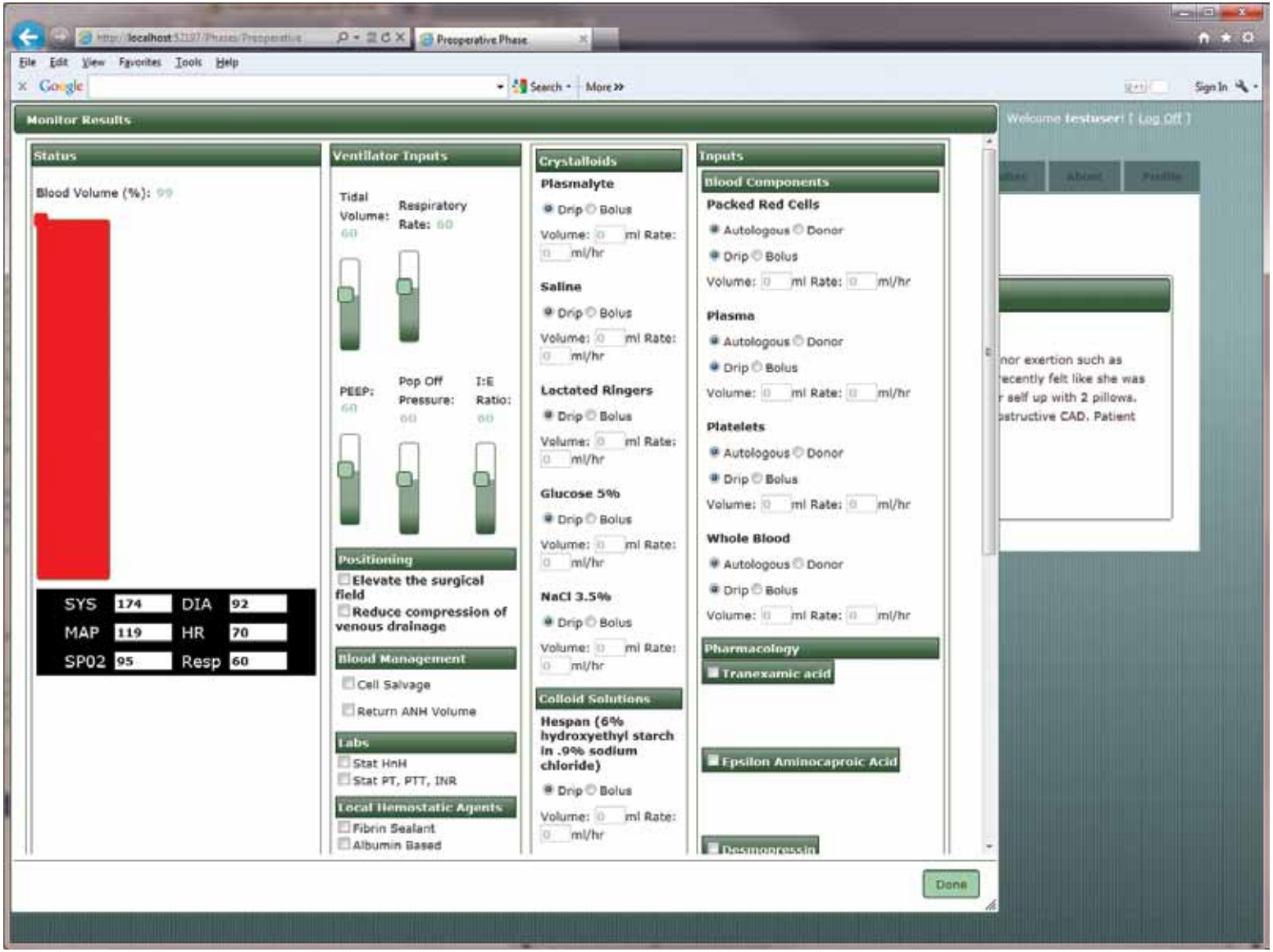
Blood management simulation allows medical professionals to experience a series of real patient case studies, make decisions about blood management and receive feedback on those decisions per published guidelines. It exposes them to a wide variety of situations and fosters rapid learning of new and improved techniques, even while minimizing their time away from actual patient care. Efforts are under way to license this simulation and it provides a useful example of how M&S innovation has the potential not only to improve the quality of life, but also to stimulate job growth.

