
**Analysis of the
Educational Pipeline for
Modeling and Simulation Graduates
in the SEVA-PORT Area**

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Executive Summary

In July 2007, the Southeastern Virginia Partnership for Regional Transformation (SEVA-PORT) was awarded a \$5 million Workforce Innovation in Regional Economic Development (WIRED) grant. The goal of the grant was to enable SEVA-PORT to build and enhance linkages between Hampton Road's emerging *Modeling and Simulation* cluster and the region's long-time port-related Transportation, Warehousing, and Distribution cluster. This report assists in that effort by providing an empirical assessment of the current capacity of the educational pipeline for graduates in *Modeling and Simulation* related programs, the future occupation-driven demand for those graduates, and potential gaps between the two.

The primary findings from that assessment are as follows:

1. *Modeling and Simulation* is a high-wage/high-growth industry within the SEVA-Port area.

- Between 1991 and 2007, employment in SEVA-PORT's *Modeling and Simulation* related industries grew by 117 percent, as compared to an average employment growth of 26 percent across all industries within the area.
- In 2007 SEVA-PORT's *Modeling and Simulation* related industries paid average weekly wages of \$1,315, as compared to \$749 across all industries.

2. Colleges and universities in the SEVA-PORT area currently produce about 1,570 graduates per year in programs and at degree levels that map directly into the occupational requirements of the regional *Modeling and Simulation* industry.

- Out of the 26 colleges and universities directly serving the SEVA-PORT area, 14 currently produce graduates in these programs.
- Between 2004-05 and 2006-07, these 14 institutions graduated approximately 2,275 individuals per year in *Modeling and Simulation* related programs, and of that total 1,570 were at degree levels that directly mapped into the occupational requirements of the *Modeling and Simulation* industry.
- The largest producer of graduates at the certificate and Associates levels was ECPI College of Technology, while at the BA/BS level and above it was Old Dominion University.
- Between 2000-01 and 2006-07, the number of *Modeling and Simulation* related graduates at the Associates, BA/BS, MA/MS, and Ph.D. levels increased by 186 percent, 12 percent, 119 percent, and 33 percent respectively.

In contrast, the number of graduates at the certificate level actually declined by 31 percent.

3. Between 2006 and 2016, the occupation driven demand for graduates from *Modeling and Simulation* related programs in the SEVA-PORT area may approach 2,129 per year.

- The bulk of this demand will be driven by increased labor demand in the two occupations *Computer Software Engineers, Applications* and *Computer Systems Analysts*.
- Most of the demand will be for graduates at the BA/BS level.

4. A comparison of data on the current educational pipeline for graduates in *Modeling and Simulation* related programs and the future occupation-driven demand for those graduates, shows that there may be some significant gaps between the two.

- The largest gaps between the two are likely to occur at the baccalaureate level.
- Specifically, there are likely to be significant shortfalls in the supply of BA/BS graduates from the *Computer and Information Sciences, General; Information Technology*; and *Computer Science* programs.
- The largest gap is likely to occur with respect to the *Computer and Information Sciences, General* program, where the annual shortfall could reach 282 per year. This is particularly noteworthy because, between 2000-01 and 2006-07 the regional number of BA/BS graduates from this program declined by 40.6 percent.

This workforce solution was funded by a grant awarded under Workforce Innovation in Regional Economic Development (WIRED) as implemented by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. This solution is copyrighted by the institution that created it. Internal use by an organization and/or personal use by an individual for non-commercial purposes is permissible. All other uses require the prior authorization of the copyright owner.

Introduction

In July 2007, the Southeastern Virginia Partnership for Regional Transformation (SEVA-PORT) was awarded a \$5 million Workforce Innovation in Regional Economic Development (WIRED) grant. The goal of the grant was to enable SEVA-PORT to build and enhance linkages between Hampton Road's emerging *Modeling and Simulation* cluster and the region's long-time port-related Transportation, Warehousing, and Distribution cluster. The purpose of this report is to assist in that effort by providing an empirical assessment of the current capacity of the educational pipeline for graduates in *Modeling and Simulation* related programs, the future occupation-driven demand for those graduates, and potential gaps between the two.

The remainder of this report is divided into three sections. In the first section, we provide a regional profile for Hampton Roads in general and the *Modeling and Simulation* industry in particular. This information is intended to illuminate the current capacity of the educational pipeline for *Modeling and Simulation* workers and provide general background and context for the empirical analysis that follows. In the second section, we compare the existing pipeline of graduates from *Modeling and Simulation* related postsecondary education programs within the broader Hampton Roads region to the estimated occupation-driven demand for those trained individuals. That comparison allows us to identify and quantify potential shortfalls in the existing educational pipeline. In the third section, we provide a summary and conclusions.

This report was prepared by Mangum Economic Consulting, LLC at the request of Opportunity Inc. of Hampton Roads.

Regional Profile

Demographic Characteristics

As depicted in the map shown in Figure 1, the SEVA-PORT initiative encompasses 25 cities and counties in Southeastern Virginia.¹ In 2000, these localities had a combined population of just under 2.0 million and accounted for 28.2 percent of Virginia's total population.² Between 2000 and 2020, the area's combined population is projected to grow to just over 2.4 million, an increase of 20.3 percent.³

¹ These localities include the counties of Chesterfield, Dinwiddie, Gloucester, Greenville, Isle of Wight, James City, Price George, Southampton, Surry, Sussex, and York, and the cities of Chesapeake, Colonial Heights, Emporia, Franklin, Hampton, Hopewell, Newport News, Norfolk, Petersburg, Poquoson, Portsmouth, Suffolk, Williamsburg, and Virginia Beach.

² *Data source:* U.S. Census Bureau. Although the U.S. Census Bureau does produce intra-decennial population estimates through the American Community Survey, these estimates are not produced for smaller communities such



Figure 1: Map of participating SEVA-PORT Cities and Counties

Among the area’s key demographic characteristics, it should be noted that in 2000 the population of these localities tended to be slightly younger than was typical for the state as a whole. Where statewide in that year the median age was 35.7, in the SEVA-PORT area it was 34.0.⁴ Another interesting demographic characteristic is that these localities exhibited slightly higher educational attainment rates than were typical for the state as a whole. Where in the SEVA-PORT area, 83.8 percent of individuals 25 years of age and older had a high school degree, statewide the figure was 81.5 percent.⁵ Similarly, where in the SEVA-PORT area 29.7 percent individuals 25 years of age and older had a baccalaureate degree, statewide the figure was 29.5 percent.

as the cities of Colonial Heights, Emporia, or Poquoson. For that reason, estimates from the 2000 Census are used here because they comprise the most recent data available for the SEVA-PORT region as a whole.

³ Data source: Virginia Employment Commission.

⁴ Data source: U.S. Census Bureau.

⁵ Data Source: U.S. Census Bureau.

Economic Characteristics

Overall Employment and Wage Trends

Figure 2 details the change in total employment in the SEVA-PORT area between 1991 and 2007 (the trough of the 1990-91 recession through the most recent year for which annual data are available). As this graph shows, total employment grew from 643,680 in 1991 to 810,750 in 2007, an increase of 26.0 percent. This growth compares favorably with most other areas of the state (*e.g.*, between 1991 and 2007 Northern Virginia led the state with a 53.6 percent increase in total employment, while total employment in greater Richmond grew by 28.8 percent, in greater Roanoke 17.5 percent, and in greater Lynchburg 14.1 percent).

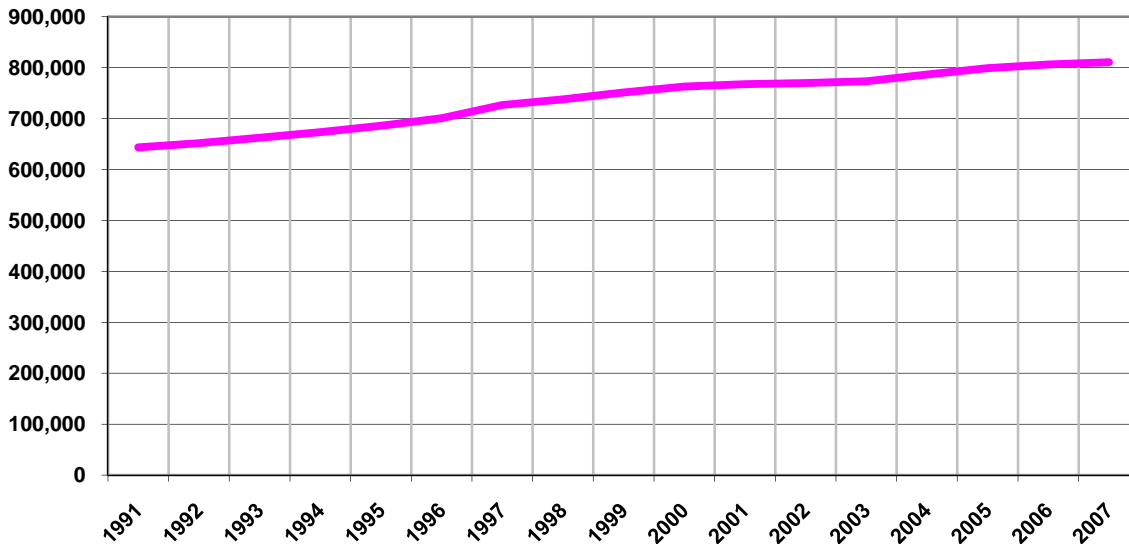


Figure 2: Total Employment – 1991 to 2007⁶

Figure 3 provides the comparable trend for real wages (depicted in constant 2008 dollars). Over this period, inflation adjusted wages in the SEVA-PORT area grew from an average of \$647 per week in 1991 to \$749 per week in 2007, a real increase of 15.8 percent over the period as a whole. This growth also compares favorably with most other areas of the state (*e.g.*, between 1991 and 2007 Northern Virginia again led the state with

⁶ *Data Source:* Virginia Employment Commission. Employment figures provided here and throughout the remainder of the report are based on data from the Crater Area, Hampton Roads, and Greater Peninsula Workforce Investment Areas. It should be noted that with one exception, these Workforce Investment Areas include all cities and counties participating in the SEVA-PORT initiative. That one exception is Chesterfield County.

a 37.1 percent increase in real wages, while real wages in greater Richmond grew by 22.2 percent, in greater Roanoke 12.3 percent, and in greater Lynchburg 11.9 percent).

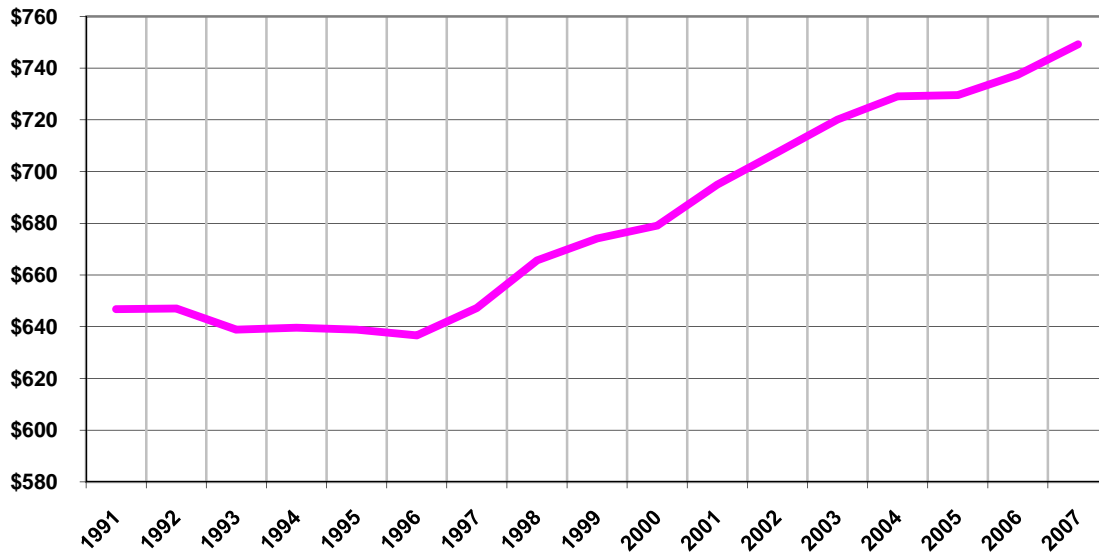


Figure 3: Real Average Weekly Wages (2008 dollars) – 1991 to 2007⁷

Employment and Wages by Industry

Figures 4 and 5 provide a snapshot of employment and wages in the SEVA-PORT area by major industry sector in the third quarter of 2008 (the most recent period for which data are available), as compared to the third quarter of 2000. As shown in Figure 4, the largest positive changes in employment over the period occurred in the *Healthcare*, *Professional and Technical Services*, *Accommodation and Food Services*, and *Education* sectors. Specifically, between 2000:Q3 and 2008:Q3:

- The *Healthcare* sector demonstrated the largest absolute increase in employment, growing by 20,478 jobs, or 27.9 percent.
- The *Professional, Scientific, and Technical Services* sector, the sector that encompasses most *Modeling and Simulation Industries*, saw the second largest absolute increase in employment, growing by 11,146 jobs, or 27.3 percent. This is a noteworthy trend because, as shown in Figure 5, in 2008 the *Professional and*

⁷ Data Source: Virginia Employment Commission.

