



SUPPLY OF INFORMATION TECHNOLOGY WORKERS AMONG NORTHEAST OHIO'S SYSTEM OF HIGHER EDUCATION

*Joint
Center
for Policy
Research*

(PHASE III)



*Public Services Institute
of
Lorain County
Community College*

SEPTEMBER 2007

ACKNOWLEDGEMENTS

The following individuals with the Joint Center for Policy Research of the Public Services Institute at Lorain County Community College conducted this research and were authors of this report:

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The Public Services Institute wishes to express its gratitude to the following research partners:

Jim Robey, Vice President for Research, Team NEO
Pat Cyrillo, President, Cypress Research Group
Claudette Robey, Assistant Director, The Center for Public Management, Cleveland State University
Sonja Thomas, Vice President, Talent and Strategic Initiatives, NorTech

We would also like to thank the Directors of Institutional Planning and Research from the following institutions of higher education within Northeast who responded to our detailed requests for information:

Ashland University	Kent State University
Baldwin Wallace College	Lakeland Community College
Case Western Reserve University	Lorain County Community College
Cleveland Institute of Music	Notre Dame College
College of Wooster	Oberlin College
Cleveland State University	Stark State College of Technology
Cuyahoga Community College	The University of Akron
Hiram College	Ursuline College
John Carroll University	Youngstown State University

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EXECUTIVE SUMMARY

This research is part of a broader initiative to assess supply and demand for Information Technology workers in Northeast Ohio. It is patterned after research conducted in 2000/01 to document the supply of IT graduates from the system of higher education and match these figures with employer demand for IT workers. The demand data comes from a comprehensive employer survey that was conducted a few months ago as part of the broader regional initiative. Three overall stages of primary data collection were used for this portion of the research. First, a review of college and university catalogs was conducted to identify the IT specialty programs offered by each institution of higher education. Once identified, each program was logged into a spreadsheet which was converted to a questionnaire and sent to offices of Institutional Planning and Research. Each institution was asked to verify their IT programs and to provide detailed information on enrollment and graduate figures for the 2005/06 and 2006/07 academic years. The third stage consisted of a qualitative assessment of IT programs so that careful judgments could be made about the nature of each program and the types of IT professionals they are intended to produce. The programs were then categorized into IT career clusters as established by the *National Association of State Directors of Career and Technical Education Consortium* in their publication *Career Cluster Resources for Information Technology*. A total of 18 colleges and universities responded to the request for information. This included all four-year public universities, all public two-year colleges, and many of the private four-year institutions in the 16 county region of Northeast Ohio. The following key findings were observed:

Student Enrollment by Level of Award

- Compared to 2000/01, enrollment in IT programs is down (from 21,174 in 2000/01 to 8,769 in 2005/06 and 9,243 in 2006/07). This means there are fewer students currently in the IT pipeline.
- Associate degree enrollment has decreased while bachelor and graduate degree enrollment have increased over the past 6 years.

Production of IT Professionals by Level of Award

- While enrollment is down, production of IT workers is stable compared to 2000/01 (i.e., 1,378 graduates in 2000/01 compared to 1,363 IT graduates in 2005/06 and 1,311 graduates in 2006/07). This means fewer students may be in the pipeline but more of them are graduating from IT programs.
- Patterns by level of award are opposite enrollment trends. There has been an increase in associate degree graduates (even though enrollment is lower) while fewer graduates are being produced at the baccalaureate and graduate degree levels (even though enrollment is higher in these areas).

Production of IT Specialists by Type of Institution

- As might be expected, the four public universities (Cleveland State University, Kent State University, The University of Akron, and Youngstown State University) are producing the greatest number of IT professionals. Combined, they produced 711 IT professionals in 2006/07.
- Public two year colleges also have a significant role in the supply of IT workers. In 2006/07 the four community colleges (Cuyahoga Community College, Lakeland Community College, Lorain County Community College, and Stark State College of Technology) produced nearly 400 IT professionals.
- Combined, the ten private universities responding to our request for information produced a total of 232 IT professionals in 2006/07. About half of these graduates came from Case Western Reserve University.

Comparison of Supply and Demand by IT Career Cluster

Technical Support Career Cluster

- Technical support programs focus on maintenance of hardware and software components of an individual terminal or an entire network. They include both replacing hardware and helping to ensure software applications function properly. All programs in Northeast Ohio are offered at the certificate and associate degree level.
- Enrollment is lower than it was 5-6 years ago (i.e., 674 students enrolled in 2000/01 compared to only 230 students in 2006/07) but production of graduates is similar to what it was in 2000/01 (i.e., 46 graduates in 2000/01, 46 in 2005/06, and 44 in 2006/07). Fewer students are enrolling in technical support programs but community colleges are doing a better job of graduating those who are enrolled.
- Employer demand for technical support professionals is far greater than what Northeast Ohio's system of higher education is producing (as determined by the comprehensive employer survey conducted as a part of this regional initiative). At the time the survey was conducted there were 74 job openings for technical support representatives (outside) and 668 openings for help desk personnel.

Network Systems Career Cluster

- These programs prepare IT professionals who contribute to the initial installation of and continuing administration, analysis, and maintenance of a network system. Most programs are offered at the associate degree level.
- Network security is a new programmatic emphasis of many degree programs. These particular programs did not exist in 2000/01. This is an indication that colleges/universities are attempting to keep pace with changes in market demand.
- Both enrollment and graduate production have increased significantly in recent years which means the system of higher education is more responsive to demand for network specialists than it was just a half decade ago.
- However, employer demand still out paces supply by a wide margin. At the time the employer survey was conducted there were a reported 371 job openings for network specialists among the 480 employers surveyed. These numbers do not include current job openings for systems engineers. In 2006/07, the Northeast Ohio system of higher education produced 100 graduates.

Database Design & Administration Career Cluster

- These programs equip students with expertise in organization, storage, and access of information. In 2000/01, database applications were embedded in other IT degree programs but stand alone database administration programs were nonexistent. Today a few programs in this area of specialty are offered at the certificate and associate degree levels.
- At the time the employer survey was conducted there were a total of 965 job openings for database administrators yet in 2006/07 there were a total of only 26 graduates from these programs. This does not include, however, graduates of other IT degree programs where database applications are integrated into teaching and learning.

Enterprise Systems Integration/Programming & Software Development Career Clusters

- Enterprise systems integration/programming programs prepare IT professionals to oversee all aspects of an information system specifically as it pertains to optimization of the operations of a specific firm. Programming and software development programs prepare IT workers who are responsible solely for the development and analysis of software applications.
- The many computer science and information systems management degree programs that exist in Northeast Ohio are classified under this career cluster.
- Like other career clusters, student enrollment is down from what it was in 2000/01. Graduate numbers, however, are fairly stable.
- The system of higher education is not producing enough graduates to keep pace with employer demand for professional workers. At the time the employer survey was conducted there were 3,703 job openings for enterprise systems personnel (including business application specialists with 2,005 openings; product managers with 371 openings; project managers with 72 openings; technical program managers with 519 openings; information systems operators/analysts with 142 openings, and quality assurance/testing positions with 594 openings). Additionally, there were 742 job openings for programmers and 543 openings for software engineers. In 2006/07 approximately 833 students graduated from related programs which is significantly short of the graduates needed to fulfill employer needs.

Interactive Media Technology Career Cluster

- These programs prepare IT workers to use various forms of communication. Some programs may specialize solely in artistic visual or video components or visual organization of information. Also included in this career track are web development and administration programs. These workers most commonly provide two or three dimensional animation or audio components for entertainment, media, advertisements, and other applications.
- Unlike most other career clusters, enrollment in interactive media technology programs has increased since 2000/01. The number of graduates produced in this career cluster has also improved in recent years.
- Supply of media technology professionals is more in line with employer needs. In 2006/07, there were a total of 245 graduates and there was a total of 141 job openings for related IT professionals at the time the employer survey was conducted.

INITIATIVE OVERVIEW, RESEARCH APPROACH & ANALYSIS FRAMEWORK

A. Initiative Overview

The Regional Information and Communications Technology Workforce Initiative will update previous research by assessing current supply and demand for IT professionals and skilled workers within the Northeast Ohio region. While previous research indicated a reduction in demand for IT workers, recent feedback from employers indicates there is renewed and growing demand for IT professionals in Northeast Ohio. The new assessment will improve understanding about the talent related factors that contribute to our region's ability to build a strong and vibrant Information Technology industry cluster. The goal of this particular portion of the research is to determine if we have the proper education and training resources in place to produce a world class IT workforce for our region.

The Initiative has broad based support from organizations like TeamNEO, the Greater Cleveland Partnership, NorTech, the Northeast Ohio Council on Higher Education (NOCHE), and the Northeast Ohio Software Association (NEOSA). The research will inform the creation of a comprehensive action plan to build a highly competitive IT workforce for Northeast Ohio. NorTech's recently published report *Navigating the New Realities of the North Shore A Vision for the Technology Economy of Northeast Ohio in 2020*, identified existing strengths that must be leveraged and gaps in investment, talent, and innovation that must be filled to make the region one of the top ten places in the world to live, learn, work, and invest by the year 2020. The roadmap developed by the ICT Workforce Initiative will build upon existing regional strengths and outline the steps necessary to fill identified gaps. Initiative goals and objectives are as follows:

Phase I: Demand Side Qualitative Research

- Identify emerging trends and issues in IT through a national and local literature review
- Create an occupational framework of IT specialty positions to be used in the phase III quantitative assessment of IT demand
- Sharpen research questions through employer input
- Recruit employers to participate in the initiative so research findings can be more effectively translated into an action agenda for Northeast Ohio

Phase II: Supply Side Qualitative Research

- Sharpen research questions with input from education/training providers
- Inventory IT education/training programs available throughout Northeast Ohio post-secondary education/training institutions (colleges, universities, adult education programs of career centers, etc)
- Assess work experience of the regions IT graduates to better understand gaps in education/training and workplace applications
- Recruit educators to participate in the initiative so research findings can be more effectively translated into an action agenda for Northeast Ohio

Phase III: Quantitative Assessment of Supply & Demand:

- Determine the number of recent job openings for IT specialists (plus IT literacy for workers in other positions) and the level of difficulty finding qualified applicants/new hires among target industries
- Assess IT educational requirements, screening/hiring criteria, skill requirements by occupation as well as skill deficiencies in new hires among target industries
- Determine the nature and level of investments in IT worker training by employers
- Understand ways in which employers are most likely to work with education/training providers to ensure programs meet business needs
- **Document the supply of IT graduates and match figures with employer demand for new hires**
- Survey IT graduates within the last 5 years to understand their work history in IT careers including upward mobility, further education, and additional education/training they recommend for new students

Phase IV: Creating an IT Road Map for Northeast Ohio

- Identify priority action areas that are informed and aligned with research findings
- Create regional strategies to address strategic priorities
- Develop regional initiatives and action steps to create a world-class IT workforce for the region
- Identify champions (either existing initiatives/organizations or new champions) to take action

B. Research Approach

This study is part of Phase III of the Regional ICT Workforce Initiative. It is patterned after research conducted in 2000/01 in Northeast Ohio. The overall intent of the research is to document the supply of IT graduates and match these figures with employer demand for IT workers. While secondary data sources are available like the *National Center for Education Statistics* and the state of *Ohio HEI* system, the research team decided that primary data collection was necessary to satisfy project goals and objectives. First, given its' expedient

evolution, there is no consistent framework or common language from which IT is defined or measured. This is further complicated by the fact that education programs are dispersed across an array of academic disciplines and cannot be found within one academic college or department (and are thereby difficult to locate within secondary databases). Second, existing data sources provide no depth about the substance of education programs and it is difficult to infer the nature of these offerings by the program or degree title alone. In addition, measures of output (enrollment/graduates) from secondary sources are typically outdated by the time of their release.

