

The US Supply Of New Technology Workers: A Report On The Number Of Graduates Of US Colleges And University Technology Programs.

***Rick Weible, Division of Management and Marketing,
Marshall University, Huntington, WV 25755,
email - weible@marshall.edu, (304) 696-2673***

ABSTRACT

The job market of technology majors has fluctuated greatly in the past fifteen years. From slow steady growth through the 80's and early 90's, to dramatic growth at the turn of the new century, to a major slump that now is seeing a major turn back to job growth. Monster.Com has developed an employment index that shows a significant increase for high tech workers through April of this year (2005). This swing in job demand has had a chilling effect on Technology programs enrollments as students follow the job market.

This paper examines the swing in Technology enrollments in Technology programs, based on graduation numbers reported to the US Department of Education.

The Department of Labor projects for the best paying occupations, based on percentage growth, 7 of the 11 fastest growing occupations are in technology. They are 1st Network systems and data communications analysts, 3rd Computer software engineers, systems software, 4th Computer software engineers, applications, 6th Database administrators, 7th Computer systems analysts, 10th Network and computer systems administrators and 11th Computer Systems Managers.

What has been happening in enrollments in technology programs? Is there a relationship between occupation growth and enrollment? What is the relationship? Is there a lag between job growth and enrollment? Can future enrollments be predicted? This paper explore these ideas.

INTRODUCTION

My division head is concern. MIS enrollments are way down. The Dean and Provost need faculty positions in other areas. With low enrollments it is hard to defend the idea of not replacing MIS faculty and moving the slot to other disciplines where enrollments are up. Have you seen this or similar situations in your discipline or institution. What is going on? The US Department of Labor consistently list technology jobs on the fastest growing lists. So where are the students?

This research will examine the problem of enrollment fluctuations from a historical viewpoint. The US Department of Education collects all kinds of data about educational programs in the US. This research will use IPEDS completion data to look for answers to the fluctuation question. The answers may not be there.

“The US Department of Education was created in 1980 by combining offices from several federal agencies. Its original directive remains its mission today — to ensure equal access to education and to promote educational excellence throughout the nation. The US Department of Education is dedicated to:

Establishing policies on federal financial aid for education, and distributing as well as monitoring those funds.

Collecting data on America's schools and disseminating research.
 Focusing national attention on key educational issues.
 Prohibiting discrimination and ensuring equal access to education.”[7]

Under this mission the department of education collects statistics on most educational programs in the U.S. The department charged with statistical collection and analysis is the National Center for Education Statistics (NCES).

DATA COLLECTION

“One of the National Center for Education Statistics programs is the Integrated Postsecondary Education Data System (IPEDS). IPEDS, established as the core postsecondary education data collection program for NCES, is a system of surveys designed to collect data from all primary providers of postsecondary education. IPEDS is a single, comprehensive system designed to encompass all institutions and educational organizations whose primary purpose is to provide postsecondary education. The IPEDS system is built around a series of interrelated surveys to collect institution-level data in such areas as enrollments, program completions, faculty, staff, and finances.”[2]

IPEDS data is available for download at <http://nces.ed.gov/ipeds/pas/index.asp>. [9] This research will examine 10 years of program completions data for the academic years between 1994-95 and 2003-04. 2003-04 is the latest data available. 2004-05 data will begin collection in August 2005. Program completion records are reports from postsecondary schools listing the number of students completing each program the school offers. The programs are coded using CIP (Classification of Instructional Programs) codes. CIP codes were created in 1980 with updates in 1985, 1990 and 2000. When updates occur, a 3 year conversion period is permitted before reporting using the new codes is mandatory [8]. Goto <http://nces.ed.gov/pubs2002/cip2000/index.asp> to see 2000 CIP codes.

Between 1994-95 and 2003-04, over 2 million program completion records were submitted to IPEDS from over 7030 schools, see Table 1. One record is created for each program a school offers. Of these 54,470 are for computer related programs.

Table 1 – IPEDS Annual Submissions 1994-95 to 2003-04.

Year	Count
2004	219,638
2003	211,841
2002	398,944
2001	194,569
2000	173,137
1999	158,879
1998	201,825
1997	159,007
1996	158,885
1995	163,377
Total	2,040,102

To get an initial feel for the accuracy of the data reported to IPEDS, an examination of one southeastern US college of business internal undergraduate graduation counts was compared to the numbers reported by that University to IPEDS for 2002-2003. The results are shown in table 2.