Technical Services sector was the SEVA-PORT area's third highest ranked sector in terms of wages, with average weekly wages of \$1,126.

- The *Accommodation and Food Service* sector saw the third largest absolute increase in employment, growing by 10,412 jobs, or 14.3 percent.
- The *Education* sector saw the fourth largest absolute increase in employment, growing by 7,949 jobs, or 13.5 percent.

At the other end of the spectrum, the largest negative changes in employment occurred in the *Manufacturing* and *Transportation and Warehousing* sectors. Specifically, between 2000:Q3 and 2008:Q3:

- The *Manufacturing* sector experienced the largest absolute decrease in employment, losing a total of 8,961 jobs, or 11.0 percent. This is also a significant trend because, as shown in Figure 5, in 2008 the *Manufacturing* sector was the SEVA-PORT area's fifth highest ranked sector in terms of wages, with average weekly wages of \$994.
- The *Transportation and Warehousing* sector saw the second largest absolute decrease in employment, losing a total of 965 jobs, or 3.0 percent.

Regional Industry Specialization

One metric economists use to shed light on the degree to which a region specializes in particular industry sectors is called a location quotient. Location quotients measure the concentration of a given industry's employment within a locality, relative to its employment concentration at the state or national level. If the location quotient is below one, that indicates the industry has a smaller "footprint" within the locality than one would expect, based on the statewide or national norm. If the location quotient is above one, the industry has a larger footprint than one would expect. As shown in Figure 6, those industry sectors demonstrating the largest footprint in the SEVA-PORT area based on 2008:Q3 data were *Real Estate* (LQ = 1.31), *Utilities* (LQ = 1.28), *Arts, Entertainment, and Recreation* (LQ = 1.28), *Accommodation and Food Services* (LQ = 1.22), and *Manufacturing* (LQ = 1.21).

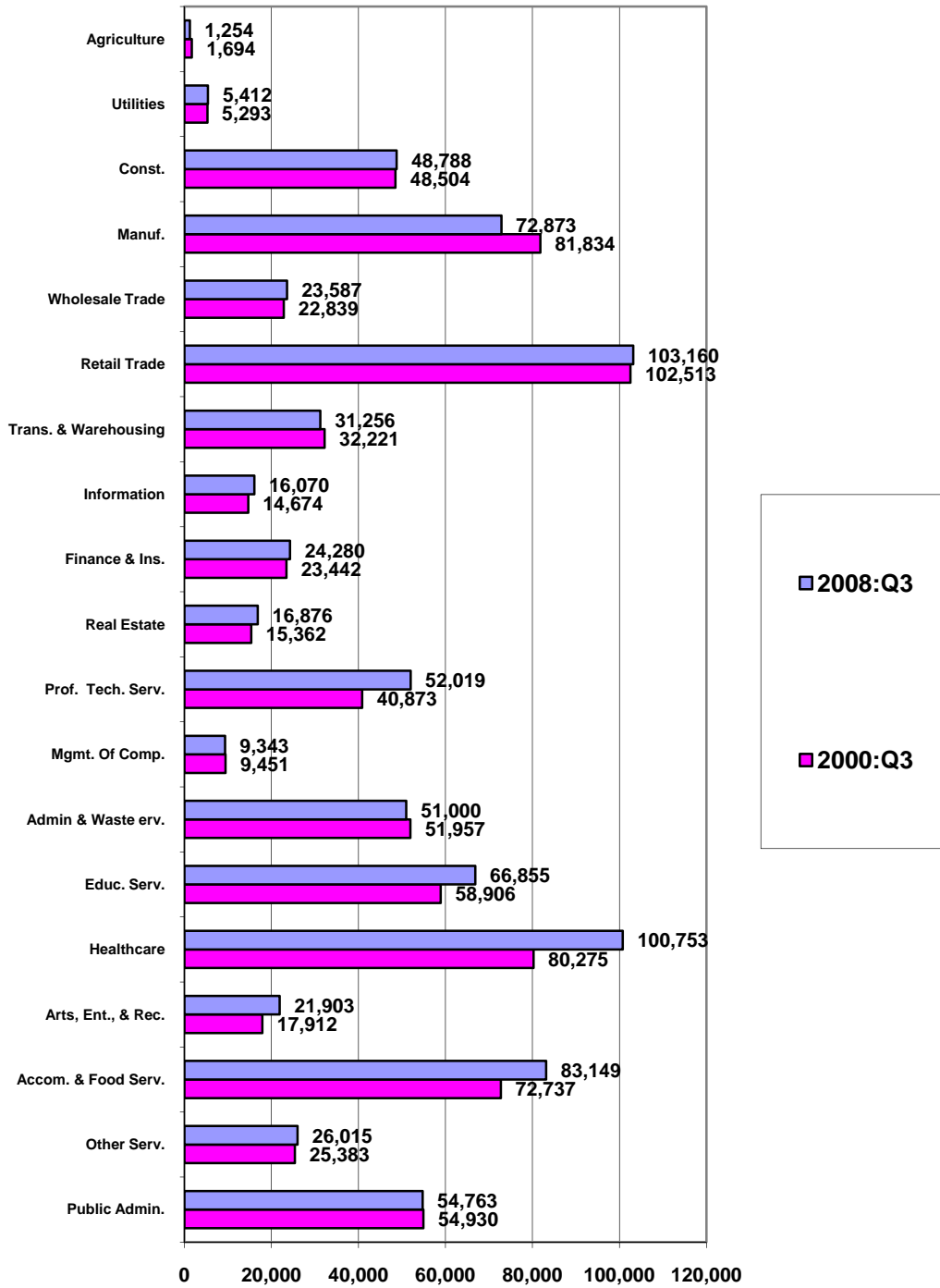


Figure 4: 2000:Q3 and 2008:Q3 Employment by Major Industry Category in the SEVA-PORT Area⁸

⁸ Data Source: Virginia Employment Commission.

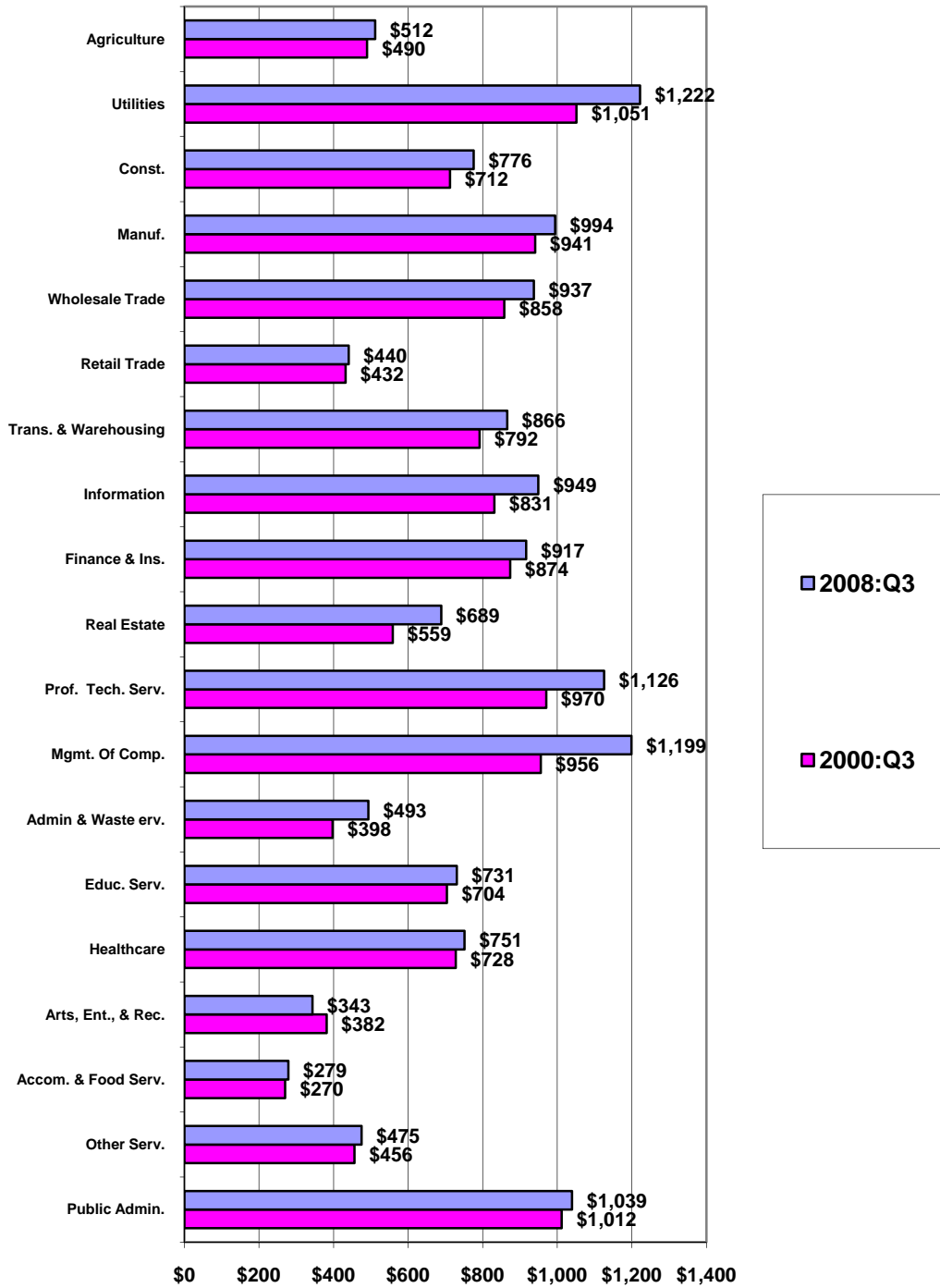


Figure 5: 2000:Q3 and 2008:Q3 Real Average Weekly Wages by Major Industry Category (2008 dollars) in the SEVA-PORT Area⁹

⁹ Data Source: Virginia Employment Commission.