Three overall stages of primary data collection were used for this portion of the study. First, a review of college and university catalogs was conducted to identify the IT specialty programs offered by each institution. Once identified, each program was logged into a spreadsheet which was converted to a questionnaire format (see Appendix A). Second, the questionnaire was forwarded to offices of Institutional Planning and Research. Each institution was asked to verify their IT specialty programs and provide detailed information on enrollment and graduation for the 2005/06 and 2006/07 academic years. The third stage consisted of a qualitative analysis of IT certificate and degree programs so that careful judgments could be made about the nature of each program and the types of IT professionals they are intended to produce. A total of 18 colleges and universities responded to our request for information. This included all public four-year universities, all public two-year colleges, and many private four-year universities.

C. Analysis Framework

A comprehensive literature review was conducted during Phase I of the Regional ICT Workforce Development Initiative to identify emerging IT trends and issues at national, state, and local levels. The literature review also identified various frameworks of IT work. The career clusters utilized by the *National Association of State Directors of Career and Technical Education Consortium* in their publication *Career Cluster Resources for Information Technology* were selected for purposes of this research. For the supply-side research, careful attempts were made to analyze course requirements and descriptive information about each and every IT specialty program so that they could be categorized by each of the career clusters provided within this framework. The framework of IT career clusters is contained on the next couple of pages.

IT Career Cluster	Description	Common Job Titles	Related SOC
I. Network Systems: Design & Administration	Contribute to the initial installation of and continuing administration, analysis, and maintenance of a network system. Efforts on providing an integrated system of multiple interconnected hardware and software components. Includes designers of hardware and software components that allow integration and coordination between multiple databases or access/input terminals, those that devise how these components might be arrayed to suit the needs in a given prospective system, individuals that install and train others on the equipment and programs, and those who continue to manage, maintain and evaluate these systems. Primary emphasis is on the network that connects various databases, stations, or communication devices rather than the disparate components that are connected by the network through the Internet, intranets, extranets, and local and wide area networks. ITAA, 2004, p 13.	Communications/Data Analyst, Network Analyst, Network Security Analyst, Information Systems Administrator, Information Systems Operator, Information Technology Engineer, Network Administrator/Manager, Network Engineer/Technician, PC/Technical/User Support Specialist, Systems Support Lead (ITAA, 2004, p 30)	15-1041 Computer Support Specialists (specifically supporting network applications) 15-1051 Computer Systems Analyst (specifically analyzing networks) 15-1071 Network and Computer Systems Administrators 15-1081 Network Systems and Data Communications Analysts 17-2061 Computer Hardware Engineers (when hardware is a network component)
II. Information Support & Services	Organization of data into useful databases and coherent documents as well as continued management and application to industries.		
II. 1: Database Development/Administration	Organization, storage, and access of information. Includes devising software and hardware intended for database use, implementing those components, managing or maintaining a database system. ITAA, 2004, p 11	Database Administrator/Manager, Database Analyst/Modeler, Database Security Expert (ITAA, 2004, p 29)	15-1051 Computer Systems Analysts (when analyzing databases) 15-1061 Database Admin 43-9011 Computer Operators 43-9021 Data Entry Keyer 43-9022 Word Processors & Typists
II. 2: Technical Writing	Specialize in generating documents in a format conducive to publication or electronic dissemination (ITAA, 2004 p 15). May create technical manuals for instruction/operation of software or hardware components. Translate existing documents from one format to another	Desktop/Electronic Publisher, Documentation Specialist, Editor, Technical Writer (ITAA, 2004, p 30)	27-3042 Technical Writers 43-9031 Desktop Publishers
II. 3: Technical Support	Maintenance of hardware and software components of an individual terminal or an entire network (ITAA, 2004, p 11). Includes both replacing faulty hardware and helping to ensure software applications function correctly.	Analyst, Customer Support Representative, Content Manager, Maintenance Technician, PC Support Specialist, Technical Support Engineer (ITAA, 2004, p 30)	15-1041 Computer Support Specialists 43-4051 Customer Service Representatives (when dealing with computer or technical support)
II. 4: Enterprise Systems Analysis/Integration	Similar job descriptions as Network Design & Admin and Database Development & Admin, however, instead of specializing in either solely the database or the network, these individuals develop and oversee all aspects of an information network that specifically pertains to optimization of the operations of a specific firm. Includes development, administration, or analysis of specific Enterprise Systems (ITAA, 2004, p 14).	Applications Integrator, Business Continuity Analyst, Information Systems Analyst, Systems Manager, Cross-Enterprise Integrator, Data Systems Designer, Electronic Transactions/Business Specialist (ITAA, 2004, p 30)	11-3021 Computer & Information Systems Managers 15-1031 & 15-1032 Computer Software Engineers. Applications & Systems Software (when is business applications of IT systems/Software) 15-1051 Computer Systems Analyst (to analyze business applications)

			15-2031 Operations Research Analysts (to develop software or decision support systems)
III. Interactive Media	Applies to communications in varying forms. May specialize solely in artistic visual/video components or the visual organization of information components of Interactive Media.		
III. 1: Digital Media	Covers the artistic audio/visual aspects of interactive media and some ability to render information in a visual way that will help to understand information being presented (ITAA, 2004, p 14). Most commonly will provide two or three dimensional animation or audio components for entertainment media, advertisements, and other applications that might require graphical or audio elements to be created.	2D/3D Artist/Animator Audio/Visual Engineer, Designer, Media Specialist, Multimedia Author/Producer/ Programmer (ITAA, 2004, p 29)	15-1031 & 15-1032 Computer Software Engineers, Applications & Systems Software (if communications applications of IT systems/Software) 17-1021 Cartographers & Photogrammetrists 27-1014 Multi-Media Artists & Animators 27-1024 Graphic Designer
III. 2: Web Development/ Administration	Only those who apply their graphical and programming skills to the design, adjustment, and administration of a website for a given firm or employer (ITAA, 2004, p 13)	Web Administrator, Web Designer, Web Specialist, Website Developer (ITAA, 2004, p 30)	15-1021 Computer Programmers 15-1061 Database Administrators 15-1071 Network & Computer Systems Admin 15-1081 Network Systems & Data Communications 27-1024 Graphic Designers * For all of the above, some might be considered Web Developers , but not all of them)
IV. Programming & Software Development	Responsible solely for the development and analysis of software applications. This software may be implemented by those in some of the other clusters. These positions aid only as an ancillary component to their main focus of actually devising new software applications and analyzing existing ones (ITAA, 2004, p 12)	Applications Analyst, Applications Engineer, Applications Data Modeler, Operating System Programmer, Systems Administrator, Systems Analyst (ITAA, 2004, p 30)	15-1011 Computer and Information Scientists, Research 15-1021 Computer Programmers 15-1031 Computer Software Engineers, Applications 15-1032 Computer Software Engineers, Systems Software 15-1051 Computer Systems Analysts

I. OVERALL PRODUCTION OF IT PROFESSIONALS BY LEVEL OF AWARD

A. Student Enrollment by Level of Award:

Enrollment in IT specialty programs at Northeast Ohio's institutions of higher education is down significantly from 2000/2001. Total credit enrollment was at 21,774 in 2000/01 but was only 8,789 in 2005/06 and 9,243 in 2006/07. This means there are fewer students currently in the IT pipeline compared to 5-6 years ago. Decrease in enrollment is due primarily to lower associate degree enrollment. On the other hand, bachelor degree enrollment has increased over the past 6 years while enrollment at the advanced degree level has also improved significantly.

Total student enrollment by level of award			
	Enrollment 2000/01	Enrollment 2005/2006	Enrollment 2006/2007
Certificate	317	388	504
Associate	10889	3991	4356
Bachelor	3418	3697	3713
Master	238	522	504
Ph D	50	171	166
*Advanced degrees combined	6,862	-	-
Total	21774	8769	9243
This figure represents a combined total of enrollment in bachelor, master & Ph D programs from Kent State University			

B. Production of IT Graduates by Level of Award:

Interestingly, while overall enrollment in IT programs is down, total *production* of IT workers (or graduates) has been stable compared to 2000/01. In 2000/01 the region's higher education system produced a total of 1,378 IT professionals. In 2005/06 higher education produced 1,363 IT graduates and in 2006/07 a total of 1,311 IT students graduated from the region's colleges and universities. While the total number of IT graduates from Northeast Ohio's system of higher education is very comparable to 5-6 years ago, patterns by level of award are opposite enrollment trends. Enrollment at the associate degree level has been lower in recent years but more students are graduating from two-year IT degree programs than in the past. Conversely, while enrollment in four-year degree programs is up, fewer graduates are being produced at the baccalaureate level. Similarly, advanced degree production from Northeast Ohio's institutions of higher education is lower than in previous years.