Complementary to VMASC is ODU's Department of Modeling, Simulation and Visualization Engineering, the only such academic department in the United States. The MSVE department offers degree programs ranging from the baccalaureate to the Ph.D. The undergraduate M&S program is the only one in the country.

These degree programs are servicing the growing demand for M&S professionals. An estimated 29,000 job vacancies existed in M&S in the United States in March 2012, according to the employment search engine CareerJet. **With the initiation of the ODU undergraduate degree program in 2010, there is now a full continuum of M&S education in Hampton Roads, and such is not found anywhere else in the world.** Notably, other institutions such as Tidewater Community College and Thomas Nelson Community College also have developed M&S academic programs that both will generate individuals who might immediately occupy jobs and graduate other students who will transfer into ODU's M&S degree programs.

FIGURE 3

BLOOD MANAGEMENT TRAINING SIMULATION



MYMIC AND SIMIS

VMASC hosts an industry consortium of 19 companies that maintain a presence in Hampton Roads and are involved in M&S. The following two examples are instructive in demonstrating what these firms do and how they operate.

MYMIC is a Hampton Roads-based small business specializing in modeling, simulation, analysis and the use of gaming technology. It evolved out of the efforts of the region, ODU and VMASC to stimulate the use of M&S and encourage economic development within Hampton Roads in this sector. Founded in 2000 by Thomas Mastaglio and William L. Younger Jr., MYMIC employs 90 people in eight locations throughout the United States. The main offices are in Portsmouth, with satellite offices in Orlando, Fla., and Alexandria, Va. MYMIC has experienced an average annual growth rate above 20 percent; over the past four years it has increased its workforce from 30 to 90 employees. Annual revenues during that period increased from $3 million to $15 million.

MYMIC applies M&S technology across multiple application areas. Primary customers have been in the defense sector; however, over the past two years, it has begun marketing its capabilities to other government agencies and industry. Among current customers are NASA, the electrical power industry and seaports. The company emphasizes the integration of domain expertise with technical knowledge in order to deliver customized solutions, in many cases based on existing corporate product lines and expertise.

MYMIC's Scalable End to End Logistics Simulation (SEELS) toolset provides the foundation for the company to tailor and deliver a simulation model for any logistics installation, from seaports to warehouse intermodal facilities. Training of medical personnel is delivered using several different platforms. The Complex Incident Response Training System (CIRTS) is architecture for delivering training to those who work in critical positions and must react and make key decisions quickly in an emergency situation. CIRTS is being used to provide training for combat medics that must respond to multiple simultaneous casualty situations in combat. A version of the system to train emergency medical technicians is in development. Another interesting medical training solution involves teaching distributed medical response teams using avatars in a virtual world. The avatars are deployed over the Internet and employ gaming technology to provide therapy training for those who treat PTSD patients with traumatic brain injuries (TBI).

A large portion of MYMIC's business involves providing on-site services to government offices. These services include support for simulation tools, development and maintenance of enterprise information technology and database solutions, and the analysis of combat operations for strategic study purposes. MYMIC provides support to the Joint Chiefs of Staff, both in the Pentagon and those elements located in Hampton Roads. The analytic support MYMIC provides to the Joint Staff J8 is key to the smooth functioning of the Joint Capabilities Integration and Development System requirements process for delivering quality products and services to war fighters.

Currently MYMIC is examining the international market potential for its goods and services in Asia, the Middle East and Europe as a strategy to sustain its continuing growth. MYMIC is emblematic of the companies in the region that have been launched and grown as a result of a regional economic development focus on modeling and simulation.