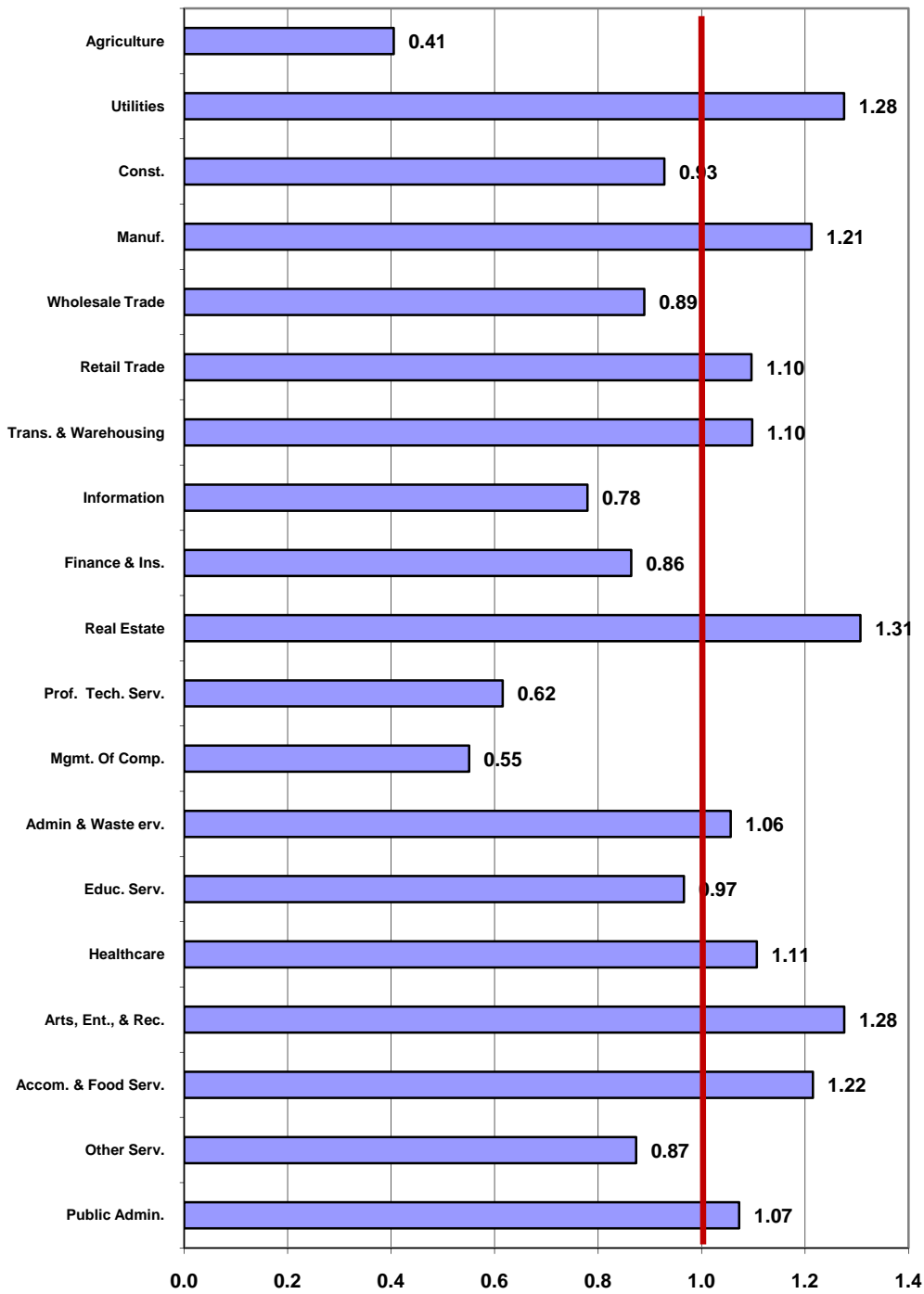


Figure 6: 2008:Q3 Industry Location Quotients in the SEVA-PORT Area¹⁰

¹⁰ *Data Source:* Derived from employment data provided by the Virginia Employment Commission.

Unemployment

Figures 7 and 8 provide information on recent unemployment trends in the SEVA-PORT area. Figure 7 compares the annual unemployment rate in the SEVA-PORT area to the statewide rate for the period from 1991 through 2007 (the trough of the 1990-91 recession through the most recent year for which annual data are available). As these data show, unemployment in the SEVA-PORT area closely paralleled the statewide trend, although on average it was 0.4 percent above the statewide rate.

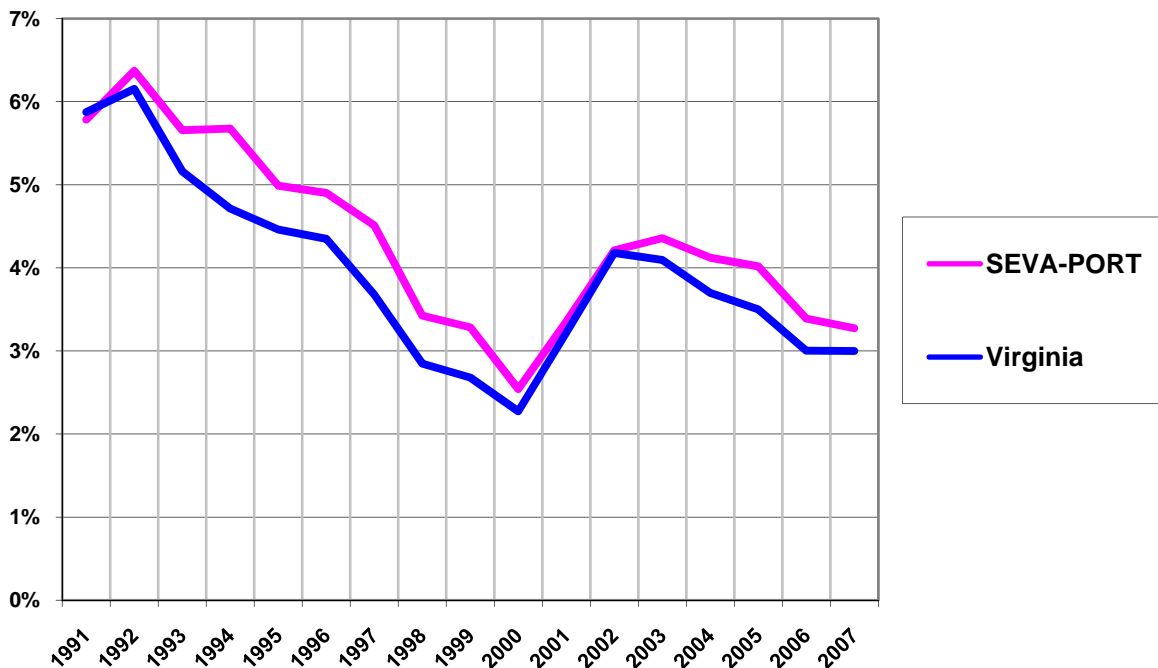


Figure 7: Unemployment Rate – 1991 to 2007¹¹

Figure 8 focuses on more recent monthly data covering the period from April 2008 through April 2009. The most striking aspect of these data is the extent to which unemployment rates increased precipitously in the fourth quarter of 2008. Between October of 2008 and February of 2009, the unemployment rate in the SEVA-PORT area increased from 4.5 percent to 7.4 percent. This was consistent with the statewide trend where unemployment rates increased from 4.2 percent in October of 2008 to 7.0 percent in February of 2009. Another interesting feature of these data is that unemployment in the SEVA-PORT area continued to closely parallel the statewide trend while remaining about 0.4 percent above the statewide average.

¹¹ Data Source: Virginia Employment Commission.

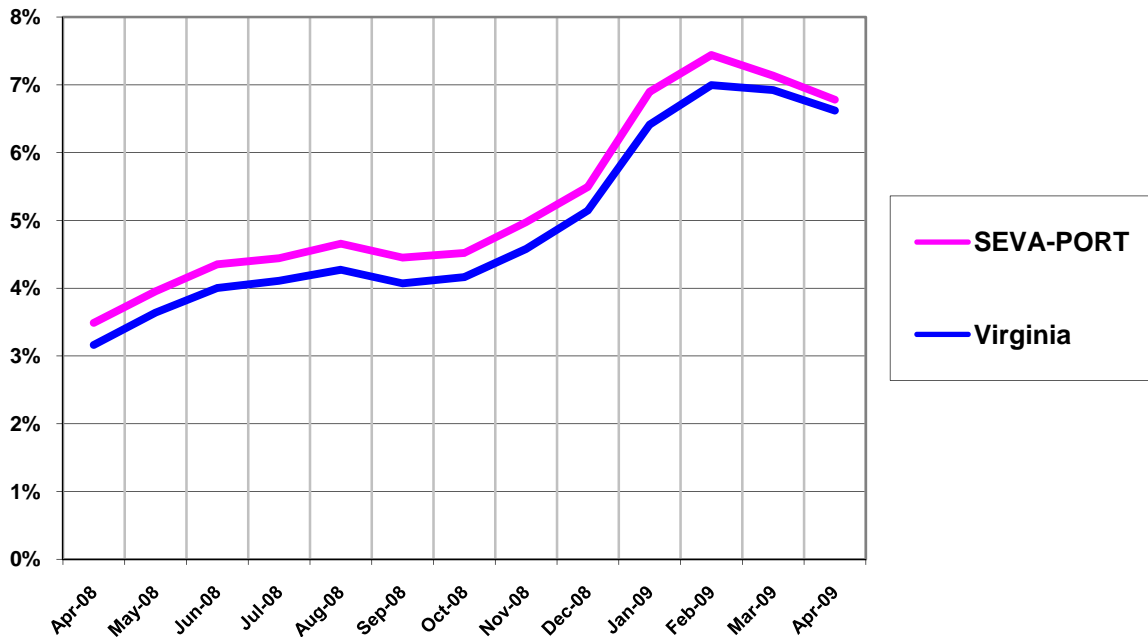


Figure 8: Unemployment Rate – April 2008 to April 2009¹²

Modeling and Simulation Industry

In this section, we narrow the focus to the SEVA-PORT area’s *Modeling and Simulation* industry specifically. The origins of this industry within the region can be traced to Old Dominion University’s creation of the Virginia Modeling, Analysis, and Simulation Center (VMASC) in July 1997. Originally intended to serve the training needs of Hampton Roads’ large military presence, the VMASC has grown into Old Dominion University’s largest research producer. And with this growth it has spearheaded the development of a thriving *Modeling and Simulation* cluster in Southeastern Virginia. According to a 2005 study, this cluster has grown to have a significant economic impact on the region, contributing \$413 million to the region’s economy in 2004.¹³

Because the *North American Industry Classification System* (NAICS) taxonomy employed by the U.S. Bureau of Labor Statistics and state employment commissions to classify industry employment data does not include codes that are specific to the *Modeling and Simulation* industry, in this section and the analysis that follows we are

¹² Data Source: Virginia Employment Commission.

¹³ Angle Technology, “Modeling, Simulation, and Visualization Economic Impact and Cluster Study for Hampton Roads Virginia,” March 2005.

constrained to use more broadly tailored industry classifications to estimate the size and workforce requirements of the SEVA-PORT area's *Modeling and Simulation* industry. Based on an analysis of the relevant literature, we selected nine specific NAICS classifications to represent SEVA-PORT's *Modeling and Simulation* industry.¹⁴ Those NAICS classifications are: 1) *Computer Facilities Management Services* (NAICS 541513), 2) *Computer Systems Design Services* (NAICS 541512), 3) *Custom Computer Programming Services* (NAICS 541511), 4) *Data Processing and Related Services* (NAICS 518210), 5) *Engineering Services* (NAICS 541330), 6) *Environmental Consulting Services* (NAICS 541620), 7) *Other Computer Related Services* (NAICS 541519), 8) *Process & Logistics Consulting Services* (NAICS 541614), and 9) *Software Publishers* (NAICS 511210).

Employment, Establishments, and Wage Trends

Data on annual employment in the SEVA-PORT area for 1991 through 2007 in the nine *Modeling and Simulation* related NAICS classifications detailed above are provided in Figure 9. As this graph shows, the largest employment increase over this period occurred in *Engineering Services*, which grew by 7,712 jobs, or 107.6 percent. *Computer Systems Design Services* posted the second largest increase, growing by 5,504 jobs, or 339.3 percent. Overall, employment in these *Modeling and Simulation* industries grew from 13,064 in 1991 to 28,331 in 2007, an increase of 15,267 jobs, or 116.9 percent.