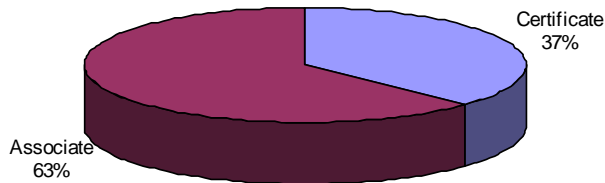
Graduate totals by level of award			
	Graduate 2000/01	Graduate 2005/2006	Graduate 2006/2007
Certificate	108	78	68
Associate	402	495	502
Bachelor	683	634	594
Master	166	144	134
Ph D	19	12	13
Total	1378	1363	1311

II. TECHNICAL SUPPORT CAREER CLUSTER

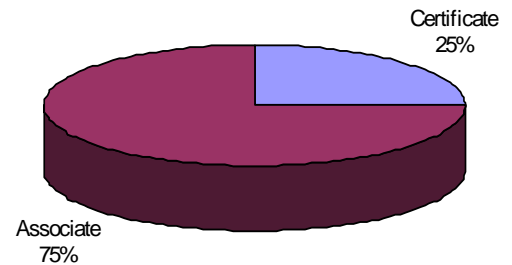
These programs are intended to produce IT supporters who engage in maintenance of hardware and software components of an individual terminal or an entire network. They include both replacing faulty hardware and helping to ensure software applications function correctly. *(Career Cluster Resources for Information Technology, The National Association of State Directors of Career and Technical Education Consortium)*

TECHNICAL SUPPORT						
	ENROLLMENT	GRADUATE	ENROLLMENT	GRADUATE	ENROLLMENT	GRADUATE
	2000/01	2000/01	2005/2006	2005/2006	2006/2007	2006/2007
CERTIFICATE	43	22	71	15	87	11
ASSOCIATE	631	24	71	31	143	33
BACHELOR	0	0	0	0	0	0
MASTER	0	0	0	0	0	0
PHD	0	0	0	0	0	0
TOTAL	674	46	142	46	230	44

Technical Support: Enrollment by Level of Award (2006/07)



Technical Support: Graduates by Level of Award (2006/07)



Key Findings:

- All technical support programs are offered at the certificate and associate degree levels which is similar to 5-6 years ago.
- Enrollment is significantly lower than it was 5-6 years ago but production of graduates today is very similar to what it was in 2000/01. This means fewer students are enrolling in two-year technical support programs but community colleges and regional branch campuses are doing a better job of graduating those who are enrolled.
 - In 2000/01 there were 674 students enrolled in technical support programs. Today, there are only about 230 students enrolled in these programs.
 - In 2000/01 there were 46 graduates of technical support programs compared to 46 in 2005/06 and 44 in 2006/07.
- Employer demand for technical support workers is far greater than what Northeast Ohio's system of higher education is producing. At the time the employer survey was conducted, there were 74 job openings for technical support representatives (outside) and 668 openings for help desk personnel compared to the 44 technical support professionals produced in 2006/07.

TECHNICAL SUPPORT PROGRAMS BY COLLEGE/UNIVERSITY

University or College	Department or College within the Institution	Degree Program	Core Courses	Award Level
Cuyahoga Community College	Engineering Technologies	Computer Maintenance Technology	Keyboarding Introduction to Microcomputer Applications Introduction to PC Maintenance Operating System Technologies Computer User Support Microcomputer Operating Systems PC Servicing and Troubleshooting Network Fundamentals Computer System Peripherals	Certificate
Lakeland Community College	Engineering Technologies	A+ Computer Maintenance Repair	Assembling, Upgrading and Repairing Personal Advanced Assembly and Repair of Personal Computers Preparation for A+ Certification Introduction to Digital Systems Digital Systems with VHD Introduction to Technology	Certificate
Lorain County Community College	Engineering Technologies	Electronic Engineering Technology-Computer Maintenance & Networking	Computer Diagnostic and Repair Technical Problem Solving Electrical Circuits II Digital Electronics Network Installation and Diagnostics Digital Communications Digital Interactive Systems Integration Computer Forensics & Data Recovery Advanced Computer Diagnostics C, C++ and Linux for Hardware Interfacing	AAS
Lorain County Community College	Engineering Technologies	Electronic Engineering Technology-Computer Maintenance & Networking	A+ Certification Preparation I Computer Diagnostic and Repair Network Installation and Diagnostics Advanced Computer and Printer Diagnostics and Repair	Certificate
Lorain County Community College	Business	Information Systems Support	Microcomputer Applications I & II Operating Systems Interfaces Program Development Using Visual Basic Database Design & Implementation Local Area Networks Spreadsheet Applications Multimedia Fundamentals Web Development Computer Diagnostic & Repair	Certificate
The University of Akron	Summit College	Computer Info Systems: Microcomputer Specialist	Math for Modern Technology Introduction to Logic/Programming Internet Tools, Operating Systems, Visual BASIC Microcomputer Application Support, Database Concepts, Client/Server Programming Systems Analysis and Design, Hardware Support Microcomputer Projects, Microcomputer Database Applications, Network Concepts	AAB
The University of Akron	Summit College	Computer Maintenance and Networking	Computer Maintenance and Networking, Introduction to Computers and Application Software, Technical Mathematics, Math for Modern Technology, Essentials of Management Technology, Internet Tools, Website Administration, Operating Systems Networking Basics, Microsoft Networking, Router and Routing Basics, WAN Technologies	AAB
The University of Akron	Wayne College	Network Support Specialist	Introduction to Computers Keyboarding for Skill Development Microsoft Networking Introduction to Network Technologies	AAB

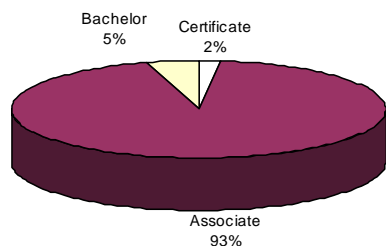
The University of Akron	Wayne College	Personal Computer Repair	Technical Report Writing Operating Systems Basic Electronics for Technicians Personal Computer Servicing Microprocessor Service Practicum Microprocessor Service Practicum Seminar	Certificate
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III. NETWORK SYSTEMS CAREER CLUSTER

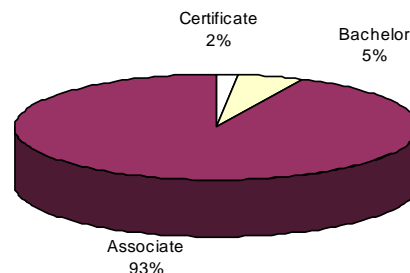
These programs prepare IT workers who contribute to the initial installation of and continuing administration, analysis, and maintenance of a network system. Efforts are on providing an integrated system of multiple interconnected hardware and software components. The cluster includes designers of hardware and software components that allow integration and coordination between multiple databases or access/input terminals, those that devise how these components might be arrayed to suit the needs in a given prospective system, individuals that install and train others on the equipment and programs, and those who continue to manage, maintain and evaluate these systems. Primary emphasis is on the network that connects various databases, stations, or communication devices rather than the disparate components that are connected by the network through the Internet, intranets, extranets, and local and wide area networks. *(Career Cluster Resources for Information Technology, The National Association of State Directors of Career and Technical Education Consortium)*

Network Systems: Design & Administration						
	Enrollment	Graduate	Enrollment	Graduate	Enrollment	Graduate
	2000/01	2000/01	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	8	0	15	5	18	2
Associate	307	34	767	116	869	120
Bachelor	0	0	30	10	42	7
Master	0	0	0	0	0	0
Ph D	0	0	0	0	0	0
Total	315	34	812	131	929	129

Network Systems, Design & Administration: Enrollment by Level of Award (2006/07)



Network Systems, Design & Administration: Graduation by Level of Award (2006/07)



Level is spelled wrong in the Graduate by level chart.

Key Findings:

- Most Network System programs are still offered at the associate degree level (like they were in 2000/01).
- There is now one networking program available at the bachelor degree level (compared to 0 programs 5-6 years ago).
- Network security is a new programmatic emphasis for multiple colleges/universities like Kent State University, Lakeland Community College and Stark State College of Technology. These programs did not exist in 2000/01.
- Both enrollment and graduate production have increased significantly in recent years which means the system of higher education is more responsive to demand for network specialists than it was just a half decade ago.
 - In 2000/01 there were only 315 students enrolled in networking programs. Today, there are more than 900 students enrolled in these programs.
 - In 2000/01 there were only 34 graduates of networking programs. Six years later there were more than 100 graduates from these programs.
- While both enrollment and graduation numbers have improved in recent years, employer demand for network specialists still out paces supply by a wide margin. At the time the survey was conducted, there were a reported 371 job openings for network specialists alone and an anticipated 662 openings in 2007 (among the 480 employers surveyed). These numbers do not include current and anticipated job openings for systems engineers.

NETWORK SYSTEMS PROGRAMS BY COLLEGE/UNIVERSITY

University or College	Department or College within the Institution	Degree Program	Core Courses	Award Level
Baldwin Wallace College	Mathematics & Computer Science	Computer Information Systems: Network Analyst	Introduction to Computer Information Systems Computer Application Software Visual Basic Programming Intermediate Programming for Information Systems Object-Oriented & Linear Structures Non-Linear Data Structures Data Communication Concepts Introduction to Database Management Systems Introduction to Local Area Networks Information Systems, Security, Privacy & Ethics Advanced Local Area Networks System and Network Administration	BS
Cuyahoga Community College	Engineering Technologies	Computer Networking Hardware	Introduction to PC Maintenance, Cisco I: LAN Design Keyboarding, Introduction to Microcomputer Applications Information Technology Concepts, Microcomputer Operating Systems Operating System Technologies, Cisco II: Basic Router Configuration Internet Fundamentals, Network Fundamentals PC Servicing and Troubleshooting, Cisco III: LAN Management TCP/IP, Cisco IV: WAN Management, Computer User Support Computer System Peripherals	AAS
Cuyahoga Community College	Business Technologies	IT Networking Software	Introduction to Microcomputer Applications Information Technology Concepts, Microcomputer Operating Systems Operating System Technologies, Computer User Support Internet Fundamentals, Networking Fundamentals TCP/IP, PC Servicing and Troubleshooting, Technical Writing Network Administration, NetWare Administration, Computer System Peripherals Microsoft Internet Information Server, Systems Administration for SQL Server	AAB
Kent State University	College of Technology	Systems Engineer	Introduction to Operating Systems & Network Technology, Computer Assembly and Configuration, Network Setup and Configuration, Local Area Networking, Internetworking, Technology of Networking	Certificate
Kent State University	College of Technology	Computer Forensics & Information Security	Introduction of OS & Networking, Computer Assembly and Configuration LAN Security & Firewalls, Law and Society Computer Forensics, Local Area Network Security Fund Network Setup and Configuration	Certificate
Lakeland Community College	Business Technologies	Information Systems: Microsoft Networking	Computers and Information Processing, Programming Logic, Using Microsoft Windows, Network+ and Networking Essentials Internet: Services, Tools and Web Page Creation, Visual Basic.NET Programming Supporting Microsoft Windows, Implementing and Supporting MS Windows 2000 Professional, Managing and Maintaining MS Windows 2003 Server Plan, Implement, and Maintain MS Windows 2003 TCP/IP I Managing and Optimizing Personal Computers, Systems Analysis Information Technology Project Management Plan, Implement, and Maintain MS Windows 2003 TCP/IP II Plan, Implement, Maintain MS Windows 2003 Directory Designing a MS Windows 2003 Directory and TCP/IP Infrastructure Implementing Security for MS Windows 2003 Designing Security for MS Windows 2003	AAB Certificate
Lakeland Community College	Engineering Technologies	Networking & Digital Communications Engineering Technology: Network Security	Cisco Networking Technology I & II, Information Assurance I & II, Cisco Network Security I & II, Managing Security, Advanced Firewalls, Network Security Design Comparative Analysis of Microcomputer, Operating Systems Introduction to the Linux/Unix Operating System Implementing and Administering Linux. Managing and Maintaining MS Windows 2003 Server Plan, Implement, and Maintain MS Windows 2003 TCP/IP II, Plan, Implement, Maintain MS Windows 2003 Implementing Security for MS Windows 2003 Linux/Unix Security	AAS Certificate