SimIS Inc. is a 26-person, minority- and veteran-owned business and an 8(a)-certified corporation with the Small Business Administration (SBA). This certification enables it to enjoy special developmental support from the SBA. SimIS concentrates on innovative approaches and solutions in two fast-growing information technology sectors – modeling and simulation and information security. **Formed in 2007, SimIS has become notable for its determination, business acumen and customer focus.**

SimIS provides an excellent example of resiliency and flexibility in response to a changing economic environment. In August 2010, the secretary of defense announced that JFCOM would close. Johnny Garcia, CEO and president of SimIS Inc., knew that this would cause problems for SimIS because it was heavily dependent upon JFCOM-related projects. And, indeed, its 2011 revenues fell to $1.7 million, a 53 percent decrease from 2010. But, SimIS proved nimble and flexible, launching several new, commercialized products for the private sector that targeted the medical, training and entertainment industries.

One of the new products is the Automated Intelligent Mentoring System (AIMS), a cloud-based, subscription software package designed to change the way people learn in the medical community by supplying new, highly interactive methods of training. AIMS replaces more costly, simulated training that historically has provided only limited feedback to users. The result has been a cost-effective means to eliminate inconsistencies in training methods and to reduce time demands placed upon expert clinical educators.

SimIS quickly came to understand that product development for the commercial sector would place different financial demands on it than defense work. Medical markets purchase products and compensate producers for their efforts, but most of these customers are not strongly interested in becoming involved with the development process. By contrast, Department of Defense contracts often involve extensive DOD involvement in the shared development of new technologies.

Hence, in its new world, SimIS would have to take risks and self-fund product developmental work. However, it had an incentive to do so because there are more than 10,000 centers providing education in health care in the United States. Further, the simulation training market is about $1.5 billion annually in size. SimIS judged that the benefits and rewards likely would justify taking significant risks.

There is a happy ending to this tale. SimIS revenue estimates for 2012 and 2013 currently range between $6 million and $9 million.

The Competition

There are two other areas in the United States that can be considered as competitors to VMASC in the M&S field – Orlando, Fla., and Huntsville, Ala. Each of these cities has a university-based M&S research center similar to VMASC, graduate degree programs in M&S and at least one significant M&S customer such as the former JFCOM. A July 2010 report in the Orlando Sentinel estimated that the M&S industry in Orlando hosts 25,000 jobs and that it has an annual economic impact of $3 billion. Both of these numbers dwarf those reflecting M&S in Hampton Roads. The majority of these jobs are in two sectors, entertainment and defense, and the DOD spends large sums in Orlando. The Huntsville simulation effort is more modest and is connected primarily to the U.S. Army and NASA's Marshall Space Flight Center.

While these cities clearly can be considered to be competitors to Hampton Roads, and Orlando's modeling and simulation activities clearly are larger than those in our region, the M&S focus of both cities is somewhat different from that here. Our region has focused on the use of computer simulations in training and decision-support roles. We have developed unique expertise in these areas of simulation application not found in the other two regions. Orlando's expertise centers on large-simulation system development, such as cockpit flight simulators. Huntsville's focus has been in the development of simulations to address specific engineering design problems. Thus, while there is overlap, it is not extensive.

Final Thoughts

There can be little doubt that the closure of JFCOM put a serious dent in M&S activity in Hampton Roads, which prior to that misfortune had been on a strong, upward trajectory. If there is a bright spot connected to this situation, it is that JFCOM's demise forced regional M&S personnel to focus much more intensely on private-sector applications. Our budding expertise in medical- and health-oriented M&S applications exemplifies such a thrust.

Ultimately, it is private-sector spinoffs from defense-oriented modeling and simulation that will determine whether our regional investment in M&S activities will have paid off. The trajectory of other technology-intensive regions (for example, Boston's Route 128 corridor, Austin, Texas, and Silicon Valley) typically began with significant public-sector investments (federal and state) in research areas such as the Defense Advanced Research Projects Agency network that evolved into the Internet, or interest in transistors and microcircuitry. These regions contained institutions of higher education and private firms that were able to capitalize on such investments and commercialize dozens of new technologies that flowed from the initial governmental interest.

It remains to be seen whether we in Hampton Roads are able to walk the same general path. We certainly aren't starting at ground zero. The extensive military presence in Hampton Roads guarantees that some defense-oriented M&S activity always will occur in our region. Further, Old Dominion University has made a major financial commitment to faculty, curricula and research in M&S. Nevertheless, it will be the end of this decade before we know whether these proverbial saplings will have grown into mighty oaks.