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Chapter 3:

LESSONS FROM THE FRONT LINES OF THE 21st CENTURY ECONOMY: The structure of job opportunities in the Massachusetts information technology industry by Michael D. Goodman

Abstract

This article describes the occupational composition of the Information Technology (IT) industry and the structure of opportunities in this major and growing employment sector. The results of a recent and detailed assessment of the IT industry in Massachusetts are used to identify implications for career development practitioners. The data presented in this article suggest two broad lessons can be learned from the Massachusetts experience: 1) that there are more opportunities for less well educated workers in this sector than is commonly understood, and 2) that the return to the technical skills demanded by growing information technology firms is substantial.

Introduction:

The late 1990s witnessed a remarkable explosion of development and investment within the Information Technology (IT) industry, generated in large part by the advent and popularization of the Internet. The dot-com bubble expanded through the second half of the 1990s and into 2000, when venture capital investment peaked and initial public offerings produced instant millionaires. The bursting of the dot-com bubble was also followed by a dramatic decrease in venture capital and other investment funding in IT companies, which proportionately dampened confidence in other industries. Despite this retrenchment and the recent recession, leading industries increasingly rely on IT to move their businesses forward and investment in the industry has continued to grow despite the profound economic difficulties of recent years. The widespread adoption of IT has created employment opportunities for many skilled IT professionals both within and outside of the core IT industry. In Massachusetts alone, more than 50,000 IT technical professionals (technical workers contributing specific computer or mathematical expertise) are dispersed throughout other industries. Overall, IT technical professionals earn higher average annual salaries than typical workers in the state and those employed by firms within the IT industry earn substantially more than

their counterparts in other industries. Taken together these developments strongly suggest that IT occupations represent solid targets of opportunity for workers seeking employment opportunities in the most difficult labor market in over a generation.

The aim of this article is to shed light on the nature of these opportunities by summarizing the results of a recent detailed study of the IT industry in Massachusetts and highlighting their implications for career development practitioners. While in many respects Massachusetts is very different from other states, particularly in terms of the educational profile of its workforce and the innovation-intensive nature of its industrial base, its experiences can provide workforce and career development practitioners in other states and regions with some insight into what they can expect should their innovation-based economic development efforts bear fruit. The data presented in the pages that follow focus on the first eight years of the past decade (2000-2008) in an effort to avoid any confounding effect of the so-called *Great Recession*.

The evolving structure of the contemporary IT industry

Over the past several decades, IT firms throughout the U.S. have evolved in response to consumer demand, business needs, globalization, and technology innovation. In Massachusetts, the IT industry includes a diverse group of firms and workers that support existing key industries and enable new industry growth by providing valuable consumer and commercial services to workers and firms throughout the Commonwealth. Although the impact of the IT industry is vast, and exists within a larger economic system, for the purposes of this analysis, we define the industry into four core sectors: Hardware, Network Communications, Software, and IT Services. Each of these can be further divided into multiple subsectors, based on the range of industrial activities in the sector. The following analysis of industry, labor, and other data reveals that IT firms sort into groups that perform four distinct functions:

Equip users with the physical tools needed to manage, store, and share information (Hardware);

Connect users and their systems by providing core communications infrastructure and products (Network Communications);

Enable users to utilize hardware, access networks, and operate IT systems and programs (Software); and

Strengthen organizations by customizing products and services, and providing technical strategy and support services that enhance productivity (IT Services).

Although some firms specialize in a core sector such as Software, many firms cut across more than one sector. This is characteristic of many large IT firms, which offer complementary products and services to different types of customers.

Employment in the core sectors continues to shift, underscoring the major structural changes that have been taking place in the IT industry. Despite the traditional strength of the Hardware sector, the Software sector has been the main driver of new growth in recent years. Now accounting for about 27 percent of employment in the Massachusetts IT industry, the Software sector grew by nearly 12,160 jobs (34.5 percent) between 1998 and 2008.