Lakeland Community College	Engineering Technologies	Networking & Digital Communications Engineering Technology: Cisco Systems	Assembling, Upgrading and Repairing, Personal Computers, Cisco Networking Technology I –VII, Advanced Assembly and Repair of Personal Computers, Advanced Assembly and Repair of Personal Computers, Multi-layer Switching Cisco Network Security I & II	AAS
Lakeland Community College	Engineering Technologies	Networking & Digital Communications Engineering Technology: Microsoft Systems	Introduction to the Linux/Unix Operating System, Supporting Microsoft Windows Visual Basic for Engineering, Telecommunications Principles, Network+ and Networking Essentials, Security Awareness, C Programming for Engineering Plan, Implement, and Maintain MS Windows 2003 TCP/IP I & II Designing Security for MS Windows 2003, Programmable Controllers Assembling, Upgrading and Repairing Personal Computers Implementing and Supporting MS Windows 2000 Professional	AAS
Lorain County Community College	Business	Computer Information Systems: Network Communications Technology	Microcomputer Applications I; Operating System Interfaces Database Design and Implementation; Local Area Networks Computer Diagnostic and Repair; Program Development Using Visual Basic Network Integration and Management; Intranet/Internet Networking	AAB
Stark State College of Technology	Information Technologies	Computer Network Admin & Security Technology	Computer Applications for Technical Professionals Programming Logic and Problem Solving PC Upgrading and Maintenance Introduction to Computer Networking MS Windows XP and 2003 Server MS Windows Server 2003 and Network Infrastructure CCNA UNIX/LINUX Operating Environment Microsoft SQL Server Administration UNIX/LINUX Network Administration UNIX/LINUX System Administration Web Server Administration Firewall and Network Security Designing Security for a Windows 2003 Network	AAS
Stark State College of Technology	Information Technologies	Cyber Security & Computer Forensics Technology	PC Upgrading and Maintenance Introduction to Computer Networking Computer Applications Support Programming Logic and Problem Solving Computer Crime and Investigation Principles of Information Security CCNA File Systems Analysis Cryptography Cyber Law and Ethics Firewall and Network Administration Cyber Forensics and Data Recovery	AAS
Stark State College of Technology	Information Technologies	Microsoft Certified Systems Engineer (MSNE)	Managing and Maintaining a Microsoft Windows Server 2003 Environment Implementing , Managing, & Maintaining a Microsoft Windows Server 2003 Network Infrastructure Planning & Maintaining a Microsoft Windows Server 2003 Network Infrastructure Planning, Implementing, & Maintaining a Microsoft Windows Server 2003 Active Directory Infrastructure Installing, Configuring, & Administering Microsoft Windows XP Professional Designing Security for Microsoft Windows Server 2003 Network	Certificate
The University of Akron	Wayne College	Computer Network Engineering Technology	Technical Report Writing, Technical Math Technical Math II Introduction to Logic/Programming Operating Systems, Basic Electronics for Technicians Digital Electronics for Technicians, Personal Computer Servicing Microprocessor Service Practicum, Microprocessor Service Practicum Seminar Introduction to Network Technologies	AAB

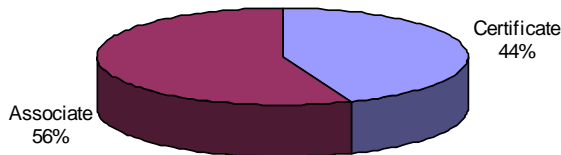
The University of Akron	Wayne College	Computer Service & Network Technology: Microsoft	Technical Report Writing, Intro to Logic/Programming Operating Systems, Basic Electronics for Technicians Digital Electronics for Technicians, Personal Computer Servicing Microprocessor Service Practicum, Microprocessor Service Practicum Seminar Microsoft Networking I –VII, Intro to Network Technologies	AAB
The University of Akron	Wayne College	Computer Service & Network Technology: Novell	Essentials of Management Technology Operating Systems Introduction to Network Technologies Novell Networking I-V	AAB

IV. DATABASE DESIGN & ADMINISTRATION CAREER CLUSTER

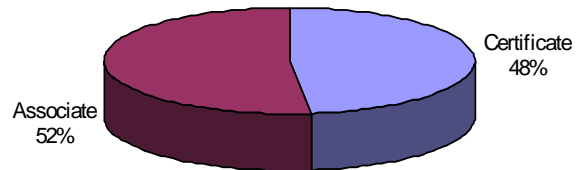
These programs equip students with expertise in organization, storage, and access of information. They prepare students to devise software and hardware intended for database use, implementing those components, managing or maintaining a database system. *(Career Cluster Resources for Information Technology, The National Association of State Directors of Career and Technical Education Consortium)*

Database Development/Administration						
	Enrollment	Graduate	Enrollment	Graduate	Enrollment	Graduate
	2000/01	2000/01	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	0	0	29	11	39	13
Associate	0	0	37	20	50	14
Bachelor	0	0	0	0	0	0
Master	0	0	0	0	0	0
Ph D	0	0	0	0	0	0
Total	0	0	66	31	89	27

Database Development/Administration: Enrollment by Level of Award (2006/07)



Database Development/Administration: Graduates by Level of Award (2006/07)



Key Findings:

- Unlike 5 to 6 years ago when programs focusing exclusively on the production of Database Development specialists were nonexistent, a few programs in this specialty area are being offered at the certificate and associate degree levels.
- However, while few certificate or degree programs exist, database development/administration course work is embedded in other degree programs. Many computer science Bachelor degree programs contain courses in database administration, for example the Computer Science programs at Kent State University, John Carroll University, and Computer Science and Information Systems at Youngstown State University all offer courses in database development/administration.
- Like the career clusters of technical support and network systems, supply of database professionals is well below employer demand. At the time the employer survey was conducted there were a total of 965 job openings for database administrators yet in 2006/07 there were a total of only 26 graduates from related programs.

DATABASE DESIGN & ADMINISTRATION PROGRAMS BY COLLEGE/UNIVERSITY

University or College	Department or College within the Institution	Title of Certificate or Degree Program	Core Courses	Award Level
Kent State University	College of Technology	Database Administrator	Network Setup & Configuration, Visual Basic Database Programming, Configuring and Admin. SQL Server 2000 Enter. Ed., Implementing Database Design - SQL 2000 Server, Developing Distributed Applications, Technology of Networking	Certificate
Lakeland Community College	Business Technologies	Information Systems: Internet Database Developer	Introduction to Oracle PL/SQL ISYS 1420 Develop Oracle PL/SQL Program Units Using Windows Applications: Database Visual Basic.NET Programming; XML Programming Introduction to ASP.NET; CGI Programming	Certificate
Lakeland Community College	Business Technologies	Information Systems: Database Administrator	Computers and Information Processing; Using Microsoft Windows i-Net+ Technologies and Concepts Internet: Services, Tools, and Web Page Creation Network+ and Networking Essentials; Introduction to Oracle PL/SQL Microsoft SQL Concepts; Principles of Accounting HTML Programming; Introduction o the Linux/Unix Operating System Supporting Microsoft Windows; Microsoft SQL Server Implementation Oracle Database Fundamentals; Microsoft SQL Server Administration Principles of Microeconomics; Java Programming Oracle Database Performance Tuning; Managing and Maintaining MS Windows 2003 Server	AAB Certificate
Lakeland Community College	Business Technologies	Information Systems: Oracle Database Applications Developer	Computers and Information Processing Programming Logic; Using Microsoft Windows i-Net+ Technologies and Concepts. Internet: Services, Tools and Web Page Creation Introduction to Oracle SQL; HTML Programming Introduction to Oracle PL/SQL; Applied Computer Mathematics Introduction to Oracle Data Warehousing; Java Programming Systems Analysis; Develop Oracle PL/SQL Program Units Oracle Developer: Forms	AAB Certificate
Stark State College of Technology	Information Technologies	Computer Programming & Database Technology	Internet/Intranet Design and Development Visual Basic Programming Data Modeling and Database Design Java Programming Microsoft Server Side Scripting Microsoft SQL Server Database Design and Implementation Java Web Database Programming Web Design Oracle Database 10g; Introduction to SQL Windows Programming with C# Programming Logic and Problem Solving	AAS Certificate

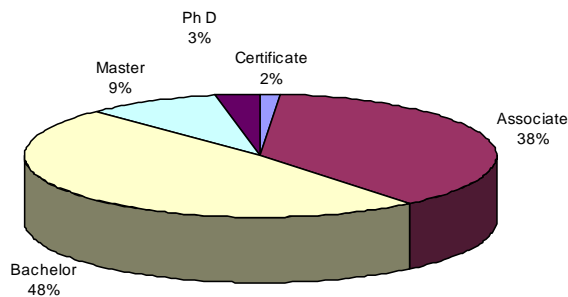
V. ENTERPRISE SYSTEMS INTEGRATION/ PROGRAMMING & SOFTWARE DEVELOPMENT

Enterprise Systems Analysis Integration have similar job descriptions as Network Design & Admin and Database Development & Admin, however, instead of specializing in either solely the database or the network these programs prepare IT workers who develop and oversee all aspects of an information network that specifically pertains to optimization of the operations of a specific firm. This includes development, administration, or analysis of a specific Enterprise System. **Programming & Software Development** programs prepare IT workers who are responsible solely for the development and analysis of software applications. This software may be implemented by those in some of the other clusters. These positions aid only as an ancillary component to their main focus of actually devising new software applications and analyzing existing ones. (*Career Cluster Resources for Information Technology, The National Association of State Directors of Career and Technical Education Consortium*)

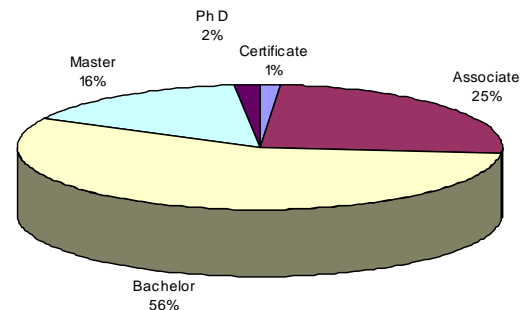
Enterprise Systems Analysis Integration/Programming & Software Development						
	Enrollment	Graduate	Enrollment	Graduate	Enrollment	Graduate
	2000/01	2000/01	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	86	68	59	16	83	12
Associate	8857	226	2016	232	2100	212
Bachelor	3002	488	2745	500	2668	464
Master	238	166	516	143	497	132
Ph D	50	19	171	12	166	13
Total	19095*	967	5507	903	5514	833

(*Including, 6,862 designated as "advanced degrees" from Kent State University, that is, bachelor, master & PhD).