Table 2. Data Verification – compare Official Graduation List to what is reported in IPEDs.

Program	MU Graduate List	IPEDs Data
Accounting	56	55
Economics	10	11
Finance	30	31
Management (includes Health Care)	106	106
MIS	62	62
Marketing	70	78
Totals	334	343

The totals in this table show a different of 9 or a 2.695% error rate for one year at this college. These errors need to be examined and explained. Is this an error on the part of the college or the University reporting system? How is the data generated? Is either count very accurate? Does this represent the error rate for all of the data? Is it high or low? Is the error rate significant?

TECHNOLOGY OCCUPATIONAL GROWTH

The US Department of Labor measures jobs in the US. From these numbers and sophisticated models predictions of occupational job grow are made. The tables in Appendix B report there predictions. In summary, the US Department of Labor predicts the fastest growing computer occupations will generate 843,000 jobs between 2000 and 2012, a 42.7% growth rate, see Table 3.

Table 3. Fastest growing occupations, 2002-12 [Numbers in thousands of jobs]				
2000 Standard Occupation Classification code and title	2002	2012	Number	Percent
15-1081 Network systems and data communications analysts	186	292	106	57
15-1031 Computer software engineers, applications	394	573	179	46
15-1032 Computer software engineers, systems software	281	409	128	45
15-1061 Database administrators	110	159	49	44
15-1051 Computer systems analysts	468	653	184	39
15-1071 Network and computer systems administrators	251	345	94	37
11-3021 Computer and information systems managers	284	387	103	36
Total	1974	2818	843	43

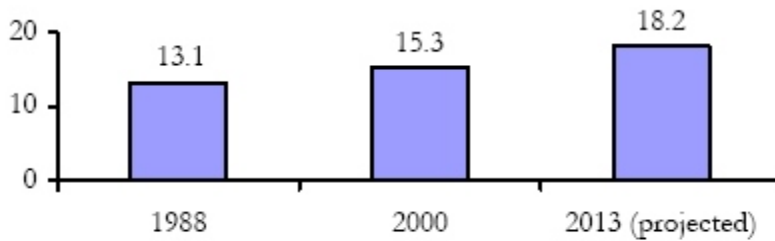
These occupations on average then will generate 84,000 jobs annually for the next ten years. Not all computer occupations will grow this fast. But this is an indication of the increasing role technology will have in the future.

DEPARTMENT OF EDUCATION POST-SECONDARY ENROLLMENT PROJECTIONS

Between 2000 and 2013, total enrollment is projected to increase 19 percent, to 18.2 million, in the middle alternative projections; 15 percent, to 17.7 million, in the low alternative projections; and 23 percent, to 18.8 million, in the high alternative projections.

Figure A. Total enrollment in degree-granting institutions, with middle alternative projections: Selected years

Millions



SOURCE: U.S. Dept. of Education, NCES: [Integrated Postsecondary Education Data System \(IPEDS\)](#), “Fall Enrollment Survey,” various years; and Enrollment in Degree-Granting Institutions Model. (See [reference table 10.](#)) [2]

During the 12 years between 1988 and 2000 enrollments increase by 2.2 million and thus this projection of a 2.9 million during this 13 year period.

So both occupations and enrollments are increasing.

RESEARCH QUESTIONS

What has been happening in enrollments in technology programs? The data shows a sharp upward trend in Technology programs between the academic years 94-95 and 2002-03. Then completions dropped. Since this is completion data, not enrollments, the decline likely started the fall semester of 2001. Based the authors discussions with other technology instructors, this downward trend seems to be continuing. This author believes the factors contributed to this downward trend. The over heating of the job IT market caused by the programming changed needed to prepare for the turn of the century and the Dot-Com bubble. Then a sudden decline in job demand as the bubble burst and companies began overseas outsourcing. Suddenly, IT did not look the gold rush of 1890 any longer and students started looking in other areas. Table 4, shows the numbers from the IPEDS completion reports and Figure B shows them in a chart.