In contrast, employment in the other sectors has either markedly declined or stayed level over the ten- year period from 1998 to 2008. The Hardware sector remains the largest, accounting for about 32 percent of industry employment in 2008. However, employment in the sector has decreased by 36.8 percent, more than 34,700 jobs, since 1998. This tremendous shift reflects ongoing consolidation of manufacturing operations in the hardware sector and ongoing realignments to maintain productivity in the face of global competition.

The remaining two sectors have stayed fairly level since 1998. IT Services, the second largest employer in the state's IT industry, accounts for about 49,900 jobs in the industry, more than 28 percent of total Massachusetts IT employment. In spite of much stronger growth nationally, this sector has not grown significantly over the ten-year period: 2008 employment numbers are on point with 1998 levels but remain 24 percent lower than the sector's employment peak in 2000. Network Communications has remained the smallest of Massachusetts' core IT sectors, hovering at 14 percent of total IT employment. Employment in the sector in 2008 is slightly lower than it was in 1998 and remains 32 percent lower than peak employment levels reached in 2000.

Figure 1 [Appendix]

IT Technical Professionals: Working in and outside of the IT industry
Firms need to employ a robust and skilled workforce that understands information technology across all markets in order to be agile and innovative. The IT technical professional workforce is defined here as workers who contribute computer-related technical expertise, whether working inside the IT industry or performing the same function outside of the industry. Prior to the recession, more than 128,500 of these IT technical professionals were employed in Massachusetts—and over half of these professionals worked within the IT industry itself.

Figure 2 [Appendix]

IT technical professionals are defined as workers employed in one of thirteen primary IT occupations (see figure 3). They provide a full range of specific computer-related expertise to the IT industry and also are employed by employers from a wide variety of industries. The thirteen

occupations include programmers, network and database administrators, system and network analysts, hardware and software engineers, information system managers, tech support, and those who research and teach computer science at the collegiate through post-graduate levels. These workers provide the full range of skills fundamental to the production of core information technologies as well as the provision of computer-related services.

Time series data show that higher-level technical positions in IT are increasing in Massachusetts while lower-level technical jobs like coding and programming have been decreasing in number (through 2008). Mirroring employment growth trends in software sector firms, most of the increase in the IT professional workforce has come from occupations related to software engineering—and these tend to be high-level technical positions. In 2007, more than 40 percent of all IT professionals were software engineers, by far the most significant of the primary occupations. Massachusetts added nearly 9,750 systems software engineering positions between 2002 and 2007, comprising 47.5 percent of the 16,490 IT professional jobs added during that period. Combining both types of software engineers (systems and applications), this group added 14,290 jobs, making up 87 percent of new IT professional positions generated in Massachusetts between 2002 and 2007. Several other primary IT occupations made significant relative gains, but no absolute figures are as impressive as the increase of software engineers. On the other end of the spectrum, since 2002 the state has lost many relatively lower-level positions including 3,800 computer systems analysts and nearly 3,000 computer programmers.

When surveyed in 2009, Massachusetts IT companies confirmed the growing demand for software engineers in the Commonwealth. One-third of survey respondents stated that their company has difficulty hiring experienced software engineers. More than 10 percent of companies disclosed difficulty filling entry-level software engineering positions. The loss of computer programming jobs was also noted. During a series of focus groups, several participants described outsourcing to other states or countries as “inevitable.” Companies cited the common practice of “farming out” lower-level technical functions, like coding, by hiring more cost-effective, entry-level workers overseas in places like the Philippines and India. Finally, with the exception of computer programmers (which category dropped by 39.8 percent from 1999 to 2007), most IT occupations in Massachusetts continue to grow through 2008, even in the face of ongoing and emerging national and global economic difficulties.