Figure 10 provides similar data for the number of *Modeling and Simulation* related firms in the SEVA-PORT area. In this case, the largest increase occurred in *Computer Systems Design Services*, where the number of existing firms grew by 385, or 527.4 percent, between 1991 and 2007. *Engineering Services* saw the second largest increase, adding 264 firms, or 128.2 percent. Overall, the number of firms in these industries went from 385 in 1991 to 1,435 in 2007, an increase of 984, or 218.2 percent.

Finally, Figure 11 provides comparable trend data for real wages (depicted in constant 2008 dollars). Between 1991 and 2007, the inflation adjusted wage in the SEVA-PORT area across all nine *Modeling and Simulation* related NAICS classifications went from \$998 to \$1,315 per week, a 31.7 percent real increase. This is substantially greater than the 15.8 percent average real wage increase across all industries within the region over this period. In addition, at \$1,315 per week these nine *Modeling and Simulation* related industries paid wages in 2007 that were significantly above the \$749 per week regional average.

¹⁴ See Innovation Insight, "Impact of Florida's Simulation, Modeling, and Training Industries," Fall 2003.

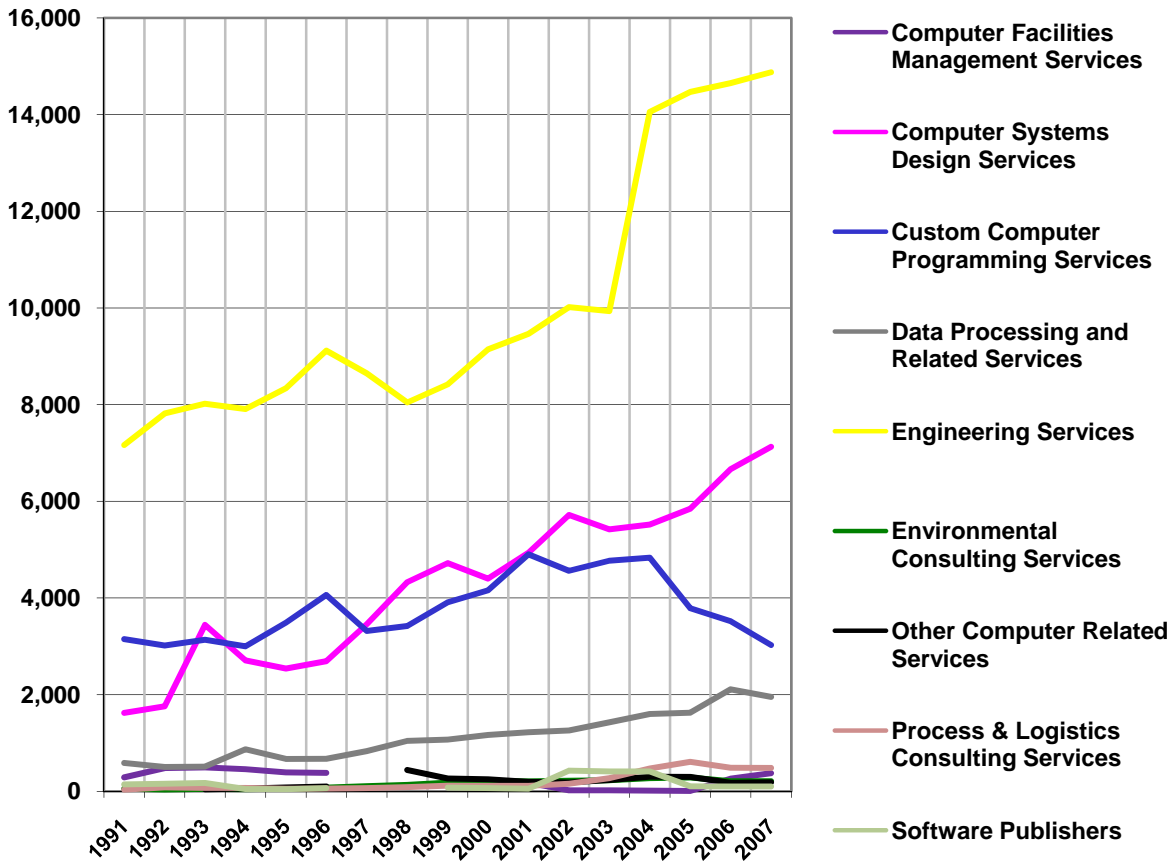


Figure 9: Modeling and Simulation related Employment in the SEVA-PORT Area – 1991 to 2007¹⁵

¹⁵ Data Source: Virginia Employment Commission. Discontinuities in the data presented are attributable to instances in which the number of firms was small enough that data was suppressed to prevent disclosure of individual firm data.

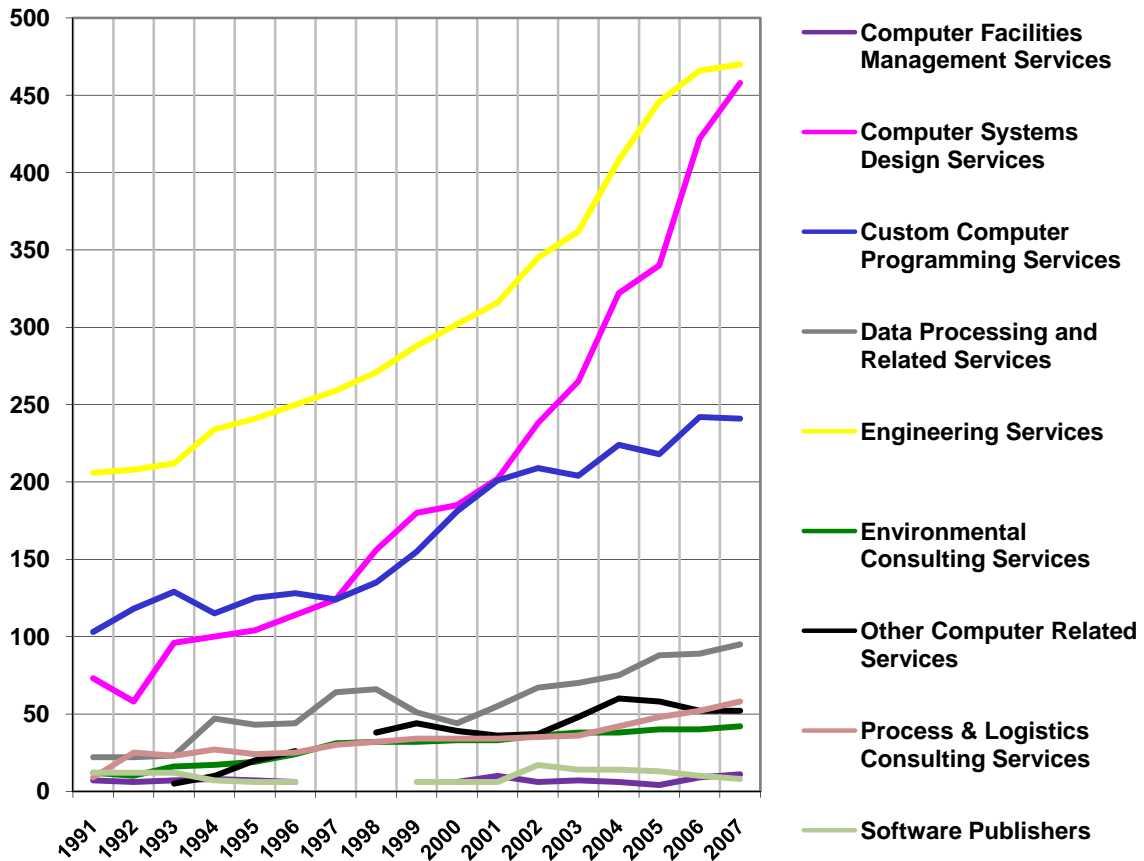


Figure 10: Modeling and Simulation related Establishments in the SEVA-PORT Area – 1991 to 2007¹⁶

¹⁶ Data Source: Virginia Employment Commission.

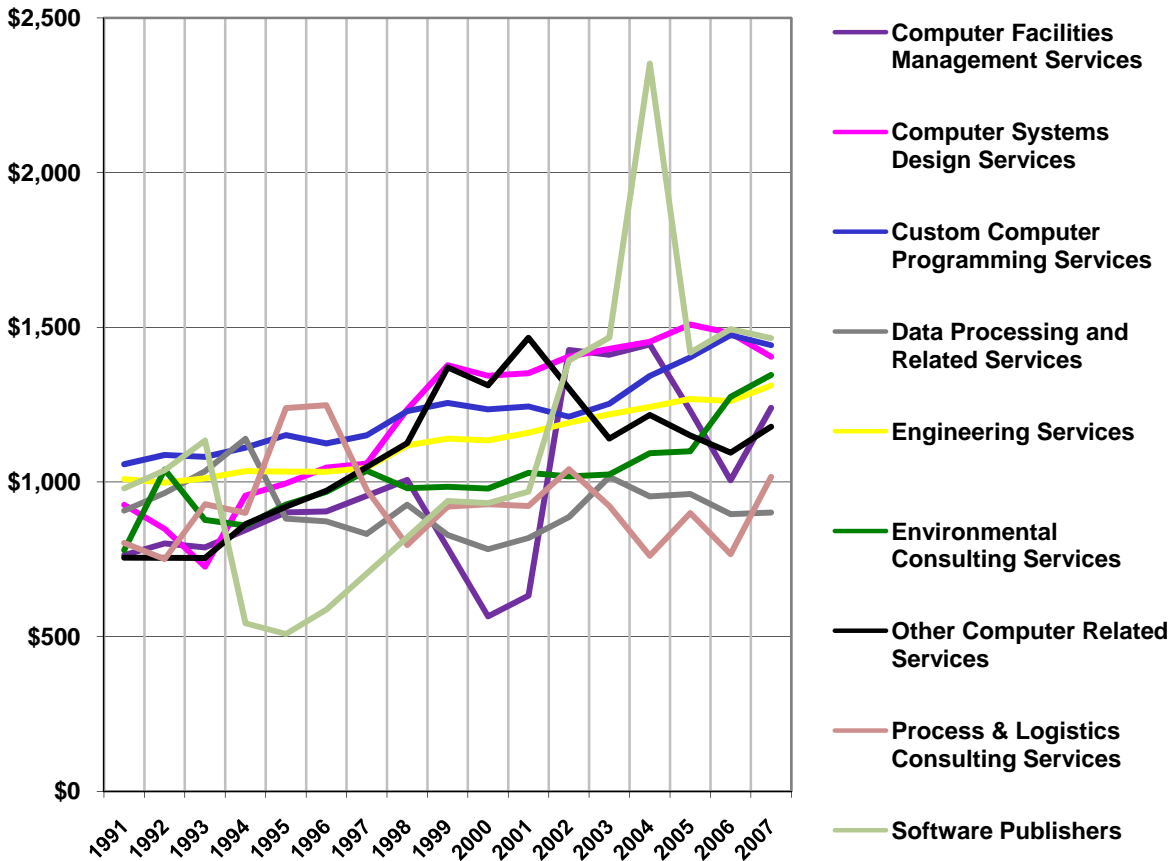


Figure 11: Modeling and Simulation related Wages in the SEVA-PORT Area (2008 dollars) – 1991 to 2007¹⁷

¹⁷ Data Source: Virginia Employment Commission.

Industry Specialization

In an effort to ascertain the extent to which the SEVA-PORT area currently specializes in these nine *Modeling and Simulation* related NAICS classifications, Figure 12 provides location quotients for each based on third quarter 2008 employment data. As these data show, only *Engineering Services* exhibits a location quotient above one. This means that of the nine *Modeling and Simulation* industries, only *Engineering Services* has a larger footprint than one would expect based on the statewide norm.