Enterprise Systems Analysis: Enrollment by Level of Award (2006/07)



Enterprise Systems Analysis: Graduates by Level of Award



Key Findings:

- The blunt of IT degree programs are categorized under these IT career clusters (i.e., systems integration and programming/software development). This includes all of the broader computer science and information systems management programs.
- Like other career clusters, student enrollment is down from what it was in 2000/01.
- Graduate numbers, however, are fairly stable. In 2000/01 there were a reported 967 graduates of college IT programs within the two career clusters. In 2005/06 the total number of graduates was 903 and in 2006/07 there were a total of 833 graduates.
- Like other IT clusters, the Northeast Ohio system of higher education is not producing enough graduates to keep pace with employer demand for professional workers.
 - At the time the employer survey was conducted there were 3,703 job openings for enterprise systems personnel (including business application specialists with 2,005 openings; product managers with 371 openings; project managers with 72 openings; technical program managers with 519 openings; information systems operators/analysts with 142 openings, and quality assurance/testing positions with 594 openings). Additionally, there were 742 job openings for programmers and 543 openings for software engineers.
 - In 2006/07 approximately 833 students graduated from related programs which is significantly short of the graduates needed to fulfill employer needs.

ENTERPRISE SYSTEMS, PROGRAMMING, & SOFTWARE DEVELOPMENT CAREER CLUSTERS

University or College	Department or College within the Institution	Title of Certificate or Degree Program	Core Courses	Award Level
Ashland University	Mathematics & Computer Science	Computer Science	Computer Programming, Data Structures Computer Architecture, Theory of Computation Computer Algorithms, Programming Languages Operating Systems, Software Development Compiler Design, Computer Graphics, Computer Networks, Adv. Systems Development, Expert Systems	BS
Ashland University	Mathematics & Computer Science	Computer Science	Computer Programming, Data Structures, Computer Architecture, Theory of Computation, Programming Languages, Operating Systems, Compiler Design Computer Graphics, Computer Networks, Web Design, Systems Analysis/Design, Systems Development, Database Management, Expert Systems	BA
Baldwin Wallace College	Mathematics and Computer Science	Computer Science	Computer Application Software Visual Basic Programming Foundations in Computer Science Computer Science I: Programs & Applications Object Orientation & Linear Structures Non-Linear Data Structures Multimedia Programming Data Communication Concepts Introduction to Database Management Systems	BS
Baldwin Wallace College	Mathematics and Computer Science	Computer Information Systems Analyst	Introduction to Computer Information Systems Intermediate Programming for Information Systems Systems Analysis & Design Information Systems Project Management Information Systems Security, Privacy, & Ethics System & Network Administration Advanced Database Management Systems	BS
Case Western Reserve University	Electrical Engineering & Computer Science	Computer Science	Computer Communications Networks Object Oriented Software Development Software Engineering, Database Systems, Analysis of Algorithms, Intelligent Systems, Computer Graphics, Computer System Architecture Web Computing, Automata and Formal Languages	Ph D MS BS
Cleveland State University	College of Business	Computer & Info Science	Computer & Society, Computer Organization Language Processors, C/C++ for Systems Programming, Object Oriented Design & Programming, Operating System Principles Internet Programming, Comparative Programming Languages, Data Base Concepts, Systems Analysis Software Engineering, Client-Server Computing Graphical User Interfaces, Data Communications & Computer Networks, Computer Graphics Object-Oriented Programming, Multimedia, Introduction to Artificial Intelligence	B A MA Ph D
Cleveland State University	Computer Science	Computer Science	Introduction to Programming Data Structures & Algorithms Object Oriented Design & Programming Language Processors C/C++ for Systems Programming Foundations of Computing	Bachelor
College of Wooster	Computer Science	Computer Science	Data Structures and Algorithms Introduction to Programming Principals of Computer Organization Algorithms Theory of Computation Programming Language Theory and Operating Systems File and Database Systems Computer Graphics Machine Intelligence Compiler Construction	Bachelor

Cuyahoga Community College	Business Technologies	IT: Microcomputer Specialist	Introduction to Microcomputer Applications Information Technology Concepts Internet Fundamentals Programming Logic Microcomputer Operating Systems Electronic Spreadsheet Use and Design Visual Basic Programming Database Use and Design Systems Analysis and Design Advanced Visual Basic Programming Java Programming Networking Fundamentals C/C++ Programming Language	AAB
Cuyahoga Community College	Business Technologies	IT: Mainframe Programming	Introduction to Microcomputer Applications Information Technology Concepts Programming Logic Internal Computer Functions Application Program Development I: COBOL Application Program Development II: COBOL, CICS Assembly Language Programming Application Program Development III: COBOL, CICS, SQL C Systems Analysis and Design	AAB
Hiram College	Computer Science	Computer Science	LISP, COBOL, C, FORTRAN, C++ The Information Age and Computers Introduction to Computer Science Introduction to Programming Java Algorithm Design, Interface Design, Numerical Software, Software Evaluation, Computer Organization, Computer Vision, Operating Systems Programming Languages, Systems Administration Database Design, Systems Analysis and Design Computer Simulation, Computer Networks Parallel Computing, Artificial Intelligence Computer Graphics, Compiler Design and Construction, Design and Analysis of Algorithms	BA
John Carroll University	Mathematics & Computer Science	Computer Info Systems	Intro to Computer Science Web Design and Programming GUI Programming Multimedia Programming Database Systems Computer Communications and Networking Software Engineering Technical Writing in Computer Science Introduction to Computers and Software Management Information Systems Computer Graphics	BS
John Carroll University	Mathematics & Computer Science	Computer Science	Introduction to Computer Science Advanced Programming Web Design and Programming Computer Architecture and Assembly Language Multi-media Programming Database Systems Computer Communications & Networking Computer Graphics Programming Languages Artificial Intelligence Software Engineering Operating Systems Design Patterns	BS
Kent State University	College of Arts & Sciences	Computer Science	Computer Literacy, Intro to Computer Science Intro to Computer Programming Database System Design, Data Mining Discrete Structures for Computer Science Programming Languages, Operating Systems Cluster Computing, Software Evolution Software Visualization, Database Systems Design	PhD MS BS

			Wireless Networks, Communication Networks Systems Administration, Software Engineering Artificial Intelligence, Internet Engineering Web Design & Program Studio	
Kent State University	College of Business: Dept of Mgt & Information Systems	Computer information systems	Computer Applications, Systems Analysis Principles of Systems Development Computer programming for business Systems Simulation, Data and file technology Small Systems Technology, Data Integration Manufacturing Process: Design & Control Communications & Network, Systems analysis Info Systems Management Software Integration, Network management	Ph D Master BS
Kent State University	College of Technology	Solutions Developer	Analyzing Requirements and Defining Solution Architectures SQL Server Technology of Networking Developing Distributed Applications Developing Desktop Applications	Certificate
Kent State University	College of Technology	Applied Business: Computer Technology	Visual Basic Programming; Intro. to Comp. Systems Introduction to Web Site Technology Operating Systems & Networking Tech Computer Assembly and Configuration Network Setup and Configuration Workgroup Productivity Software Visual Basic Database; C++ Programming JAVA Programming; Web Scripting LAN Troubleshooting	
Lakeland Community College	Business Technologies	Information Systems: Computer Information Systems	Discrete Structures Fundamentals of Software Engineering Computer Architecture and Organization Data Structures	AAB Certificate
Lakeland Community College	Business Technologies	Information Systems: PC Enterprise Programming	Computers and Information Processing Programming Logic Using Microsoft Windows Visual Basic.NET Programming Java Programming Visual C#.NET Programming i-Net+ Technologies and Concepts Network+ and Networking Essentials Introduction to the Linux/Unix Operating System Systems Analysis Supporting Microsoft Windows Choose any two of the following three courses: Introduction to Oracle SQL	AAB Certificate
Lakeland Community College	Business Technologies	Information Systems: RPG/Midrange Programming	Computers and Information Processing Programming Logic Introduction to the iSeries (AS/400) Programming iSeries (AS/400) Operating System/CL Interactive RPG Programming	Certificate
Lorain County Community College (in partnership with the University of Akron)		Business Applications Specialist	In Development	AAB BS
Lorain County Community College	Business	Computer Information Systems: Software Development	Microcomputer Applications Operating System Interfaces Program Development Using Visual Basic Local Area Networks Web Development Introduction to E-Commerce Advanced Visual Basic.NET Web Database Integration Systems Development	AAB