Table 4 – Total Enrollments in Computer Related Programs 1994-95 thru 2003-04

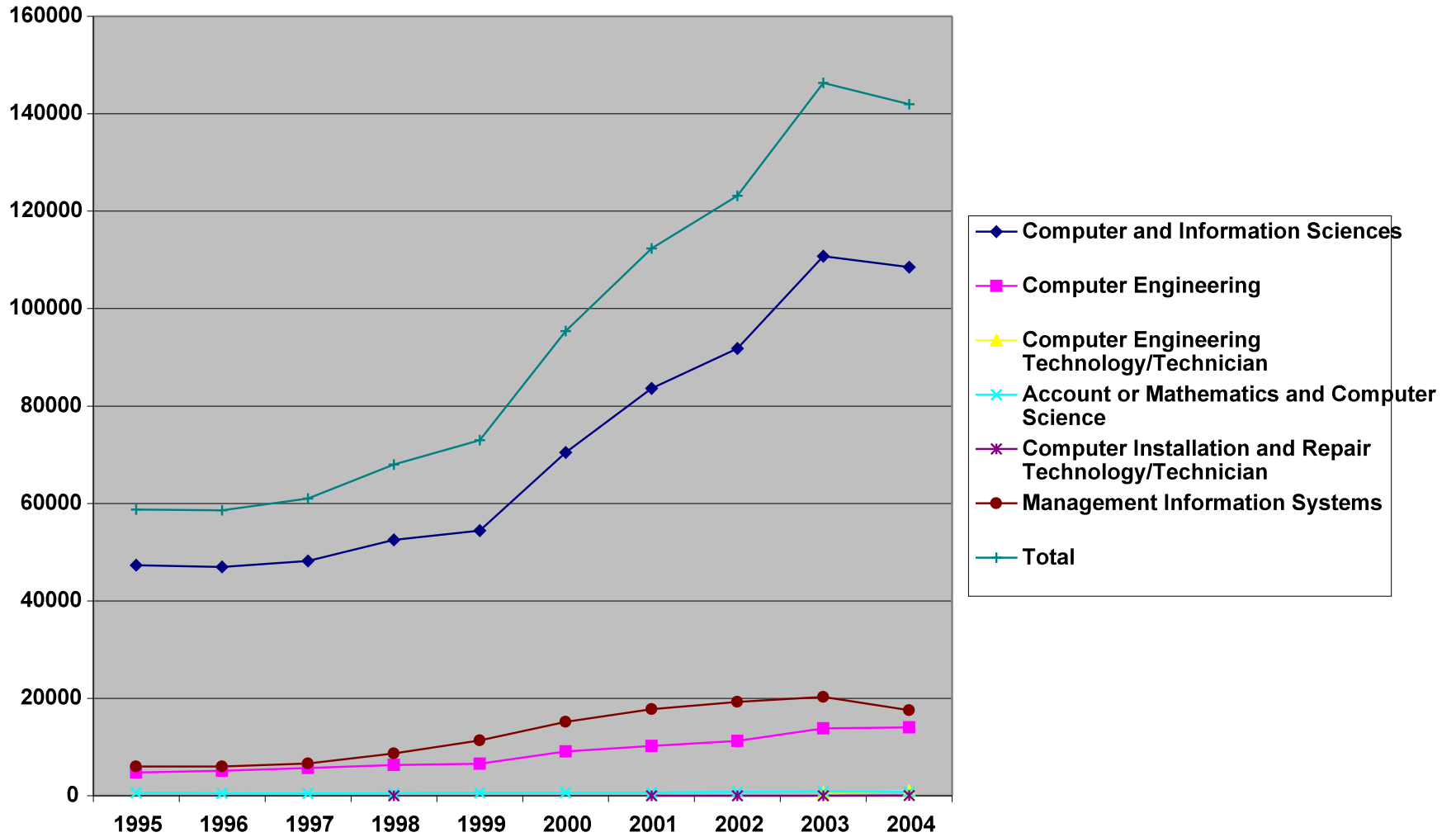
Computer and Information Sciences	Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Men	3396	3411	3518	3854	4027	5087	6065	6669	81124	81747
Women	1339	1286	1300	1396	1475	1957	2295	2508	29630	26742	
Black									8892	11339	10998
Total	4735	4697	4819	5250	5443	7045	8361	9178	11075	10848	
Computer Engineering	Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Men	4176	4558	4942	5506	5850	7986	8952	9788	12012	12250
	Women	608	564	768	796	822	1120	1296	1450	1797	1788
	Black								412	719	701
	Total	4784	5122	5710	6302	6592	9106	10248	11238	13809	14038
Computer Engineering Technology/Technician	Year									2003	2004
	Men									467	859
	Women									85	118
	Black									109	137
	Total									552	977