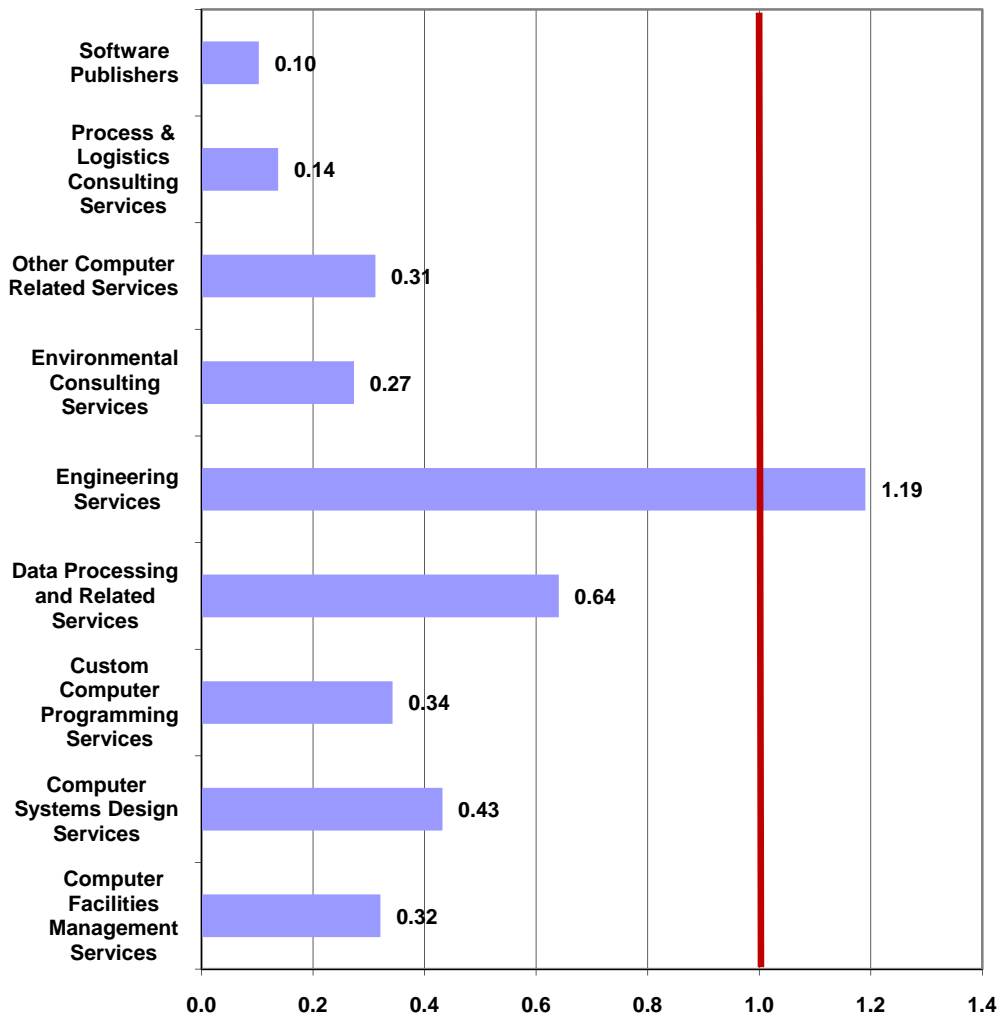


Figure 12: 2008:Q3 Modeling and Simulation related Industry Location Quotients in the SEVA-PORT Area¹⁸

¹⁸ *Data Source:* Derived from data provided by the Virginia Employment Commission.

Education Infrastructure

In fall 2007, the SEVA-PORT area was served by 26 colleges and universities. Table 1 lists these institutions and catalogues some of their more pertinent characteristics. By quantifying the area's current postsecondary education performance, these data provide the best available estimate of the SEVA-PORT area's current postsecondary educational capacity. As shown in Table 1:

- In the fall of 2007, total enrollment across all institutions was 117,030 students. Tidewater Community College exhibited the largest individual enrollment with 25,857 students, but was followed closely by Old Dominion University with 22,287 students.
- On average, the student body at these institutions was comprised of 48 percent minority students. The largest minority student ratios were in the historically black colleges of Virginia State University (97 percent), Hampton University (95 percent), and Norfolk State University (85 percent). These institutions were closely followed by several of the private for-profit institutions, such as Tidewater Tech – Chesapeake (85 percent), Tidewater Tech – Trades (85 percent), Everest Institute – Chesapeake (84 percent), and Tidewater Tech – Norfolk (82 percent).
- In fall 2007, 4 percent of the student body at these institutions was under 18 (largely attributable to dual enrollment classes with local high schools). The largest under 18 ratios were in Paul D. Camp Community College (22 percent), Richard Bland College (22 percent), John Tyler Community College (19 percent), and Thomas Nelson Community College (10 percent).
- In fall 2007, 62 percent of the student body at these institutions were “traditional students” (*i.e.*, between the ages of 18 and 24). The largest traditional student ratios were in the College of William and Mary (97 percent), Christopher Newport University (95 percent), Virginia State University (90 percent), and Hampton University (88 percent). In contrast, the institutions serving the largest proportion of non-traditional students (*i.e.*, those over 24 years of age) were Tidewater Tech – Virginia Beach (77 percent), Regent University (72 percent), Bryant and Stratton College – Virginia Beach (64 percent), and Tidewater Tech – Newport News (64 percent).
- On average, these institutions experienced a 35 percent student graduation rate. The institutions demonstrating the highest graduation rates were the College of William and Mary (91 percent), Advanced Technology Institute (83 percent), Virginia Career Institute (65 percent), Tidewater Tech – Newport News (59 percent), and Tidewater Tech – Trades, ECPI College of Technology, and Everest College – Newport News (all 57 percent).

- In total these institutions employed 5,032 instructional staff, 1,019 administrative staff, 2,851 other professional staff, and 4,848 non-professional staff.
- In academic year 2006-07, on average 12 percent of the degrees awarded in these institutions were in the *Modeling and Simulation* related program areas of computer science, engineering, and engineering technology. The institutions awarding the largest proportion of computer science, engineering, and engineering technology degrees were ITT Technical Institute – Norfolk (85 percent), ECPI College of Technology (62 percent), Tidewater Tech – Newport News (31 percent), Tidewater Community College (18 percent), and Old Dominion University (16 percent).¹⁹

¹⁹ Nationally, postsecondary enrollment and completions data are collected by the U.S. Department of Education's, National Center for Education Statistics. The taxonomy used to classify these data is called the Classification of Instructional Programs (CIP) code. Currently, there are no CIP codes that pertain specifically to modeling and simulation programs. As a result, here and in the analysis that follows we are constrained to use the broader modeling and simulation related categories of *Computer and Information Sciences and Support Services* (CIP code 11), *Engineering* (CIP code 14), and *Engineering Technologies* (CIP code 15).

Table 1: Colleges and Universities serving the SEVA-PORT Area²⁰

Institution	Type	Enrollment		Student Characteristics					Staff				% comp. sci., eng., & eng. tech. degrees awarded 2006-07
		2006-07 FTE	Fall 2007 HC	% part-time	% minority	% under 18	% 18 to 24	Grad rate	Instruc	Admin	Other Prof	Non-Prof	
Advanced Technology Institute	Priv. for-profit	803	656	0%	43%	1%	65%	83%	26	11	18	5	0%
Bryant and Stratton College-Virginia Beach	Priv. for-profit	428	499	58%	76%	0%	36%	44%	26	12	19	7	5%
Christopher Newport University	Public	4,500	4,884	7%	17%	1%	95%	52%	271	23	205	345	4%
College of William and Mary	Public	7,865	7,795	7%	34%	0%	97%	91%	678	67	614	876	2%
Eastern Virginia Medical School	Public	836	725	3%	30%	0%	37%	0%	222	48	311	474	0%
ECPI College of Technology	Priv. for-profit	9,036	8,122	6%	58%	1%	43%	57%	340	119	213	86	62%

²⁰ Data Source: U.S. Department of Education, National Center for Education Statistics.

Table 1: Colleges and Universities serving the SEVA-PORT Area (continued)

Institution	Type	Enrollment		Student Characteristics					Staff				% comp. sci., eng., & eng. tech. degrees awarded 2006-07
		2006-07 FTE	Fall 2007 HC	% part-time	% minority	% under 18	% 18 to 24	Grad rate	Instruc	Admin	Other Prof	Non-Prof	
Everest College-Newport News	Priv. for-profit	525	123	0%	76%	2%	53%	55%	20	7	0	11	0%
Everest Institute-Chesapeake	Priv. for-profit	636	178	0%	84%	2%	54%	57%	10	9	0	26	2%
Hampton University	Priv. non-profit	6,302	5,658	10%	95%	3%	88%	54%	391	25	149	442	4%
ITT Technical Institute-Norfolk	Priv. for-profit	713	780	20%	68%	0%	43%	29%	33	8	27	7	85%
John Tyler Community College	Public	4,028	8,082	75%	33%	19%	45%	13%	185	17	31	94	5%
Norfolk State University	Public	5,086	6,155	23%	94%	2%	76%	31%	307	146	183	384	9%
Old Dominion University	Public	16,469	22,287	41%	37%	1%	71%	49%	839	142	468	909	16%

Table 1: Colleges and Universities serving the SEVA-PORT Area (continued)

Institution	Type	Enrollment		Student Characteristics					Staff				% comp. sci., eng., & eng. tech. degrees awarded 2006-07
		2006-07 FTE	Fall 2007 HC	% part-time	% minority	% under 18	% 18 to 24	Grad rate	Instruc	Admin	Other Prof	Non-Prof	
Paul D Camp Community College	Public	820	1,544	74%	41%	22%	38%	11%	48	17	4	35	3%
Regent University	Priv. non-profit	3,380	4,115	55%	39%	1%	29%	0%	165	40	148	177	0%
Richard Bland College of the College of William and Mary	Public	930	1,402	43%	27%	22%	66%	35%	34	14	14	28	0%
Thomas Nelson Community College	Public	5,461	9,368	69%	43%	10%	50%	10%	237	36	42	173	11%
Tidewater Community College	Public	16,312	25,857	64%	42%	3%	51%	11%	638	74	127	310	7%
Tidewater Tech - Chesapeake	Priv. for-profit	309	290	0%	85%	0%	39%	52%	15	10	10	2	18%

Table 1: Colleges and Universities serving the SEVA-PORT Area (continued)

Institution	Type	Enrollment		Student Characteristics					Staff				% comp. sci., eng., & eng. tech. degrees awarded 2006-07
		2006-07 FTE	Fall 2007 HC	% part-time	% minority	% under 18	% 18 to 24	Grad rate	Instruc	Admin	Other Prof	Non-Prof	
Tidewater Tech - Newport News	Priv. for-profit	172	224	0%	78%	0%	36%	59%	17	14	3	2	31%
Tidewater Tech - Norfolk	Priv. for-profit	724	283	0%	82%	0%	41%	49%	28	11	10	3	0%
Tidewater Tech - Virginia Beach	Priv. for-profit	4,973	1,423	0%	64%	0%	23%	28%	55	22	10	89	14%
Tidewater Tech-Trades	Priv. for-profit	71	157	0%	85%	0%	47%	57%	8	6	3	0	0%
Virginia Career Institute	Priv. for-profit	196	270	0%	63%	0%	49%	65%	16	14	0	3	0%
Virginia State University	Public	4,782	4,720	15%	97%	2%	90%	42%	323	76	179	253	8%

Table 1: Colleges and Universities serving the SEVA-PORT Area (continued)

Institution	Type	Enrollment		Student Characteristics					Staff				% comp. sci., eng., & tech. degrees awarded 2006-07
		2006-07 FTE	Fall 2007 HC	% part-time	% minority	% under 18	% 18 to 24	Grad rate	Instruc	Admin	Other Prof	Non-Prof	
Virginia Wesleyan College	Priv. non-profit	1,181	1,433	17%	27%	1%	79%	42%	100	51	63	107	0%
Regional		96,538	117,030	40%	48%	4%	62%	35%	5,032	1,019	2,851	4,848	12%

In addition to the data snapshot provided in Table 1, Figure 13 also details the total number of graduates by degree level from these institutions for the years 2001 through 2007. Over this period, the total number of:

- Certificates awarded went from 3,024 in 2001 to 1,706 in 2007, a decline of 1,318 or 43.6 percent,
- Associates degrees awarded went from 3,171 in 2001 to 5,468 in 2007, an increase of 2,297 or 72.3 percent,
- BA/BS degrees awarded went from 6,399 in 2001 to 7,417 in 2007, an increase of 1,018 or 15.9 percent,
- MA/MS degrees awarded went from 2,205 in 2001 to 2,306 in 2007, an increase of 101 or 4.6 percent, and
- Ph.D. degrees awarded went from 136 in 2001 to 187 in 2007, an increase of 51 or 37.5 percent.