Wages in Massachusetts

Wage data illustrate that IT positions in Massachusetts are high-value

jobs, yielding far higher than average wages across all positions. Taken together, primary IT professionals in the Commonwealth earn almost double the average Massachusetts salary, \$42.19 per hour and \$87,784 per year as compared to statewide averages of \$23.59 per hour and \$49,070 per year. Additionally, the mean salary for workers in each of the individual primary IT occupations is also far above that of Massachusetts overall. These findings reveal that Massachusetts IT workers, whether employed by IT firms or companies in other industries, are highly compensated for their services.

Figure 3 [Appendix]

Figure 4 highlights the distribution of Massachusetts IT professionals by mean annual salary categories. In 2007, the vast majority (84 percent) of IT professionals in the Commonwealth earned \$75,000 or more. Only 13 percent of IT professionals earn less than \$60,000 and the mean annual salary of each IT professional occupation is significantly higher than the statewide average across all occupations of \$49,070.

Figure 4 [Appendix]

Educational Attainment Trends

Increasingly, IT employers rely on a well-educated workforce. Over time, demand has been growing for those in technical occupations with Bachelor's or Master's degrees. Though there are fewer openings for those with an Associates degree, opportunities for these workers remain. To measure these trends, the Bureau of Labor Statistics assigns each occupation an 'expected level of education and training' based on the most commonly held educational attainment of people actually performing these jobs nationally. While many occupations with the expectation of higher-level degrees grew robustly, IT occupations that are accessible to workers holding an Associate's degree have grown slowly since the late 1990s. Computer support specialists account for 13.0 percent of primary IT professionals, the most popular occupation after software engineering. While there was some growth within this occupation between 1999 and 2007, it grew at the slowest rate of all growing IT professions.

Though among technical professionals there is an emphasis on having a Bachelor's degree, there are still some opportunities for those without. Between 2005 and 2007, 23.8 percent of the Commonwealth's primary IT workers had Associates degrees or less. During the same period, 48.5 percent of primary IT professionals possessed a Bachelor's degree. In three occupations, more than a third of workers hold an Associate's degree or less: over half of Computer Support Specialists (52.6 percent); Network and Computer Systems Administrators (35.6 percent) and Network Systems and Data Communications Analysts (35.1 percent).

Figure 5 [Appendix]

Opportunities for IT workers in other industries

IT products and services are used and managed in every industry and significant numbers of IT professionals in Massachusetts are employed both inside and outside of the core IT industry. While more than 50 percent of IT professionals work within the IT industry, a large number of IT primary professionals, at least 39.0 percent, are supporting other important industries in the Commonwealth.

Figure 6 [Appendix]

Primary IT professionals make up at least a third of the total workforce in the Massachusetts IT industry. Outside of the IT industry, primary IT professionals are far less common. Overall, they make up an estimated 4 percent of the total Massachusetts workforce. Of the primary occupations, database administrators are the most likely to be located outside of the core IT industry. Over two-thirds of these positions are found in non-IT related industries. Additionally, four other IT primary occupations are most likely to be found in non-IT sectors: Computer Support Specialists (56.8 percent), Network and Computer Systems Administrators (56.5 percent), Network Systems and Data Communications Analysts (55.5 percent), and Computer and Information Systems Managers (53.6 percent).

Conversely, engineering and programming positions are more likely to be found inside the core IT industry sectors. These are the production-related IT occupations, with workers responsible for developing core information technology products. More than 80 percent of Massachusetts' hardware engineers work for a firm in the core IT industry. Computer Software Engineers, both Systems and Applications, are also more likely to work within the industry at 78.4 and 68.5 percent, respectively.

Figure 7 [Appendix]

Regardless of occupation type, IT workers earn higher wages when employed by firms within the IT industry than by firms in other industries. In all identified primary IT occupations, with the exception of network systems and data communications analysts, IT professionals earn more annually working within the IT industry than outside of it. This constitutes an in-IT industry premium that can average up to \$15,745 per year over and above the average wage or salary earned in the same occupation in other industries (for example, the case of Computer and Information Scientists in the figure below). In the aggregate, IT professionals earn \$45.14 per hour working in any IT occupation within the industry, as compared to \$39.38 per hour working outside of it. Network Systems and Data Communications Analysts, the only exception, earned \$40.03

per hour inside the industry and \$40.38 working outside of IT, an average in-IT industry salary penalty of just over \$700 a year. From an economic standpoint, those who implement technology products and services are well compensated, but it is the innovators who conceive and develop new technologies that are getting paid the highest wages.