Account or Mathematics and Computer Science	Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Men	392	326	338	324	450	462	478	592	622	600
	Women	226	184	148	182	208	196	202	240	246	218
	Black								40	44	48
	Total	618	510	486	506	624	658	680	832	868	818
Computer Installation and Repair Technology/Technician	Year				1998			2001	2002	2003	2004
	Men				0			12	13	15	21
	Women				0			3	1	10	8
	Black								0	0	0
	Total				0			15	14	25	29
Management Information Systems	Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Men	3539	3589	4056	5363	6888	9230	11108	12081	12988	11686
	Women	2449	2409	2585	3306	4490	5933	6696	7179	7307	5906
	Black								1786	2011	1965
	Total	5988	5998	6641	8669	11351	15163	17804	19260	20295	17592
Grand Total		11976	11996	13282	17338	22729	30326	35623	40320	42626	37178

This data shows a steady increase in the number of IT graduates from 11,976 in 1995 to a high of 42,626 in 2003. Then a drop of 5,448 or 14.65% in 2004. This decline started 2, 3, or even 4 years early as students enrollments.

Figure B graphically shows these trends. Only totals for all graduates are shown in Figure B.

Figure B - Technology Program Enrollments



Other research questions remain, please contact the author for a completed copy of the paper.

Other Research Questions

Is there a relationship between occupation growth and enrollment?

What is the relationship?

Is there a lag between job growth and enrollment?

Can future enrollments be predicted?

ANALYSIS

This paper will explore these ideas.

DISCUSSION AND CONCLUSIONS

An interesting paradox exists in the IT career field. Jobs are increasing and enrollments are declining. Just the fastest growing IT careers will generate over 84,000 jobs a year for the next 10 years, if the Department of Labor predictions for close. Yet, we are graduation less than 43,000 students in our best year to date. That is almost a 100% short fall in the number of IT graduates needed to meet demand. The job market is growing at a rate, twice the graduation rate. This author predicts a return to the shortages of IT workers greater than that of the turn of the century in the next 5 years. In 2004 only 37,178 IT graduates entered the job market that is a shortage of 47,122. Where are these workers coming from? H1 visas is one source. The other must be English majors and graduates of other programs.

What is to be done about this problem. If the US is to continue the productivity gains of the 1990 that technology provided, the IT professionals needed to support must be prepared. This is an urgent national problem.

SELECTED REFERENCES

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[1] IPEDS - <http://nces.ed.gov/ipeds/>
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APPENDIX A - Computer Related CIP (Classification of Instructional Programs) Codes used in the study

Broad areas of study are coded with 2 digit codes, which are then divided into more specific areas with 4 digit codes and finally specific programs are listed under 6 digit codes. Two (2) and 4 digit codes are used for aggregation of data. The 2 digit codes use are: 11 – Computer Sciences, 14, 15 – Engineering 30 – Math and Computer Science and 52 – Business. An example of a 6 digit code is 52.1201 – Management Information Systems, General. All results in this study are from the 6 digit codes in this list.

Code	Program
11	Computer and information sciences and support services.
11.01	Computer and Information Sciences, General
11.0101	Computer and Information Sciences, General
11.0102	Artificial Intelligence and Robotics
11.0103	Information Technology
11.0199	Computer and Information Sciences, Other
11.02	Computer Programming
11.0201	Computer Programming/Programmer, General
11.0202	Computer Programming, Specific Applications
11.0203	Computer Programming, Vendor/Product Certification
11.0299	Computer Programming, Other
11.03	Data Processing
11.0301	Data Processing and Data Processing Technology/Technician
11.04	Information Science/Studies
11.0401	Information Science/Studies
11.05	Computer Systems Analysis
11.0501	Computer Systems Analysis/Analyst
11.06	Data Entry/Microcomputer Applications
11.0601	Data Entry/Microcomputer Applications, General
11.0602	Word Processing
11.0699	Data Entry/Microcomputer Applications, Other
11.07	Computer Science
11.0701	Computer Science
11.08	Computer Software and Media Applications
11.0801	Web Page, Digital/Multimedia and Information Resources Design