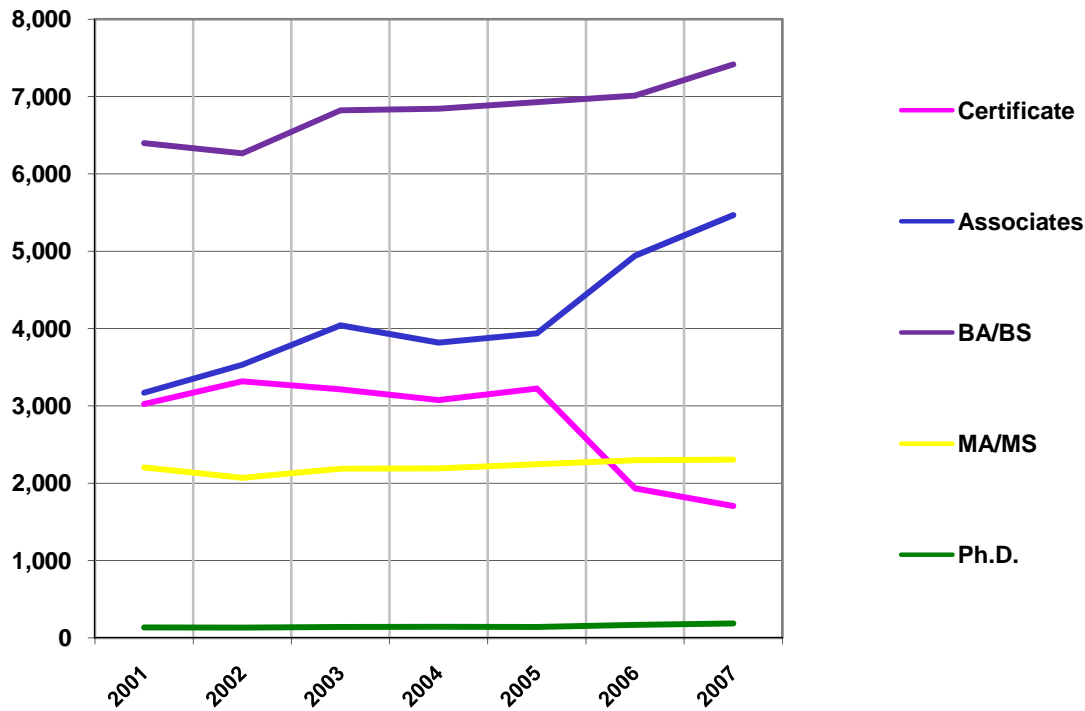


Figure 13: Total Postsecondary Graduates in SEVA-PORT Area – 1991 to 2007 ²¹

²¹ Data Source: Virginia Employment Commission.

Modeling and Simulation Workers – Supply and Demand

In this section, we compare the existing pipeline of graduates from *Modeling and Simulation* related postsecondary education programs within the SEVA-PORT area to the estimated occupation-driven demand for those trained individuals. The goal of that comparison is to illuminate potential gaps in the current educational pipeline for *Modeling and Simulation* workers.

Method

The method used to accomplish this analysis is not new and has been successfully employed in earlier studies conducted in several states, including Virginia.²² However, because neither the *North American Industry Classification System* (NAICS) taxonomy employed by the U.S. Bureau of Labor Statistics and state employment commissions to classify industry employment, nor the *Classification of Instructional Programs* (CIP) taxonomy used by the U.S. National Center for Education Statistics to classify postsecondary enrollment and completions, contain codes that are specific to *Modeling and Simulation* industries or instructional programs, it was necessary to identify the linkage between local industries and postsecondary programs using a two-step process.

In the first step, we used a Virginia Staffing Matrix provided by the Virginia Employment Commission to identify the complete list of occupations employed in the nine *Modeling and Simulation* related NAICS industry classifications used in this report. It is important to realize that because this list includes *all* occupations employed in the selected NAICS classifications, it includes positions that one would normally associate with *Modeling and Simulation* (e.g., *Computer Programmers*) along with many that one would not normally think of in that context (e.g., *Sales Managers*). We then use a crosswalk developed by the National Crosswalk Service Center (NCSC) to “map” this comprehensive list of occupations into the prerequisite education and training program(s) necessary for employment in each occupation.²³ That mapping is then further refined by using a classification scheme developed by the U.S. Bureau of Labor Statistics to “sort”

²² Similar methods are used in at least seven states (California, Georgia, Idaho, Illinois, New Jersey, Utah, and Virginia) to project anticipated education and training demands. For an excellent exposition of this method see, William J. Drummond and Jan L. Youtie, “Occupational Employment, Demand for College Graduates, and Migration: A Statewide View,” a report to the Board of Regents, University System of Georgia, 1999. For an example of how this method has been used previously in Virginia see, A. Fletcher Mangum, “System-Wide Needs Assessment for Virginia Education,” State Council of Higher Education for Virginia, March 28, 2002, p.90.

²³ The National Crosswalk Service Center (NCSC) is funded by the U.S. Department of Labor, Employment and Training Administration. The specific NCSC crosswalk used in this analysis is the *2000 Standard Occupational Classification Crosswalk to 2000 Classification of Instructional Programs*. This crosswalk identifies the prerequisite instructional programs (classified according to the National Center for Educational Statistics’ *2000 Classification of Instructional Program*, or *CIP*, code) necessary for employment in 1,364 specific occupations (classified according to the Bureau of Labor Statistics’ *2000 Standard Occupational Classification*, or *SOC*, code).

occupations according to the minimum degree or award required for employment in that occupation.²⁴

In the second step, we refine this comprehensive list of prerequisite education and training program to include only those that are closely related to *Modeling and Simulation* specifically. We do that by truncating the list to include only those programs in the broader *Modeling and Simulation* related CIP classifications *Computer and Information Sciences and Support Services* (CIP code 11), *Engineering* (CIP code 14), and *Engineering Technologies* (CIP code 15). Because the occupation to instructional program relationships contained in the NCSC crosswalk in several cases reflect a “many-to-many” relationship, we then “walk back” that refined list of programs to identify the total universe of occupations that draw upon them for graduates.

Through this series of steps we are able to: 1) identify the specific list of *Modeling and Simulation* related postsecondary education programs that are associated with the *Modeling and Simulation* related industries in the SEVA-PORT area, and 2) identify the total universe of occupations (not just those within *Modeling and Simulation* related industries) that are likely to demand graduates from those programs. Once this mapping exercise is complete, we are able to compare the pipeline of graduates from local *Modeling and Simulation* related programs to the occupation driven demand for those graduates to identify potential shortfalls. The remainder of this section presents the results from that analysis.

Educational Pipeline

To estimate the likely supply of trained *Modeling and Simulation* workers, we use data from the U. S. National Center for Education Statistics. These data are comprised of all graduates reported to the National Center for Education Statistics by colleges and universities within the SEVA-PORT area from the *Modeling and Simulation* related programs identified through the mapping exercise. Table 2 presents these data by program and degree level for academic years 2000-01 through 2006-07.

In addition to the annual number of graduates, Table 2 also provides data on the average number of graduates over the three most recent academic years. In order to control from random year to year variances, it is this number that we use to estimate the current supply of graduates from each program. The total percentage growth in graduates over the 2000-01 to 2006-07 period is also provided in Table 2.

²⁴ The Bureau of Labor Statistics classifies occupations according to eleven education and training categories. Four of these involve on-the-job training or work experience only and the remaining seven require some level of postsecondary education (*i.e.*, first-professional degree, doctoral degree, master’s degree, bachelor’s degree, associate’s degree, or postsecondary vocational training). For purposes of this study, we restrict the analysis to occupations that fall within these seven education and training categories.

A review of Table 2 shows that, between 2000-01 and 2006-07 the number of regional graduates from *Modeling and Simulation* related postsecondary programs:

- decreased by 31.0 percent at the certificate level,
- increased by 185.5 percent at the Associates level,
- increased by 12.3 percent at the BA/BS level,
- increased by 118.7 percent at the MA/MS level, and
- increased by 33.3 percent at the Ph.D. level.

Table 3 takes these data and breaks them down by college and university. What these data show is that:

- at the certificate level, the largest producer of graduates from *Modeling and Simulation* related programs within the SEVA-PORT area is ECPI College of Technology,
- at the Associates level, the largest producer of graduates from *Modeling and Simulation* related programs within the SEVA-PORT area is again ECPI College of Technology, and
- at the BA/BS, MA/MS, and Ph.D. levels, the largest producer of graduates from *Modeling and Simulation* related programs within the SEVA-PORT area is Old Dominion University.

Table 2: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline ²⁵

Certificates										
CIP	CIP Title	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
110101	Computer and Information Sciences, General	158	174					15	15	-90.5%
110901	Computer Systems Networking and Telecommunications (NEW)			132	106	134	61	18	71	NA
150399	Electrical and Electronic Engineering Technologies/Technicians, Other	7	11	8	6	5	7	14	9	100.0%
150699	Industrial Production Technologies/Technicians, Other	1	4	5	2	2	4	4	3	300.0%
150899	Mechanical Engineering Related Technologies/Technicians, Other	8	7	11	9	10	29	35	25	337.5%
151202	Computer Technology/Computer Systems Technology (NEW)			208	150	86	46	29	54	NA
151203	Computer Hardware Technology/Technician (NEW)							5	5	NA
Grand Total		174	196	364	273	237	147	120	181	-31.0%

²⁵ Data Source: U.S. Department of Education, National Center for Education Statistics.

Table 2: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline (continued)

Associates										
CIP	CIP Title	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
110101	Computer and Information Sciences, General	345	437	603	589	487	789	800	692	131.9%
110801	Web Page, Digital/Multimedia and Information Resources Design (NEW)					29	19	23	24	NA
110901	Computer Systems Networking and Telecommunications (NEW)					30	38	78	49	NA
140101	Engineering, General	47	45	40	55	44	65	49	53	4.3%
150201	Civil Engineering Technology/Technician	8	3	5	1	7	8	7	7	-12.5%
150303	Electrical, Electronic and Communications Engineering Technology/Technician			41	46			11	11	NA
150399	Electrical and Electronic Engineering Technologies/Technicians, Other	21	28	25	25	16	32	40	29	90.5%
150612	Industrial Technology/Technician (NEW)					26	45	46	39	NA
150699	Industrial Production Technologies/Technicians, Other	35	41	41	23	30	35	33	33	-5.7%
150899	Mechanical Engineering Related Technologies/Technicians, Other	53	48	44	48	59	89	63	70	18.9%
151202	Computer Technology/Computer Systems Technology (NEW)			379	287	269	264	288	274	NA
151302	CAD/CADD Drafting and/or Design Technology/Technician (NEW)			13	24			15	15	NA
Grand Total		509	602	1,191	1,098	997	1,384	1,453	1,295	185.5%

Table 2: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline (continued)