Implications for Career Development Practitioners

In many respects, the Massachusetts economy offers career development practitioners a living laboratory that can provide a glimpse into the job and career opportunities presented by the 21st century innovation and knowledge driven economy. The data presented in this article suggest two broad career development lessons can be learned from the Massachusetts experience.

Lesson 1 – The IT industry employs workers at every level of educational attainment, from those without a high school diploma to PhDs, and these workers are well compensated. Although there is a wide range of opportunity for workers with different levels of educational attainment, workers in the IT industry are significantly more likely to have Bachelor's and Master's degrees than workers in other industries. The largest occupational groups of non-technical workers in the IT industry include management analysts, managers and executives, and sales representatives.

Lesson 2- IT technical professionals (workers with specific computer and mathematical expertise) are exceptionally well compensated, highly educated, and are expected to grow rapidly according to the US Bureau of Labor Statistics. Over 80 percent of IT technical professionals in Massachusetts have jobs that require at least a Bachelor's degree and pay over \$75,000 per year. These jobs appear to be more resilient in difficult economic times; in 2009 the unemployment rates for these occupations for these workers and occupations are much lower than the overall rate.

Concluding Thoughts

At a time in our history marked by considerable economic uncertainty and high levels of unemployment and underemployment, our need to better understand the structure of employment opportunities in industry sectors that are expected to create relatively stable and well-paying jobs has arguably never been greater. The experience of the Massachusetts Information Technology industry described in this article highlights some of the opportunities available to workers who possess both the educational attainment and the technical skills demanded by growing IT employers as well as the potential opportunities for their relatively lower-skilled counterparts. While it remains to be seen whether the experience of Massachusetts will be replicated in other states and communities, it is

clear that the IT industry offers career development practitioners and the clients they serve with an important target of opportunity during what most economists expect will be an extended period of weakness in our national and regional labor markets.

End Notes

1. Goodman, M., Loveland, R. and Wilkinson, K. (2009). The IT Industry: Hub of the Massachusetts Technology Economy. UMass Donahue Institute: Hadley, MA.
2. Ibid.
3. As part of the Goodman, Loveland, and Wilkinson study, a survey of Massachusetts IT industry businesses was conducted in February 2009. More information on the survey and its findings is available in the original study.
4. As part of the Goodman, Loveland, and Wilkinson study, key informant interviews and focus groups were conducted in late 2008. More information on the survey and its findings is available in the original study.
5. Due to suppressed data, 9.4 per cent of IT professionals were not assigned to an industry sector and may be in sectors either inside or outside of the core IT industry sectors.
6. This calculation required a slightly broader industry definition than the method used to calculate total industry employment. This represents the most conservative estimate of the share of IT technical professionals in the IT industry.
7. Premium is calculated as the difference between average salaries in the same occupation working within and outside of the IT industry, not weighted by number of workers.

Acknowledgements

The data described in this article is the product of a research effort that was led by the author in collaboration with staff members of the UMass Donahue Institute. Particular thanks are due to Rebecca Loveland and Kathleen Wilkinson who co-authored the larger research report that this article draws heavily upon. Special thanks are also due to this issue's guest editor, Bill Charland, who provided insightful feedback on early drafts of this article.

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Appendix Supporting Figures

Figure 1 : Massachusetts IT Industry Employment by Sector, 1998 – 2008.

Figure 2 The Massachusetts Information Technology Workforce.

Figure 3: Massachusetts Mean Wages and Salaries vs. National Salaries, by IT Occupation, May 2007.