Code	Program
11.0802	Data Modeling/Warehousing and Database Administration
11.0803	Computer Graphics
11.0899	Computer Software and Media Applications, Other
11.09	Computer Systems Networking and Telecommunications
11.0901	Computer Systems Networking and Telecommunications
11.1	Computer/Information Technology Administration and Management
11.1001	System Administration/Administrator
11.1002	System, Networking, and LAN/WAN Management/Manager
11.1003	Computer and Information Systems Security
11.1004	Web/Multimedia Management and Webmaster
11.1099	Computer/Info Tech Services Administration & Management, Other
11.99	Computer and Information Sciences and Support Services, Other.
11.9999	Computer and Information Sciences and Support Services, Other
14.09	Computer Engineering, General
14.0901	Computer Engineering, General
14.0902	Computer Hardware Engineering
14.0903	Computer Software Engineering
14.0999	Computer Engineering, Other
15.12	Computer Engineering Technologies/Technicians
15.1201	Computer Engineering Technology/Technician
15.1202	Computer Technology/Computer Systems Technology
15.1203	Computer Hardware Technology/Technician
15.1204	Computer Software Technology/Technician
15.1299	Computer Engineering Technologies/Technicians, Other
30.08	Mathematics and Computer Science
30.0801	Mathematics and Computer Science
30.16	Accounting and Computer Science
30.1601	Accounting and Computer Science
47.0104	Computer Installation and Repair Technology/Technician
52.0208	E-Commerce/Electronic Commerce
52.12	Management Information Systems and Services

Code	Program
52.1201	Management Information Systems, General
52.1206	Information Resources Management/CIO Training
52.1207	Knowledge Management
52.1299	Management Information Systems and Services, Other

Appendix B

Table 3. Fastest growing occupations, 2002-12
 [Numbers in thousands of jobs]

2000 Standard Occupation Classification code and title	Employment		Change		Quartile rank by 2002 median annual earnings (1)	Most significant source of postsecondary education or training (2)
	2002	2012	Number	Percent		
31-9092 Medical assistants	365	579	215	59	3	Moderate-term on-the-job training
15-1081 Network systems and data communications analysts	186	292	106	57	1 (1)	Bachelor's degree
29-1071 Physician assistants	63	94	31	49	1 (2)	Bachelor's degree
21-1093 Social and human service assistants	305	454	149	49	3	Moderate-term on-the-job training
31-1011 Home health aides	580	859	279	48	4	Short-term on-the-job training
29-2071 Medical records and health information technicians	147	216	69	47	3	Associate degree
31-2022 Physical therapist aides	37	54	17	46	3	Short-term on-the-job training
15-1031 Computer software engineers, applications	394	573	179	46	1 (3)	Bachelor's degree
15-1032 Computer software engineers, systems software	281	409	128	45	1 (4)	Bachelor's degree
31-2021 Physical therapist assistants	50	73	22	45	2	Associate degree
39-9031 Fitness trainers and aerobics instructors						
39-9031 Fitness trainers and aerobics instructors	183	264	81	44	3	Postsecondary vocational award
15-1061 Database administrators	110	159	49	44	1 (5)	Bachelor's degree
29-2056 Veterinary technologists and technicians	53	76	23	44	3	Associate degree
47-4041 Hazardous materials removal workers	38	54	16	43	2	Moderate-term on-the-job training
29-2021 Dental hygienists	148	212	64	43	1 (6)	Associate degree
31-2012 Occupational therapist aides	8	12	4	43	3	Short-term on-the-job training
31-9091 Dental assistants	266	379	113	42	3	Moderate-term on-the-job training

Table 3. Fastest growing occupations, 2002-12
 [Numbers in thousands of jobs]

2000 Standard Occupation Classification code and title	Employment		Change		Quartile rank by 2002 median annual earnings ⁽¹⁾	Most significant source of postsecondary education or training ⁽²⁾
	2002	2012	Number	Percent		
39-9021 Personal and home care aides	608	854	246	40	4	Short-term on-the-job training
25-3021 Self-enrichment education teachers	200	281	80	40	2	Work experience in a related occupation
15-1051 Computer systems analysts	468	653	184	39	1 (7)	Bachelor's degree
31-2011 Occupational therapist assistants	18	26	7	39	2	Associate degree
17-2081 Environmental engineers	47	65	18	38	1 (8)	Bachelor's degree
25-1000 Postsecondary teachers	1,581	2,184	603	38	1 (9)	Doctoral degree
15-1071 Network and computer systems administrators	251	345	94	37	1 (10)	Bachelor's degree
19-4091 Environmental science and protection technicians, including health	28	38	10	37	2	Associate degree
25-2011 Preschool teachers, except special education	424	577	153	36	4	Postsecondary vocational award
11-3021 Computer and information systems managers	284	387	103	36	1 (11)	Bachelor's or higher degree, plus work experience
29-1123 Physical therapists	137	185	48	35	1 (12)	Master's degree
29-1122 Occupational therapists	82	110	29	35	1 (13)	Bachelor's degree
29-1126 Respiratory therapists	86	116	30	35	2	Associate degree

Footnotes:

(1) The quartile rankings of Occupational Employment Statistics annual earnings data are presented in the following categories: 1=very high (\$41,820 and over), 2=high (\$27,500 to \$41,780), 3=low (\$19,710 to \$27,380), and 4=very low (up to \$19,600). The rankings were based on quartiles using one-fourth of total employment to define each quartile. Earnings are for wage and salary workers.