BA/BS										
CIP	CIP Title	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
110101	Computer and Information Sciences, General	143	145	130	136	128	93	85	102	-40.6%
110103	Information Technology (NEW)					30	33	30	31	NA
110401	Information Science/Studies	44	43	58	57	49	35	23	36	-47.7%
110701	Computer Science	39	37	30	40	62	56	45	54	15.4%
140101	Engineering, General	7	7	20	18	8	9	4	7	-42.9%
140801	Civil Engineering, General	18	23	21	26	28	28	38	31	111.1%
140901	Computer Engineering, General	31	28	39	38	41	20	26	29	-16.1%
141001	Electrical, Electronics and Communications Engineering	31	34	26	33	36	49	41	42	32.3%
141401	Environmental/Environmental Health Engineering	1	7	5	3	5	6	3	5	200.0%
141901	Mechanical Engineering	41	35	40	43	45	48	78	57	90.2%
143601	Manufacturing Engineering (NEW)					5	1	7	4	NA
149999	Engineering, Other							5	5	NA
150303	Electrical, Electronic and Communications Engineering Technology/Technician	4	1	8	5	4	6	3	4	-25.0%
150899	Mechanical Engineering Related Technologies/Technicians, Other	2	4	3	4	2	3	4	3	100.0%
151001	Construction Engineering Technology/Technician	6	5	7	5	4	5	5	5	-16.7%
151201	Computer Engineering Technology/Technician			5	5	6	10	15	10	NA
Grand Total		367	369	392	413	453	402	412	426	12.3%

Table 2: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline (continued)

MA/MS										
CIP	CIP Title	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
110101	Computer and Information Sciences, General	44	36	52	52	46	82	55	61	25.0%
110701	Computer Science					0	0	14	5	NA
140101	Engineering, General	80	81	85	100	118	115	84	106	5.0%
141001	Electrical, Electronics and Communications Engineering							6	6	NA
149999	Engineering, Other	26	38	98	106	150	164	169	161	550.0%
Grand Total		150	155	235	258	314	361	328	348	118.7%
Ph.D.										
CIP	CIP Title	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
110101	Computer and Information Sciences, General	9	5	11	6	13	3	6	7	-33.3%
140101	Engineering, General	12	9	19	21	14	17	22	18	83.3%
Grand Total		21	14	30	27	27	20	28	25	33.3%

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution²⁶

Certificate									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
ECPI College of Technology	158	174	340	256	220	107	67	145	-57.6%
110101	158	174					15	15	-90.5%
110901			132	106	134	61	18	71	NA
151202			208	150	86	46	29	54	NA
151203							5	5	NA
John Tyler Community College	3		1	5	2	0	1	1	-66.7%
150899	3		1	5	2	0	1	1	-66.7%
Thomas Nelson Community College	2	7	7	3	6	23	37	22	1750.0%
150699	1	4	5	2	2	4	4	3	300.0%
150899	1	3	2	1	4	19	33	19	3200.0%
Tidewater Community College	11	15	16	9	9	17	15	14	36.4%
150399	7	11	8	6	5	7	14	9	100.0%
150899	4	4	8	3	4	10	1	5	-75.0%
Grand Total	174	196	364	273	237	147	120	181	-31.0%

²⁶ Data Source: U.S. Department of Education, National Center for Education Statistics.

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

Associates									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
Bryant and Stratton College-Virginia Beach		16	12	12	13	11	6	10	NA
110101		16	12	12	13	11	6	10	NA
Centura College					11	50	80	59	NA
110101					11	35	25	24	NA
110901						15	55	35	NA
ECPI College of Technology	345	421	970	864	732	1,007	1,057	932	206.4%
110101	345	421	591	577	463	743	769	658	122.9%
151202			379	287	269	264	288	274	NA
ITT Technical Institute-Norfolk			54	70	59	42	72	75	NA
110801					29	19	23	24	NA
110901					30	23	23	25	NA
150303			41	46			11	11	NA
151302			13	24			15	15	NA
John Tyler Community College	5	1	1	4	13	27	13	17	160.0%
150612					12	26	11	16	NA
150899	5	1	1	4	1	1	2	1	-60.0%
Paul D Camp Community College	5	1	10	2	5	4	4	4	-20.0%
150699	5	1	10	2	5	4	4	4	-20.0%

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

Associates									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
Thomas Nelson Community College	58	49	41	49	62	102	81	82	39.7%
140101	23	12	7	18	13	19	13	15	-43.5%
150399	6	7	7	7	7	13	21	14	250.0%
150612					0	1	5	2	NA
150899	29	30	27	24	42	69	42	51	44.8%
Tidewater Community College	96	114	103	97	102	141	140	128	45.8%
140101	24	33	33	37	31	46	36	38	50.0%
150201	8	3	5	1	7	8	7	7	-12.5%
150399	15	21	18	18	9	19	19	16	26.7%
150612					14	18	30	21	NA
150699	30	40	31	21	25	31	29	28	-3.3%
150899	19	17	16	20	16	19	19	18	0.0%
Grand Total	509	602	1,191	1,098	997	1,384	1,453	1,295	185.5%

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

BA/BS									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
Christopher Newport University	76	71	67	71	70	56	43	56	-43.4%
110401	26	30	37	31	34	22	17	24	-34.6%
110701	39	37	24	29	25	29	19	24	-51.3%
140901	11	4	6	11	11	5	7	8	-36.4%
College of William and Mary	55	48	41	38	39	24	16	26	-70.9%
110101	55	48	41	38	39	24	16	26	-70.9%
ECPI College of Technology							7	7	NA
110101							7	7	NA
Hampton University	44	33	59	53	45	38	26	36	-40.9%
110101	19	13	18	9		1	2	1	-89.5%
110401	18	13	21	26	15	13	6	11	-66.7%
110701					22	15	14	17	NA
140101	7	7	20	18	8	9	4	7	-42.9%
Norfolk State University	50	47	59	53	42	48	63	59	26.0%
110101	36	35	34	34	26	24	25	25	-30.6%
141001	2	2	2				7	7	250.0%
149999							5	5	NA
150303	4	1	8	5	4	6	3	4	-25.0%
150899	2	4	3	4	2	3	3	3	50.0%
151001	6	5	7	5	4	5	5	5	-16.7%
151201			5	5	6	10	15	10	NA

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

BA/BS									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
Old Dominion University	142	170	160	187	207	187	200	198	40.8%
110101	33	49	37	55	63	44	35	47	6.1%
140801	18	23	21	26	28	28	38	31	111.1%
140901	20	24	33	27	30	12	12	18	-40.0%
141001	29	32	24	33	36	49	34	40	17.2%
141401	1	7	5	3	5	6	3	5	200.0%
141901	41	35	40	43	45	48	78	57	90.2%
Virginia State University			6	11	50	49	57	54	NA
110103					30	33	30	31	NA
110701			6	11	15	12	12	13	NA
140901						3	7	5	NA
143601					5	1	7	4	NA
150899							1	1	NA
Grand Total	367	369	392	413	453	402	412	426	12.3%

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

MA/MS									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
College of William and Mary	19	16	19	16	20	17	16	18	-15.8%
110101	19	16	19	16	20	17	16	18	-15.8%
Hampton University							14	5	NA
110701							14	5	NA
Norfolk State University					2	9	18	18	NA
110101					2	9	6	6	NA
141001							6	6	NA
149999							6	6	NA
Old Dominion University	131	139	216	242	292	335	280	303	113.7%
110101	25	20	33	36	24	56	33	38	32.0%
140101	80	81	85	100	118	115	84	106	5.0%
149999	26	38	98	106	150	164	163	159	526.9%
Grand Total	150	155	235	258	314	361	328	348	118.7%

Table 3: SEVA-PORT Modeling and Simulation related Postsecondary Educational Pipeline by Institution (continued)

Ph.D.									
Institution	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	3 Year Avg.	Change 2000-01 to 2006-07
College of William and Mary	3	3	5	4	8	1	3	4	0.0%
110101	3	3	5	4	8	1	3	4	0.0%
Old Dominion University	18	11	25	23	19	19	25	21	38.9%
101010	6	2	6	2	5	2	3	3	-50.0%
140101	12	9	19	21	14	17	22	18	83.3%
Grand Total	21	14	30	27	27	20	28	25	33.3%

Occupation-Driven Demand for Graduates

To estimate the occupation-driven demand for graduates from regional *Modeling and Simulation* related postsecondary programs, we use projections of occupational employment produced by the Virginia Employment Commission. These projections estimate the average annual number of openings in every occupation within a region over the period from 2006 through 2016. The regions employed in this analysis are the Crater, Hampton Roads, and Greater Peninsula Workforce Investment Areas. It should be noted that with one exception, these Workforce Investment Areas include all cities and counties participating in the SEVA-PORT initiative. That one exception is Chesterfield County.

Table 4 provides data on the estimated total number of average annual openings for the universe of occupations identified through the mapping exercise that are likely to demand graduates from *Modeling and Simulation* related postsecondary programs. In addition to the estimated average annual number of occupational openings, Table 4 also provides information on the degree level typically required for entry into each occupation listed.

What these data show is that, between 2006 and 2016 it is estimated that the average annual demand for graduates from *Modeling and Simulation* related postsecondary programs in the SEVA-PORT area may approach 2,129 per year.²⁷ Further, in the near term the largest demand for these graduates is likely to be at the baccalaureate level and the two occupations that will likely drive much of that demand are *Computer Software Engineers, Applications* (237 average annual openings) and *Computer Systems Analysts* (216 average annual openings).

²⁷ The reason that we say “may” has to do with the way that the Virginia Employment Commission computes their average annual openings estimate. That estimate is composed of two figures – average annual openings attributable to growth, and average annual openings attributable to replacement. Where the first figure is clearly a measure of additional labor demand, the second may not be. The reason for this is that it captures both openings that are due to retirements, where someone leaves the workforce and thereby generates additional labor demand, and openings that are attributable to “churn,” where individuals move between jobs within the same field and thereby on net do not generate additional labor demand. For this reason, the total number of 2,129 average annual openings should more properly be viewed as an upper limit to likely labor demand as opposed to a precise estimate of labor demand.

Table 4: Estimated Average Annual Openings in Modeling and Simulation related Occupations within the SEVA-PORT area – 2006 to 2016²⁸

SOC	SOC Title	Required Degree Level	Estimated Average Annual Openings 2006-16
113021	Computer and Information Systems Managers	BA/BS	36
119021	Construction Managers	BA/BS	83
119041	Engineering Managers	BA/BS	35
119121	Natural Sciences Managers	BA/BS	3
131051	Cost Estimators	Experience only	77
151011	Computer and Information Scientists, Research	Ph.D.	6
151021	Computer Programmers	BA/BS	45
151031	Computer Software Engineers, Applications	BA/BS	237
151032	Computer Software Engineers, Systems Software	BA/BS	103
151041	Computer Support Specialists	Associates	154
151051	Computer Systems Analysts	BA/BS	216
151061	Database Administrators	BA/BS	33
151071	Network and Computer Systems Administrators	BA/BS	117
151081	Network Systems and Data Communications Analysts	BA/BS	104
151099	Computer Specialists, All Other	Associates	83
152031	Operations Research Analysts	MA/MS	17
171021	Cartographers and Photogrammetrists	BA/BS	5
171022	Surveyors	BA/BS	14
172011	Aerospace Engineers	BA/BS	49
172031	Biomedical Engineers	BA/BS	2
172041	Chemical Engineers	BA/BS	2
172051	Civil Engineers	BA/BS	97
172061	Computer Hardware Engineers	BA/BS	14
172071	Electrical Engineers	BA/BS	49
172072	Electronics Engineers, Except Computer	BA/BS	34
172081	Environmental Engineers	BA/BS	23
172111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	BA/BS	4

²⁸ Data Source: Virginia Employment Commission.