Lorain County Community College (in Collaboration with the University of Toledo)		Computer Science & Engineering/Computer Science & Engineering Technology	GUI Programming and Visual Basic Advanced Web Site Design Applied Programming Languages Client/Server Computing Client-Side Scripting Database-Driven Web Sites Web Server Administration Microcomputer Architecture Field Programmable Logic Devices Computer Networks & Data Communications Assembly Language Programming Digital Systems Design Advanced Programming	AAS BS
Oberlin College	College of Arts & Sciences	Computer Science	Computer Organization Systems Programming (C/C++ Programming) Programming Abstractions; Operating Systems Computer Networks; Computer and Information Security; Theory of Computer Science Artificial Intelligence; Digital Animation Computer Graphics	BA
Stark State College of Technology	Information Technologies	Computer Engineering Technology	Electronic Devices and Circuits Programming Logic and Problem Solving PC Upgrading and Maintenance Introduction to Computer Networking Visual Basic Programming UNIX/LINUX Operating Environment Assembly Language Programming Pulse and Digital Integrated Circuits Computer Applications for Technical Professionals PLCs and Industrial Controls Assembly Language Programming	AAS Certificate
Stark State College of Technology	Information Technologies	Computer Science Engineering Technology	Computer Applications for Technical Professionals Programming Logic and Problem Solving Java Programming Internet/Intranet Design and Development C++ Programming Visual Basic Programming Data Modeling and Database Design Java Web Database Programming Windows Programming with C# Advanced C++ Programming Microsoft Server-Side Scripting Analyzing Software Requirements and Developing Solutions Software Engineering for Hand-held Devices	AAS Certificate
The University of Akron	Summit College	Computer Information Systems: Programming Specialist	CIS Programming Specialist, Technical Mathematics Math for Modern Technology, Introduction to Logic/Programming, Internet Tools, Operating Systems, Java Programming, Visual BASIC Database Concepts, Client/Server Programming Advanced Business Programming, Systems Analysis and Design, Computer Applications Project C++ Programming	AAS Certificate
The University of Akron	College of Engineering	Computer Engineering	Programming for Engineers, Computer Systems, VLSI Design Operating Systems Concepts, Computer Methods, Object Oriented Design System Simulation, Expert Systems Design & Development Knowledge Engineering, Framebased Expert System Design, Advanced Processor Design	BS
The University of Akron	College of Arts & Sciences	Computer Science	Intro to Computer Science, Data Structures and Algorithms, Object Oriented Programming Applied Systems Programming, Computer Organization, Software Engineering, Theory of Programming Languages, Operating Systems	MA BA Certificate

Youngstown State University	College of Arts & Sciences	Computer Information Systems	Global Electronic Information Resources. Business Computer Systems. Advanced Object Oriented Programming Foundations of Electronic Commerce System Configuration and Maintenance Development of Databases Networking Concepts and Administration Visual/Object-Oriented Programming Introduction to Computer Graphics User Interface Design; Electronic Commerce Programming; Cisco Networking Academy Parallel and Distributed Computing; Data Base Applications; Artificial Intelligence in Decision Making; Computer Network Security Remote Access and Multilayer Switched Networks	BS AAS
Youngstown State University	College of Arts & Sciences	Computer Science & Information Systems: Computing & Information Systems	Theory and Practice of Information Systems Advanced Database Design and Administration Client-Side Web Development and Programming Server-Side Web Development and Programming Remote Access and Multilayer Switched Networks Game Design and Programming Graphics/Animation for Gaming	MS
Youngstown State University	College of Arts & Sciences	Computer Science & Information Systems: Computer Science	Introduction to Discrete Structures Advanced UNIX and C Programming Survey of Programming Languages Microcomputer System Software System Programming; Advanced Computer Graphics; Evaluation of Educational Software & Hardware; Software Engineering; Operating Systems; Computer Architecture; Simulation Database Design and Information Retrieval Communication Networks; Artificial Intelligence Microcomputer System Architecture Data Structures and Algorithms	BS
Ashland University	College of Business & Economics	Management Information Systems	Programming for Business, Systems Anal. & Design, Database Management, Mgmt. of Info. Systems, Business Spreadsheets, Electronic Commerce Programming for Business, Advanced Systems Development, Decision Support System./E.S., Intro. to Information Security, Computer Programming I & II	BSBA
Cleveland State University	Computer and Information Science	Information Systems Auditing	Fundamentals of System Development Introduction to Programming Information Systems in the Organization Systems Development for the Organization Data Structures and Algorithms Design and Implementation of DBMS Information Systems Auditing Systems Analysis Methods Project Management for Information Systems Web-Based Programming	Bachelor
Cleveland State University	College of Business- Business Admin	Information Systems & Technology	Software Tools for Personal Productivity Fundamentals of Systems Development Information Systems in Organizations Advanced Programming of Business Systems Systems Analysis Methods Modern Database Design and Implementation Management of Business Networks Object-Oriented Programming for IS Project Management for Information Systems Knowledge Management Web-based Programming Electronic Business	BBA

John Carroll University	School of Business	Business Information Systems	Introduction to Computers & Software Comprehensive Spreadsheet Applications Communicating Through Multimedia Management Information Systems Business Applications Development Management Science Quality Management Systems Analysis & Design Legal Environment of Information Technology	BSBA
Stark State College of Technology	Information Technologies	Management Information Systems (formerly Computer Technology)	Computer Applications for Technical Professionals Internet, Intranet, Extranet Technologies Advanced Microsoft Applications Spreadsheet Analysis Internet/Intranet Design and Development Planning, Designing and Implementing an Imaging System Quantitative Business Statistics Microsoft Access Database Microsoft Project Tools Internet Design Tools Data Modeling and Database Design Flash Animation and Design Computer Applications Support	AAS
Notre Dame College	Information Systems	Management Information Systems	Management Information Systems Programming Logic and Design Database Management Systems Information Technology Hardware and Software Network Essentials Systems Analysis	BA
The University of Akron	College of Business Administration	Information Systems Management	Business Information Systems Applications Development for Business Processes Data Management by Information Systems Analysis & Design of Information Systems Telecommunications for Businesses Decision Support w/Data Warehousing and Data Mining Systems Integration E-Business Application Development Information Systems Security	MSM BS
Ursuline College	College of Accelerated Programs	Management Information Systems	Hardware and Systems Software Introduction to Networking Introduction to Programming with Visual Basic Computer User Support Web Development Systems Analysis and Design Database Management Managerial Accounting Managerial Economics Advanced Programming with Visual Basic Information Systems Management Marketing Strategies for Managers Project Management	BA
Case Western Reserve University	Electrical Engineering and Computer Science	Computer Engineering	Intro to Data Structures Logic Design & Computer Organization Digital Logic Laboratory Systems Programming Semiconductor Electronic Devices Computer Architecture Intro to Operating Systems or VLSI/CAD	Ph D MS BS

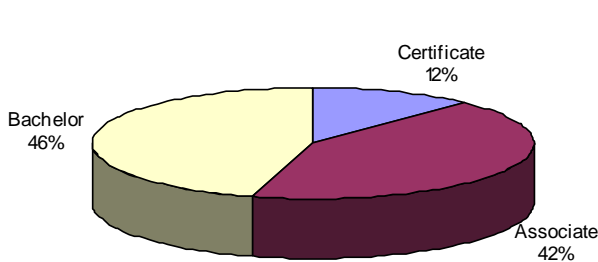
Cleveland State University	College of Engineering	Computer Engineering	Introduction To Engineering Design Introduction to Programming, Electric Circuits, Data Structures and Algorithms Fundamentals of Microcomputer Architecture C/C++ for Systems Programming Engineering Statistics & Probability Digital Systems, Architecture & OS, Computer Organization, Engineering Economy Modern Digital Design, High Performance Architectures, Computer Networks	Bachelor
Case Western Reserve	Weatherhead School of Management	Master of Engineering & Management	Accounting, Finance and Engineering Economics Understanding People and Change in Organizations Engineering Statistics and Quality, Engineering Statistics for Biosciences, Product and Process Design, Development and Delivery I & II, Information Technology & Systems, Analyze Mobility of Mobile E-Business Developing Interpersonal Skills for Managers, Industry/New Technologies, MOS Integrated Circuit Design, New Enterprise Development, Object-Oriented Software Development Web Systems Integration	Master

VI. INTERACTIVE MEDIA TECHNOLOGY CAREER CLUSTER

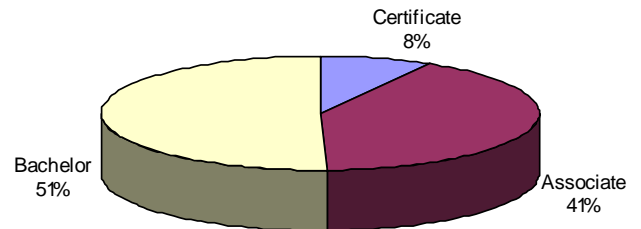
These programs prepare IT workers to use various forms of communication. Some programs may specialize solely in artistic visual/video components or the visual organization of information components of Interactive Media. Digital Media covers the artistic audio/visual aspects of interactive media and some ability to render information in a visual way that will help to understand information being presented. These workers most commonly provide two or three dimensional animation or audio components for entertainment media, advertisements, and other applications that might require graphical or audio elements to be created. Also included in this career track are Web Development/Administration programs. These programs prepare individuals to apply graphical and programming skills to the design, adjustment, and administration of a website for a given firm or employer. *(Career Cluster Resources for Information Technology, The National Association of State Directors of Career and Technical Education Consortium)*

Interactive Media Technology (Combining all Interactive Media programs)						
	Enrollment	Graduate	Enrollment	Graduate	Enrollment	Graduate
	2000	2000	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	162	6	206	28	264	20
Associate	814	32	863	72	936	100
Bachelor	341	184	922	124	1003	123
Master	0	0	6	1	7	2
Ph D	0	0	0	0	0	0
Total	1317	222	1997	225	2212	245

Interactive Media Technology: Enrollment by Level of Award (2006/07)



Interactive Media Technology: Graduates by Level of Award (2006/07)



(A) Digital Media/Media Production				
	Enrollment	Graduate	Enrollment	Graduate
	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	170	9	238	16
Associate	713	61	772	73
Bachelor	694	90	796	102
Master	1		2	1
Ph D	0		0	0
Total	1578	160	1808	192

(B) Web development/Administration (including internet)				
	Enrollment	Graduate	Enrollment	Graduate
	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	2	2	1	0
Associate	135	10	143	24
Bachelor	8	5	6	1
Master	0	0	0	0
Ph D	0	0	0	0
Total	145	17	150	25

(C) Interactive Media Technology: E-Commerce/E-Business				
	Enrollment	Graduate	Enrollment	Graduate
	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	34	17	25	4
Associate	15	1	23	3
Bachelor	220	29	201	20
Master	5	1	5	1
Ph D	0	0	0	0
Total	274	48	254	28

Key Findings:

- Interactive media technology programs are offered at the associate, bachelor, and graduate degree levels.
- Enrollment is strong in both the associate and bachelor degree programs. In fact, enrollment in these programs has increased from 1,317 in 2000/01 to 1,997 in 2005/06 and 2,212 in 2006/07. This is one of only three IT career clusters for which enrollment has increased in recent years.
- However, similar to 5- 6 years ago, the greatest production of Interactive Media specialists is occurring at the baccalaureate level.
- E-business and Commerce represent new programmatic emphasis for numerous degree programs (offered primarily by Lakeland Community College and The University of Akron). These programs did not exist in 2000/01.
- Unlike most IT career clusters, it appears as if supply of interactive media specialists is more in line with employer needs.
 - In 2006/07, Northeast Ohio's institutions of higher education produced 245 interactive media graduates.
 - At the time the employer survey was conducted there were a total of 141 job openings for related interactive media technology professionals.