Figure 4: Distribution of Massachusetts IT Technical Professionals by Mean Annual Salary.

Figure 5: Educational Attainment in Massachusetts Primary IT Occupations, 2005-2007.

Figure 6: Distribution of Massachusetts IT Technical Professionals in IT and Non-IT Sectors, 2007.

Figure 7: IT Industry Salary Premiums, May 2007.

Figure 1 : Massachusetts IT Industry Employment by Sector, 1998 – 2008.

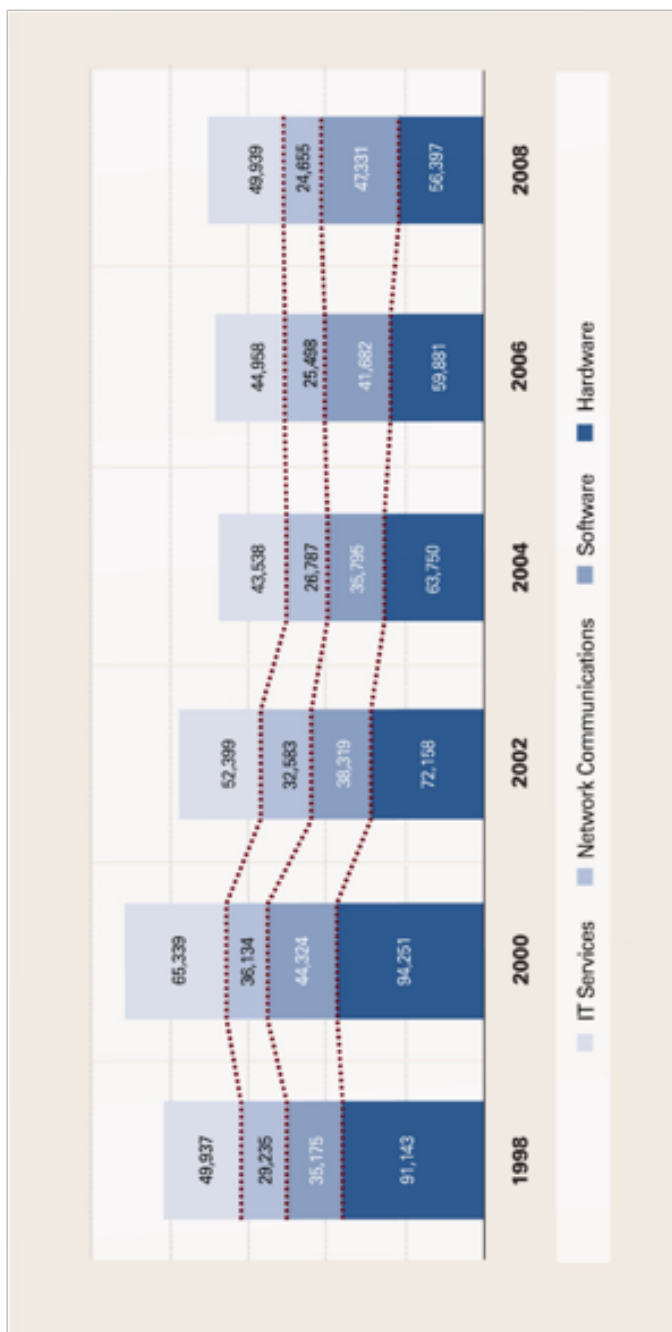


Figure 2 The Massachusetts Information Technology Workforce

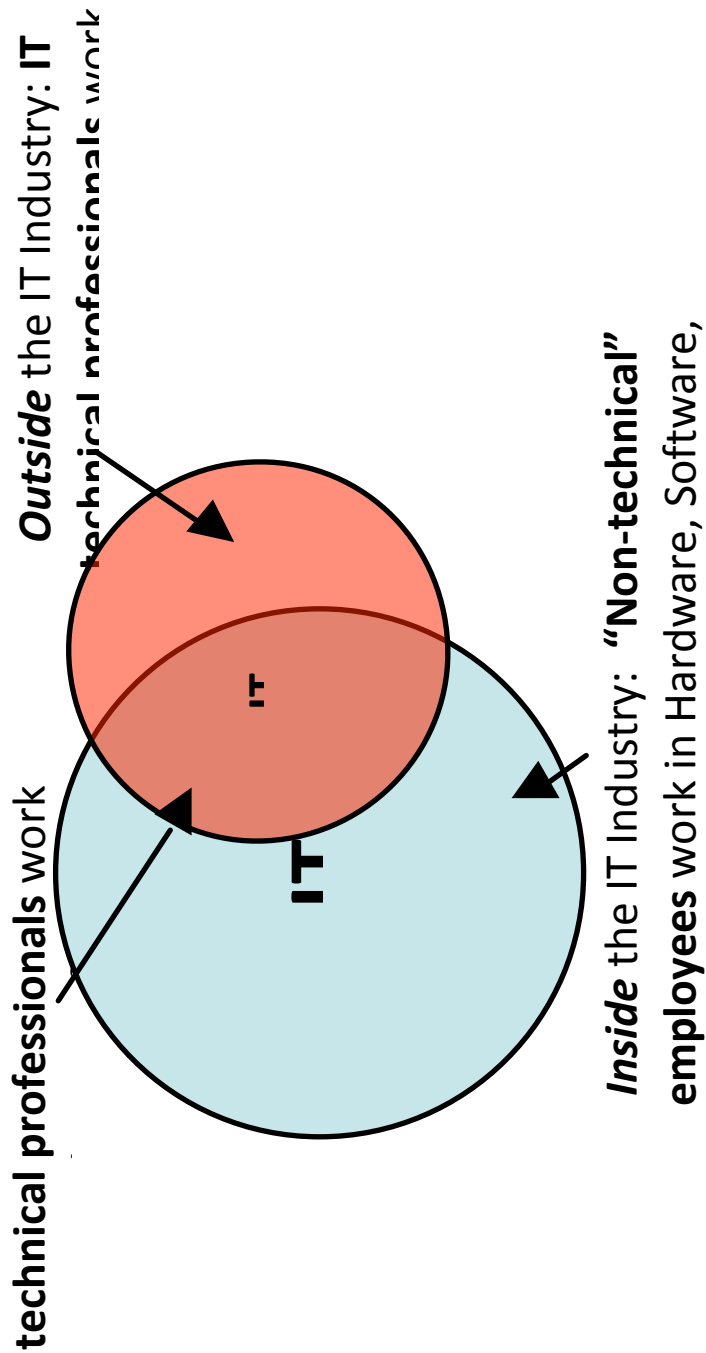


Figure 3: Massachusetts Mean Wages and Salaries vs. National Salaries, by IT Occupation, May 2007.

Occupation Title	Total Workers	Mean MA Hourly Wage	Mean MA Salary	Mean U.S. Salary
Statewide Total, All Occupations	3,207,840	\$23.59	\$49,070	--
Computer and Information Systems Managers	11,070	\$59.53	\$123,820	\$113,880
Computer and Information Scientists, Research	1,510	\$59.15	\$123,030	\$100,640
Computer Hardware Engineers	4,500	\$48.58	\$101,040	\$94,270
Computer Software Engineers, Systems Software	23,750	\$46.43	\$96,580	\$90,780
Computer Software Engineers, Applications	23,140	\$45.95	\$95,570	\$85,660
Computer Science Teachers, Postsecondary	1,040	*	\$90,850	\$69,660
Computer Systems Analysts	15,170	\$40.59	\$84,420	\$75,890
Network Systems and Data Communications Analysts	5,710	\$39.00	\$81,110	\$70,760
Computer Programmers	10,010	\$37.63	\$78,270	\$72,010
Computer Specialists, All Other	2,650	\$36.96	\$76,870	\$72,310
Network and Computer Systems Administrators	9,400	\$36.08	\$75,040	\$67,850
Database Administrators	3,810	\$35.49	\$73,830	\$70,260
Computer Support Specialists	16,760	\$27.35	\$56,890	\$45,300
Total, IT Occupations	128,520	\$42.19	\$87,784	\$79,175

Source: Goodman, Loveland and Wilkinson (2009)

*Wages for occupations that do not generally work year-round, full time, are reported either as hourly wages or annual salaries depending on how they are typically paid.