(2) An occupation is placed into one of 11 categories that best describes the education or training needed by most workers to become fully qualified.

Table 4. Occupations with the largest job growth, 2002-12
[Numbers in thousands of jobs]

2000 Standard Occupation Classification code and title	Employment		Change		Quartile rank by 2002 median annual earnings(1)	Most significant source of postsecondary education or training(2)
	2002	2012	Number	Percent		
	29-1111 Registered nurses	2,284	2,908	623		
15-1031 Computer software engineers, applications	394	573	179	46	1	Bachelor's degree
15-1051 Computer systems analysts	468	653	184	39	1	Bachelor's degree
13-1111 Management analysts	577	753	176	30	1	Bachelor's or higher degree, plus work experience
13-2011 Accountants and auditors	1,055	1,261	205	19	1	Bachelor's degree
25-2031 Secondary school teachers, except special and vocational education	988	1,167	180	18	1	Bachelor's degree
11-1021 General and operations managers	2,049	2,425	376	18	1	Bachelor's or higher degree, plus work experience
25-2021 Elementary school teachers, except special education	1,467	1,690	223	15	2	Bachelor's degree

Table 4, Occupations with the largest job growth, 2002-2012,
in "Occupational employment projections to 2012," published in the February 2004 Monthly Labor Review - <http://www.bls.gov/opub/mlr/2004/02/contents.htm>

General										
year	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Men	4558	4942	5506	5850	7986	8952	9788	1175	1198	
Women	564	768	796	822	1120	1296	1450	8	0	
Black							412	702	688	
Total	5122	5710	6302	6592	9106	10248	11238	13498	13726	
Computer Engineering, Other										
year								2003	2004	
Men								133	109	
Women								31	24	
Black								13	11	
Total								164	133	
Computer Programming, Other										
year								2003	2004	
Men								34	47	
Women								0	4	
Black								0	2	
Total								34	51	
Computer Programming, Specific Applications										
year								2003	2004	
Men								221	116	
Women								104	42	
Black								56	12	
Total								325	158	
Computer Programming/Programmer, General										
year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Men	205	184	185	198	185	281	315	445	569	666
Women	86	103	92	88	93	139	99	166	211	208
Black								62	70	60
Total	291	287	277	286	259	420	414	611	780	874
Computer Science										
year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Men	5146	5388	5534	5838	6832	8606	9794	1139	1884	2115
Women	1572	1488	1530	1654	1956	2438	2716	4	0	0
Black								1346	1740	1846
Total	6718	6876	7064	7492	8474	11044	12510	14666	23934	26284
Computer Software and Media Applications, Other										
year								2003	2004	
Men								4	73	
Women								1	28	

year										2003	2004
Men										130	100
Women										90	53
Black										9	12
Total										220	153
Data Processing and Data Processing Technology/Technician											
year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Men	108	113	77	89	112	128	166	177	286	217	
Women	86	64	50	51	83	77	104	79	103	104	
Black								38	43	50	
Total	194	177	127	140	195	205	270	256	389	321	
Information Resources Management/CIO Training											
year										2003	2004
Men										5	20
Women										6	16
Black										0	5
Total										11	36
Information Science/Studies											
year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Men	4704	5000	5312	6000	6584	8478	10716	12800	14882	10806	
Women	3150	2998	3174	3564	4008	5278	6174	7158	8218	5492	
Black								2864	3512	2592	
Total	7854	7998	8486	9564	10520	13756	16890	19958	23100	16298	
Information Technology											
year										2003	2004
Men										720	4108
Women										299	1580
Black										83	521
Total										1019	5688
Knowledge Management											
year											2004
Men											14
Women											0
Black											1
Total											14
Management Information Systems and Services, Other											
year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Men	40	55	60	133	75	106	211	270	372	355	
Women	44	47	73	138	67	96	136	175	194	153	
Black								33	43	43	
Total	84	102	133	271	142	202	347	445	566	508	

E-Commerce/Electronic
Commerce

year
Men
Women
Black
Total

2003	2004
57	170
48	63
2	21
105	233