INTERACTIVE MEDIA TECHNOLOGY CAREER CLUSTER

A. Digital Media/ Media Production

University or College	Department or College within the Institution	Degree Program	Core Courses	Award Level
Ashland University	Communications Art	Computer Art & Graphics Programming	Elements of design, Color theory, 2-D Design, 3-D Design, Fundamentals of drawing, Art & ideas, Photography, Computer Art	BS
Stark State College of Technology	Information Technologies	Interactive Media Technology	Interactive Media Graphic Arts Design 3D Graphics Modeling Digital Video Recording and Editing Texture and Effects for 2D and 3D Design Internet/Intranet Design and Development Graphics for Illustration 3D Graphics Animation Digital Audio Recording and Editing	AAS Certificate
Kent State University	College of Communication & Information	Visual Communication Design: 2D Design	Issues for Graphic Design Businesses History of Graphic Design Advances Studio Skills Graphic Design/Illustration Electronic Prepress Production Typographic/Photographic Graphic Design Corporate Identity/Graphic Design Kinetic and Sequential Graphic Design	BFA MFA
Kent State University	College of Communication & Information	Visual Communication Design: 3D Design	Issues for Graphic Design Businesses History of Graphic Design Advances Studio Skills Graphic Design/Illustration Electronic Prepress Production Typographic/Photographic Graphic Design 3D Graphic Design-Direct Mail/Packaging/Point Purchase Environmental Design	BFA MFA
Kent State University	College of Communication & Information	Visual Communication Design: Illustration	Advanced Illustration/Media Editorial Illustration Advertising Illustration Computer Illustration 3D and Illustration Professional Portfolio Graphic Design/Illustration	BFA MFA
Kent State University	College of Technology	Computer Design & Animation Engineering	PC/Network Engineering & Troubleshoot, Computer Animation II&III, Advanced CAD II, Animation Theory, Technology of Light, Color, Design, Layout, Advanced Animation Development, Technology of Media & Film Production, Graphics Design Technology, Multimedia & Visual Reality, Unix Scripting with Application	AAS BS
Notre Dame College		Graphic Communication	Drawing, Introduction to Graphic Design, Photography, Basic Design, Color and Design, Graphic Design, Multimedia Development, Impressionism to Today, Web Site Design and Development, Writing for the Non-Print Media	BA
Cleveland State University	Liberal Arts & SS: Art Department	Graphic Design	The Graphic Design certificate program prepares students, with or without a baccalaureate degree in art, for the conception and production of two-dimensional graphic designs, with emphasis on the utilization of software for the Macintosh computer. The certificate program is an alternative to a traditional four-year art degree, for creative and self-motivated students who specifically want to develop their technical proficiency, aesthetic sensibility, and design expertise	Certificate
Lakeland Community College	Arts & Humanities	Graphic Design	Visual Organization, Typography, Life Drawing, Graphic Production Illustration, Advertising Design, Basic Photography, Package Design Advertising Design, Graphic Design Portfolio, Commercial Photography Electronic Imaging, Computer Graphics QX, Computer Graphics ID Computer Graphics FH, Computer Graphics AI	AAB
Lorain County Community College	Communications & Creative Arts	Graphic Design	Graphic Design I Graphic Design II Graphic Design III	Associate
Lorain County Community College	Communications & Creative Arts	Computer Art	Arts and Crafts, Printmaking, Drawing, Two-dimensional design, Three-dimensional Design, Graphic Design, Computer Art, Digital Photography, Typography.	Associate

The University of Akron	Myers School of Art	Graphic Design	Typography, Digital Imaging, Typography I-IV, Web Page Design, History of Graphics, Graphics Review, Illustration, Graphics Present	
Youngstown State University	College of Fine Arts & Performing Arts	Studio Art: Graphic Design	Intro. to Digital Imaging, Intro. to Graphic Design, Intro. to Typography Intermediate Graphic Design, Advanced Typography, Illustration Interface Design, History of Graphic Design, Graphic Design Internship Publication Design, 3-D Graphics, Advertising Graphics	BFA
Ashland University	Communication Art	Computer Art and Graphics Programming	Elements of design, Color theory, 2-D Design, 3-D Design Fundamentals of drawing, Art and ideas, Photography, Computer Art	BS
Cuyahoga Community College	Art	Graphic Design	Introduction to Graphic Design Computer Graphic: Letter Form and Image	Certificate
Youngstown State University	College of Fine Arts & Performing Arts	Studio Art: Art and Technology	Conceptual Ideation, Digital Photography, Intro. to Graphic Design Junior Portfolio Review, Web Graphics Programming, Intro. to Motion Studies, Interface Design for the Internet, Digital A/V Production 3D Computer Animation 1 & 2, Multimedia Design	BFA
Lakeland Community College	Business Technologies	Media Technology: Animation and Cartoon Arts	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Video I: Introduction to Video Production and Broadcast Interactive Media I: Introduction to Interactive Production Animation I: Introduction to Two and Three-Dimensional Animation Animation II: Two Dimensional Animation and Cartooning Cartoon Animation Drawing Staff Practice I: Animation and Cartoon Arts Interactive Entertainment I: Intro. to Entertainment Production Animation III: Three Dimensional Animation Animation IV: Advanced Animation Virtual Set and World Design Staff Practice II: Animation and Cartoon Arts	Certificate-
Ashland University	Communications Art	Electronic Media Production	Media Technology & Operations, Broadcast Management, Media Effects, Media Criticism, Field Production, Studio Production, Basic Audio Production Radio, Electric Post Production	BA
Cleveland Institute of Music		Audio Recording	Recording Studio Maintenance Audio Recording Internship Multi-track Recording Techniques Audio Recording Techniques Advanced Audio Recording Tech	BMus
Lakeland Community College	Business Technologies	Media Technology: Video Production and Broadcast	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Writing for Broadcast and Interactive Media Vocalization and Diction for Broadcast Media Sports Reporting, Commentary and Videography Video II: Action Videography and Video Technique Audio I: Introduction to Audio Production and Recording Video III: Electronic News Gathering Video IV: Independent Commercial Video Production Video Compositing and Special Effects Video I: Introduction to Video Production and Broadcast	Certificate
Lakeland Community College	Business Technologies	Media Technology: Radio Production and Broadcast	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Writing for Broadcast and Interactive Media Vocalization and Diction for Broadcast Media Radio I: Introduction to Radio Production and Broadcast Radio Business Techniques and Broadcast Direction Live Radio Performance and Engineering Audio I: Introduction to Audio Production and Recording Radio III: Electronic News Gathering Radio IV: Commercial Radio Production Radio II: Advanced Radio Techniques	Certificate
Cuyahoga Community College	Engineering Technologies	Recording Arts & Technology	MIDI Technology; Intro to Recording; Studio Operations Audio Transducers; Basic Audio Electronics; Audio Signal Processing Digital Audio Theory; Digital Audio Mixing	AAS

Lakeland Community College	Business Technologies	Media Technology: Audio Engineering and Production	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Video I: Introduction to Video Production and Broadcast Radio I: Introduction to Radio Production and Broadcast Audio I: Introduction to Audio Production and Recording Audio II: Recording and Studio Techniques Electronic Music Staff Practice I: Audio Audio III: Sound Shaping and Advanced Production Audio IV: Advanced Recording and Editing Foley Sound Design and Recording Basics of Sound Reinforcement	Certificate
Cleveland State University	School of Communication	Journalism & Promotional Communication	Principles of Communication Single Source Video/Audio Production and Editing Introduction to Film Audio Production for Radio Multi-Source Video Production Media Electronics Advertising Media Planning and Sales Interactive Advertising Designs Advanced Video/Audio Production Advanced Video/Audio Editing Editing and Graphics DVD and Emerging Media: Authoring and Project Management	BA
Lakeland Community College	Business Technologies	Media Technology: Interactive Entertainment Technology	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Video I: Introduction to Video Production and Broadcast Interactive Media I: Introduction to Interactive Production Staff Practice II: Interactive Entertainment Technologies Cartoon Animation Drawing Interactive Entertainment I: Intro. to Entertainment Production Interactive Entertainment II: Interactive Game Design Techniques Interactive Entertainment Design Theory Staff Practice I: Interactive Entertainment Technologies Interactive Entertainment III: Applied Game Logic Interactive Entertainment IV: Advanced Game Design and Production Animation I: Introduction to Two and Three-Dimensional Animation	Certificate
Lakeland Community College	Business Technologies	Media Technology: Interactive Media	Introduction to the Multimedia Computer The Business and History of Broadcast and Interactive Media Video I: Introduction to Video Production and Broadcast Audio I: Introduction to Audio Production and Recording Interactive Media I: Introduction to Interactive Production Interactive Media II: Interactive Production Technology Interactive Media Design Theory Animation I: Introduction to Two and Three-Dimensional Animation Interactive Media III: Multiple Media Integration3 Interactive Media IV: Advanced Interactive Presentation Interactive Educational Design	Certificate
Stark State College of Technology	Information Technologies	Commercial Music	Applied Music Technology; Music Technology Practicum Digital Video Recording and Editing; Programming Logic and Problem Solving; Music Technology; Webcasting Internet/Intranet Design and Development Flash Animation and Design Digital Audio Recording and Editing Computer Applications for Technical Professionals	AAS
Youngstown State University	Department of Communication and Theater	Telecommunication Studies	Introduction to Telecommunication, Telecommunication Technologies Scriptwriting for Electronic Media, Media Operations and Performance Principles and Practices of Media Announcing, Video Production, Telecommunication Regulation	BA