Figure 4: Distribution of Massachusetts IT Technical Professionals by Mean Annual Salary

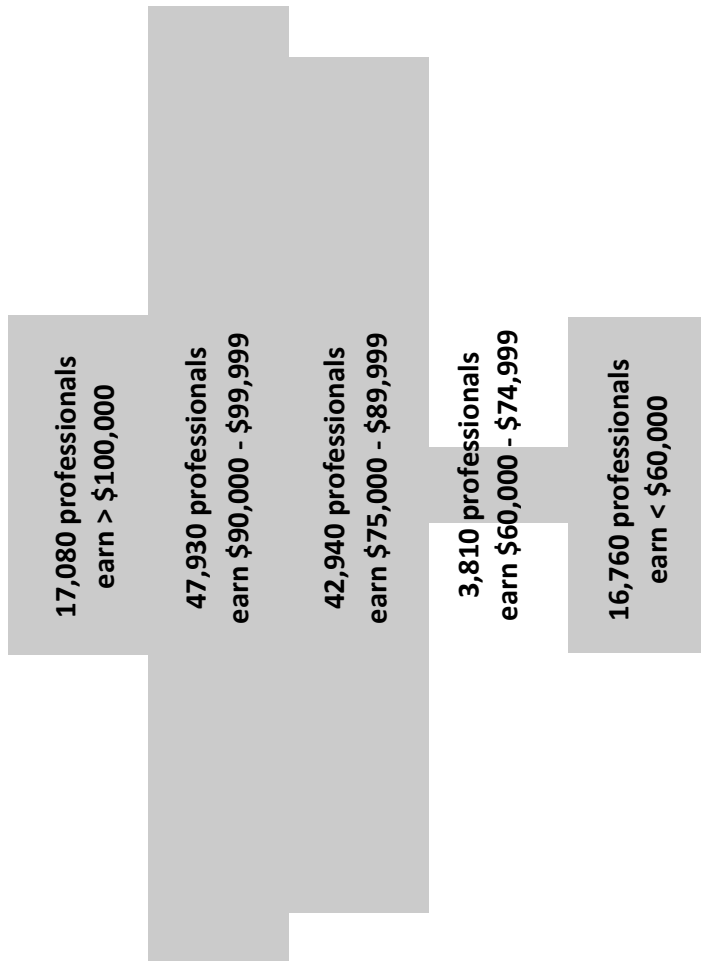


Figure 5: Educational Attainment in Massachusetts Primary IT Occupations,* 2005-2007

Figure 5: Educational Attainment in Massachusetts Primary IT Occupations,* 2005-2007

Occupation	Associate's degree or less	Bachelor's degree	Master's degree or more
Computer Support Specialists	52.6%	37.1%	10.2%
Network and Computer Systems Administrators	35.6%	51.3%	13.1%
Network Systems and Data Communications Analysts	35.1%	48.8%	16.1%
Computer Scientists and Systems Analysts**	24.8%	50.5%	24.7%
Computer and Information System Managers	24.6%	46.1%	29.3%
Database Administrators	24.4%	47.7%	28.0%
Computer Programmers	19.6%	52.6%	27.8%
Computer Software Engineers*** (Systems and Applications)	12.0%	49.1%	38.9%
Computer Hardware Engineers	10.5%	50.7%	38.8%
All primary IT occupations, except Computer Science Teachers	23.8%	48.5%	27.7%

Source: U.S. Census Bureau, 2005-2007 American Communities Survey (ACS). Goodman, Loveland and Wilkinson (2009)

*Does not include Computer Science Teachers, Postsecondary.