Table 4: Estimated Average Annual Openings in Modeling and Simulation related Occupations within the SEVA-PORT area – 2006 to 2016 (continued)

SOC	SOC Title	Required Degree Level	Estimated Average Annual Openings 2006-16
172112	Industrial Engineers	BA/BS	41
172141	Mechanical Engineers	BA/BS	68
172161	Nuclear Engineers	BA/BS	17
172199	Engineers, All Other	BA/BS	36
173011	Architectural and Civil Drafters	Certificate	22
173012	Electrical and Electronics Drafters	Certificate	8
173013	Mechanical Drafters	Certificate	10
173021	Aerospace Engineering and Operations Technicians	Associates	2
173022	Civil Engineering Technicians	Associates	21
173023	Electrical and Electronic Engineering Technicians	Associates	54
173025	Environmental Engineering Technicians	Associates	3
173026	Industrial Engineering Technicians	Associates	17
173027	Mechanical Engineering Technicians	Associates	11
173031	Surveying and Mapping Technicians	Experience only	21
271014	Multi-Media Artists and Animators	BA/BS	14
271024	Graphic Designers	BA/BS	41
439011	Computer Operators	Experience only	10
439021	Data Entry Keyers	Experience only	39
439022	Word Processors and Typists	Experience only	12
519061	Inspectors, Testers, Sorters, Samplers, and Weighers	Experience only	40
Total			2,129

Gap Analysis

Tables 5 and 6 detail the results obtained from the analysis of gaps between the estimated educational pipeline for graduates from *Modeling and Simulation* related postsecondary programs within the SEVA-PORT area, and the estimated occupation-driven demand for those graduates within the SEVA-PORT area. Specifically, Table 5 provides a mapping between postsecondary programs and related occupations, while Table 6 summarizes that information to succinctly show potential gaps in the educational pipeline.

The most salient finding from this analysis is that the largest potential gaps in the educational pipeline for graduates from *Modeling and Simulation* related postsecondary programs within the SEVA-PORT area are likely to be at the baccalaureate level. In particular, there are likely to be significant gaps in the supply of BA/BS graduates from the *Computer and Information Sciences, General; Information Technology; and Computer Science* programs. The largest gap is likely to occur with respect to the *Computer and Information Sciences, General* program, where the annual shortfall could reach 282 per year. This is noteworthy, because as shown earlier in the Educational Pipeline section, between 2000-01 and 2006-07 the regional number of BA/BS level graduates from this program declined by 40.6 percent.

Table 5: Supply and Demand for Modeling and Simulation related Graduates – 2006 to 2016

CIP Title	Estimated Annual Graduates					SOC Title	Degree Required	Estimated Avg. Annual Openings
	Cert.	Assoc	BA/BS	MA/MS	Ph.D.			
CAD/CADD Drafting and/or Design Technology/Technician (NEW)		15				Architectural and Civil Drafters	Certificate	22
Civil Engineering Technology/Technician		7				Civil Engineering Technicians	Associates	21
Civil Engineering, General			31			Civil Engineers	BA/BS	97
						Engineering Managers	BA/BS	35
Computer and Information Sciences, General	15	692	102	61	7	Computer and Information Scientists, Research	Ph.D.	6
						Computer and Information Systems Managers	BA/BS	36
						Computer Specialists, All Other	Associates	83
						Computer Systems Analysts	BA/BS	216
						Database Administrators	BA/BS	33
						Network and Computer Systems Administrators	BA/BS	117
						Network Systems and Data Communications Analysts	BA/BS	104
Computer Engineering Technology/Technician			10			Electrical and Electronic Engineering Technicians	Associates	54
Computer Engineering, General			29			Computer Hardware Engineers	BA/BS	14
						Computer Software Engineers, Applications	BA/BS	237
						Computer Software Engineers, Systems Software	BA/BS	103
						Engineering Managers	BA/BS	35

Table 5: Supply and Demand for Modeling and Simulation related Graduates – 2006 to 2016 (continued)

CIP Title	Estimated Annual Graduates					SOC Title	Degree Required	Estimated Avg. Annual Openings
	Cert.	Assoc	BA/BS	MA/MS	Ph.D.			
Computer Science			54	14		Computer and Information Scientists, Research	Ph.D.	6
						Computer and Information Systems Managers	BA/BS	36
						Computer Software Engineers, Applications	BA/BS	237
						Computer Software Engineers, Systems Software	BA/BS	103
						Computer Specialists, All Other	Associates	83
Computer Systems Networking and Telecommunications (NEW)	71	49				Network and Computer Systems Administrators	BA/BS	117
						Network Systems and Data Communications Analysts	BA/BS	104
Computer Technology/Computer Systems Technology (NEW)	54	274				Electrical and Electronic Engineering Technicians	Associates	54
Construction Engineering Technology/Technician			5			Civil Engineering Technicians	Associates	21
						Construction Managers	BA/BS	83
Electrical and Electronic Engineering Technologies/Technicians, Other	9	29				Electrical and Electronic Engineering Technicians	Associates	54
Electrical, Electronic and Communications Engineering Technology/Technician		11	4			Electrical and Electronic Engineering Technicians	Associates	54

Table 5: Supply and Demand for Modeling and Simulation related Graduates – 2006 to 2016 (continued)

CIP Title	Estimated Annual Graduates					SOC Title	Degree Required	Estimated Avg. Annual Openings
	Cert.	Assoc	BA/BS	MA/MS	Ph.D.			
Electrical, Electronics and Communications Engineering			42	6		Electrical Engineers	BA/BS	49
						Electronics Engineers, Except Computer	BA/BS	34
						Engineering Managers	BA/BS	35
Engineering, General		53	7	106	18	Engineering Managers	BA/BS	35
						Engineers, All Other	BA/BS	36
Engineering, Other			5	161		Engineering Managers	BA/BS	35
						Engineers, All Other	BA/BS	36
Environmental/Environmental Health Engineering			5			Engineering Managers	BA/BS	35
						Environmental Engineers	BA/BS	23
						Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	BA/BS	4
Industrial Production Technologies/Technicians, Other	3	33				Industrial Engineering Technicians	Associates	17
Industrial Technology/Technician (NEW)		39				Industrial Engineering Technicians	Associates	17

Table 5: Supply and Demand for Modeling and Simulation related Graduates – 2006 to 2016 (continued)

CIP Title	Estimated Annual Graduates					SOC Title	Degree Required	Estimated Avg. Annual Openings
	Cert.	Assoc	BA/BS	MA/MS	Ph.D.			
Information Science/Studies			36			Computer and Information Scientists, Research	Ph.D.	6
						Computer and Information Systems Managers	BA/BS	36
						Computer Software Engineers, Systems Software	BA/BS	103
						Computer Specialists, All Other	Associates	83
						Network and Computer Systems Administrators	BA/BS	117
Information Technology (NEW)			31			Computer Software Engineers, Applications	BA/BS	237
						Computer Software Engineers, Systems Software	BA/BS	103
						Computer Systems Analysts	BA/BS	216
						Network Systems and Data Communications Analysts	BA/BS	104
Manufacturing Engineering (NEW)			4			Engineering Managers	BA/BS	35
						Engineers, All Other	BA/BS	36
Mechanical Engineering			57			Engineering Managers	BA/BS	35
						Mechanical Engineers	BA/BS	68
Mechanical Engineering Related Technologies/Technicians, Other	25	70	3			Mechanical Engineering Technicians	Associates	11

Table 5: Supply and Demand for Modeling and Simulation related Graduates – 2006 to 2016 (continued)

CIP Title	Estimated Annual Graduates					SOC Title	Degree Required	Estimated Avg. Annual Openings
	Cert.	Assoc	BA/BS	MA/MS	Ph.D.			
Web Page, Digital/Multimedia and Information Resources Design (NEW)		24				Computer Programmers	BA/BS	45
						Graphic Designers	BA/BS	41
						Multi-Media Artists and Animators	BA/BS	14

Table 6: Potential Gaps in the Educational Pipeline for Modeling and Simulation related Graduates – 2006 to 2016

CIP	CIP Title	Degree Level	Avg. Annual Grads.	Avg. Annual Openings	Estimated Gap
110101	Computer and Information Sciences, General	Associates	692	83	NA
150201	Civil Engineering Technology/Technician	Associates	7	21	14
150303	Electrical, Electronic and Communications Engineering Technology/Technician	Associates	11	2	NA
150399	Electrical and Electronic Engineering Technologies/Technicians, Other	Associates	29	5	NA
150612	Industrial Technology/Technician (NEW)	Associates	39	9	NA
150699	Industrial Production Technologies/Technicians, Other	Associates	33	8	NA
150899	Mechanical Engineering Related Technologies/Technicians, Other	Associates	70	11	NA
151202	Computer Technology/Computer Systems Technology (NEW)	Associates	274	47	NA
110101	Computer and Information Sciences, General	BA/BS	102	384	282
110103	Information Technology (NEW)	BA/BS	31	160	129
110401	Information Science/Studies	BA/BS	36	61	26
110701	Computer Science	BA/BS	54	160	106
140101	Engineering, General	BA/BS	7	17	10
140801	Civil Engineering, General	BA/BS	31	103	72
140901	Computer Engineering, General	BA/BS	29	100	71
141001	Electrical, Electronics and Communications Engineering	BA/BS	42	91	49
141401	Environmental/Environmental Health Engineering	BA/BS	5	28	23
141901	Mechanical Engineering	BA/BS	57	79	22
143601	Manufacturing Engineering (NEW)	BA/BS	4	10	6

**Table 6: Potential Gaps in the Educational Pipeline for Modeling and Simulation related Graduates – 2006 to 2016
(continued)**

CIP	CIP Title	Degree Level	Avg. Annual Grads.	Avg. Annual Openings	Estimated Gap
149999	Engineering, Other	BA/BS	5	12	7
151001	Construction Engineering Technology/Technician	BA/BS	5	83	78
110101	Computer and Information Sciences, General	Ph.D.	7	6	NA
Total					895

Summary

In this report, we have provided an empirical assessment of the current capacity of the educational pipeline for graduates in *Modeling and Simulation* related programs, the future occupation-driven demand for those graduates, and potential gaps between the two. That analysis has shown that *Modeling and Simulation* is a high-wage/high-growth industry within the SEVA-Port area. Between 1991 and 2007, employment in SEVA-PORT's *Modeling and Simulation* related industries grew by 117 percent, as compared to an average employment growth of 26 percent across all industries within the area. Similarly, in 2007 SEVA-PORT's *Modeling and Simulation* related industries paid average weekly wages of \$1,315, as compared to \$749 across all industries.

With regard to the current capacity of the educational pipeline for graduates in *Modeling and Simulation* related programs, our analysis has shown that out of the 26 colleges and universities directly serving the SEVA-PORT area, 14 currently produce graduates in these programs. On average between 2004-05 and 2006-07, these 10 institutions graduated 2,275 individuals per year out of *Modeling and Simulation* related programs, and of that total 1,570 were at degree levels that directly mapped into the occupational requirements of the *Modeling and Simulation* industry. The largest producer of graduates at the certificate and Associates levels was ECPI College of Technology. While Old Dominion University was the largest producer of graduates at the BA/BS level and above.

Our analysis of trends in the number of graduates over the period from 2000-01 to 2006-07 yielded some interesting findings. Principal among these was that while the number of graduates at the Associates, BA/BS, MA/MS, and Ph.D. levels increased by 186 percent, 12 percent, 119 percent, and 33 percent respectively over this period, the number of graduates at the certificate level actually declined by 31 percent.

With regard to the estimated future occupation-driven demand for *Modeling and Simulation* related graduates, our analysis shows that, between 2006 and 2016 the average annual demand for these graduates may approach 2,129 per year. In addition, our analysis indicates that the bulk of this demand will be driven by increased labor demand in the two occupations *Computer Software Engineers, Applications* and *Computer Systems Analysts*, and most of this demand will be for graduates at the BA/BS level.

When we compare these data on the current educational pipeline for graduates in *Modeling and Simulation* related programs, and the future occupation-driven demand for those graduates, what we find is that the largest gaps between the two are likely to occur at the baccalaureate level. More specifically, our analysis indicates that there are likely to

be significant shortfalls in the supply of BA/BS graduates from the *Computer and Information Sciences, General*; *Information Technology*; and *Computer Science* programs. The largest gap is likely to occur with respect to the *Computer and Information Sciences, General* program, where the annual shortfall could reach 282 per year. This is noteworthy, because as shown earlier in the Educational Pipeline section, between 2000-01 and 2006-07 the regional number of BA/BS level graduates from this program declined by 40.6 percent.

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