**For this data series, this occupation includes Computer and Information Systems Managers; Computer Scientists; and Computer Specialists, All Other.

***For this data series, this occupation includes both Systems and Applications Software Engineers.

Figure 6: Distribution of Massachusetts IT Technical Professionals in IT and Non-IT Sectors, 2007

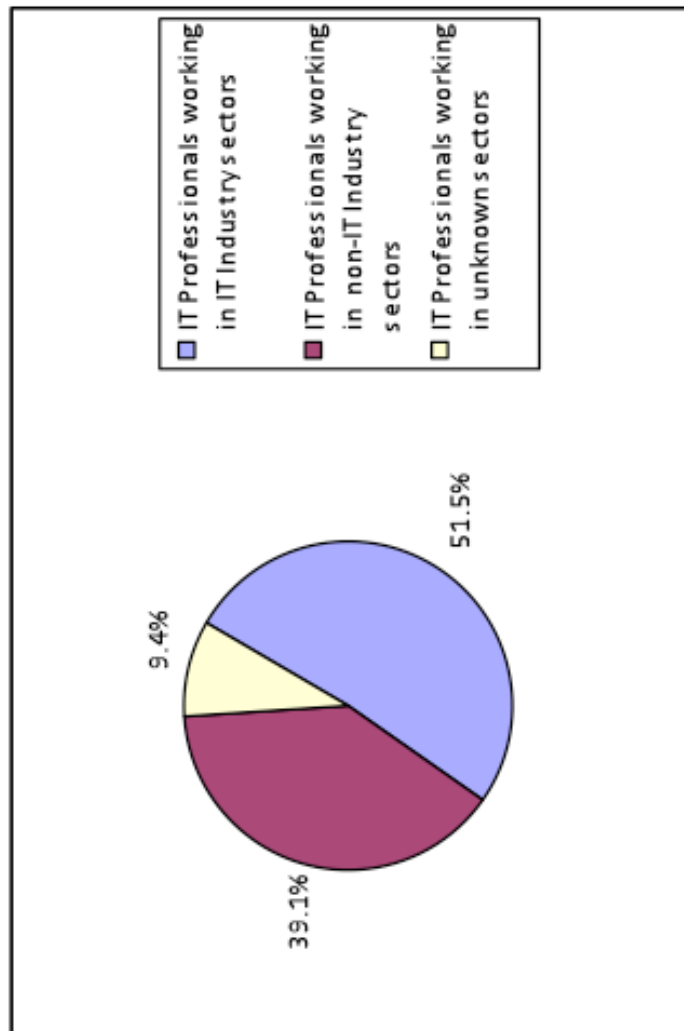


Figure 7: IT Industry Salary Premiums,* May 2007

Occupation Title	Within-IT Industry Premium on Average Salary
Computer and Information Scientists, Research	\$15,744.65
Computer Software Engineers, Applications	\$13,915.81
Computer Support Specialists	\$12,078.35
Computer Programmers	\$11,306.99
Computer Specialists, All Other	\$10,530.52
Computer and Information Systems Managers	\$9,780.27
Computer Systems Analysts	\$5,852.24
Computer Hardware Engineers	\$4,796.84
Computer Software Engineers, Systems Software	\$4,686.22
Network and Computer Systems Administrators	\$3,680.15
Database Administrators	\$3,538.86
Network Systems and Data Communications Analysts	(\$718.03)

Source: EOLWD, Occupations by Industry Matrices, Custom Data for UMDI; ES-202 Series. Goodman, Loveland and Wilkinson (2009)

*The difference between average pay in a single occupation, in vs. outside of the IT industry. Computer Science Teachers, Postsecondary work exclusively outside the IT Industry and therefore a premium could not be calculated.