Kent State University	College of Communication & Information	Journalism & Mass Communication: Broadcast Journalism	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication, Introduction to Videography, Newswriting, Broadcast Beat Reporting, Producing and Electronic Editing, Computer-Assisted Reporting, Reporting Public Affairs, Advanced Broadcast News	BS
Lakeland Community College	Business Technologies	Information Systems: Interactive Game Programming	Computers and Information Processing Programming Logic Using Microsoft Windows Principles of Accounting Internet: Services, Tools and Web Page Creation HTML Programming, Introduction to Flash, Java Programming, i-Net+ Technologies and Concepts Flash ActionScript, Introduction to Oracle SQL, Systems Analysis, LEGO Robotics for Game Programmers Flash Game Programming, Robotics for Game Programmers	AAB
Lorain County Community College	Engineering Technologies	Computer Gaming & simulation Development	IN DEVELOPMENT	AAS
Kent State University	College of Communication & Information	Journalism & Mass Communication: Electronic Media Production	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication Videography Basics, Photography Basics, Writing for Electronic Media, Programming for the Electronic Media, Basic Electronic Media Production, Basic Media Engineering, Audio Studio Production, Audio Field Production, Video Studio Production, Video Field Production	BS
Kent State University	College of Communication & Information	Journalism & Mass Communication: Information Design	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication, Visual Design for Visual Design for Media I –III, Information Graphics, Newswriting, Copyediting, Newspaper Design, Videography Basics, Photography Basics, Magazine Design	BS
Kent State University	College of Communication & Information	Journalism & Mass Communication: Magazine Journalism	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication, Newswriting, Copyediting, Photography Basics, Videography Basics, Visual Design for Media I-III, Feature Writing, Magazine Publishing, Magazine Design or Magazine Writing and Editing, Print Beat Reporting	BS
Kent State University	College of Communication & Information	Journalism & Mass Communication: Photo Journalism	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication, Photography, Videography Basics, Visual Design for Media I-III, Newswriting, Print Beat Reporting, Photojournalism I &II, Color Photography, Advanced Journalism	BS
Kent State University	College of Communication & Information	Journalism & Mass Communication: Video and Film Programming	Introduction to Mass Communication, Media Writing, Media Information Gathering, Visual Design for Media I Law of Mass Communication, Ethics and Issues in Mass Communication Intro to Mass Communication, Photography Basics, Media Writing, Media Information Gathering, Law of Mass, Communication, Ethics and Issues in Mass, Communication, Visual Design for Media I, Videography Basics, Writing for the Electronic Media, Programming for the Electronic Media, Basic Electronic Media Production, Film as Communication, Advanced Electronic Media Programming, Film Workshop, Mass Media Research or Concept Psychographics Scriptwriting for Video and Film or Media Sales and Promotion	BS

B. Web Development/Administration (including Internet)

Baldwin Wallace College	Mathematics and Computer Science	Web Applications Engineer	Web Programming I Web Programming II	BS
Cuyahoga Community College	Business Technologies	IT: Web Page Development & Maintenance	Introduction to Microcomputer Applications Information Technology Concepts; Internet Fundamentals Programming Logic; Microcomputer Operating Systems Advanced Internet Concepts; Creating Web Pages with HTML and JavaScript; Interactive Internet Programming; Imaging and Design Imaging and Design Studio; Database Use and Design Networking Fundamentals; Media Design; E-Commerce Technologies C; C/C++ Programming Language	AAB
Lorain County Community College	Business	CIS-Web Development	Microcomputer Applications Operating System Interfaces Introduction to E-Commerce Program Development Using Visual Basic Database Design and Implementation Web Development Web Database Integration Local Area Networks Principles of E-Marketing Systems Development	AAB
Stark State College of Technology	Information Technologies	Web Design & Development	Computer Applications for Technical Professionals Programming Logic and Problem Solving Internet/Intranet Design and Development Client Side Scripting Data Modeling and Database Design Visual Basic Programming Flash Animation Web Design Microsoft SQL Server Database Design and Implementation Windows Programming with C# Microsoft Server Side Scripting Search Engine Optimization Advanced XML and Web Services Internet Design Tools Advanced Web Development	AAS Certificate
The University of Akron	Summit College	Web Development	Introduction to Logic/Programming, Internet Tools, Operating Systems Visual BASIC, Database Concepts, Java Programming, Math for Modern Technology, Systems Analysis and Design, Interactive Web Programming, Multimedia and Interactive Web Elements, Web Site Administration	AAB
Youngstown State University	Computer Science & Information Systems	Multimedia & Web Design	Multimedia Technology Multimedia Authoring Web Development and Design Computer Technology for Digital Image	Certificate
Lakeland Community College	Business Technologies	Information Systems: Internet Specialist Programming	Introduction to Business, Computers and Information Programming Logic, Using Microsoft Windows Internet: Services, Tools and Web Page Creation i-Net+ Technologies and Concepts, Introduction to Web Design, Principles of E-Business, Applied Computer Mathematics, Introduction to Oracle SQL, Using an HTML Editor, Introduction to the Linux/Unix Operating System Systems Analysis, Java Programming, PHP Programming	AAB Certificate
Lakeland Community College	Business Technologies	Information Systems: Internet Specialist Web Content Developer	Computers and Information Processing, Programming Logic Using Microsoft Windows, Internet: Services, Tools and Web Page Creation, i-Net+ Technologies and Concepts, Introduction to Web Design, Principles of Marketing HTML Programming, Introduction to Flash	AAB Certificate

			Visual Basic.NET Programming, Java Programming Direct and Internet Marketing, Applied Computer Mathematics Using an HTML Editor, Systems Analysis, JavaScript Programming, Electronic Imaging, Principles of E-Business Principles of Microeconomics	
Lakeland Community College	Business Technologies	Information Systems: E-Business Programming: Midrange Enterprise	Computers and Information Processing, Programming Logic Introduction to the iSeries (AS/400), Principles of E-Business Using Microsoft Windows, i-Net+ Technologies & Concepts, Introduction to Oracle SQL, RPG Programming, iSeries (AS/400) Operating System/CL, Systems Analysis SQL Development for DB2 UDB/400 WebSphere E-Business Development for iSeries (AS/400), Interactive RPG Programming, Internet: Services, Tools, and Web Page Creation, Java Programming	AAB
Kent State University	College of Technology	Internet	Visual Basic Programming, Intro to OS & Networking Technology, Intro to Web Site Technology, Internet Ethics and Policies, Techniques of Multimedia Web Design, Web Scripting	Certificate
Certificate	Certificate	Advanced Internet	Computer Assembly & Configuration, Network Setup & Configuration, Visual Basic Database Programming, Multimedia Development Tools, Web Scripting II Technology of Networking, Web-Database Integration	Certificate

C. E-Commerce, E-Business

Lakeland Community College	Business Technologies	Information Systems: E-Business Programming: Large Scale Enterprise Systems	Applied Computer Mathematics Computers and Information Processing Programming Logic Introduction to the iSeries (AS/400) 1 Principles of E-Business Using Microsoft Windows i-Net+ Technologies and Concepts Introduction to Oracle SQL Large Scale Enterprise Operating Systems Programming Enterprise Applications in COBOL5 Systems Analysis SQL Development for DB2 UDB/400 WebSphere E-Business Development for iSeries (AS/400) Transaction Server for the Web Principles of Microeconomics Java Programming I Large Scale Enterprise Systems Business Statistics	AAB
Lakeland Community College	Business Technologies	Business Management: E-Business	Principles of E-Business Direct and Internet Marketing Computers and Information Processing Introduction to Web Design Principles of Accounting Principles of Management Marketing Information and Research International Marketing HTML Programming	Certificate
The University of Akron	College of Business Administration	E-Marketing & Advertising	Introduction to e-Business Marketing Research and Analytics Multi-Channel Marketing Integrated Marketing Communications e-Marketing Practices Database Management for Information Systems Decision Support with Data Warehousing/Data Mining Systems Integration	BS
The University of Akron	College of Business Administration	Management: E-Business Technologies	Business Information Systems Introduction to E-business Data Management for Information systems Telecommunications for Business E-business Application Development Information Systems Security E-Marketing Practices Decision Support with Data Warehouses & Data Mining	BS

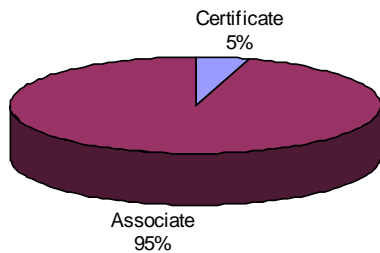
The University of Akron	College of Business Administration	Electronic Business	E-Business Marketing Strategies & Tactics Knowledge Management & Business Intelligence Innovative Marketing Strategies Management of Technology Enterprise Risk Assessment & Assurance	MBA
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VII. OFFICE & MICROCOMPUTER TECHNOLOGY

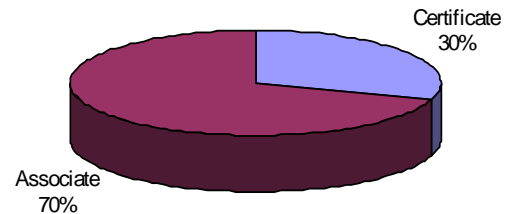
These education/training programs help prepare workers primarily for front office work. Many of the "micro-computing" degree and certificate programs are also applicable to any individual interested in learning how to use a personal computer for a variety of applications. Training usually focuses on general keyboarding skills, use of PC operating systems (DOS and Windows), and word processing, spreadsheet, database development, desktop publishing, and multi-media presentation applications. Heavy emphasis is placed on Microsoft Office applications (Word, Excel, Access, Power Point, Project Management, Desktop Publishing). Some programs incorporate fundamentals of exploring and finding information on the Internet. They may also include introductory course work on PC design, installation, maintenance, and repair but this does not comprise the primary emphasis of these programs. This cluster is not included in the *Career Cluster Resources for Information Technology* by The National Association of State Directors of Career and Technical Education Consortium, but was included in this research given the array of existing educational programs.

Office & Microcomputer Technology						
	Enrollment	Graduate	Enrollment	Graduate	Enrollment	Graduate
	2000	2000	2005/2006	2005/2006	2006/2007	2006/2007
Certificate	18	12	8	3	13	10
Associate	280	86	237	24	258	23
Bachelor	75	11	0	0	0	0
Master	0	0	0	0	0	0
Ph D	0	0	0	0	0	0
Total	373	109	245	27	271	33

Office & Microcomputer Technology: Enrollment by Level of Award (2006/07)



Office & Microcomputer Technology: Graduates by Level of Award (2006/07)



Key Findings:

- Similar to Technical Support, Office and Microcomputer Technology programs are offered only at the Associate degree level.
- This is a shift from 5-6 years ago when these programs were offered at both the Associate and Bachelor degree levels.
- Though enrollment at the Associate degree level is comparable to Technical Support, production of Office and Microcomputer specialists is relatively lower.
- Production of Office and Microcomputer Technology specialists is also low compared to 5-6 years ago.
- Employer demand for office microcomputer specialists was not probed in the employer survey and therefore, cannot be compared with supply of graduates.

OFFICE & MICROCOMPUTER TECHNOLOGY

University or College	Department or College within the Institution	Degree Program	Core Courses	Award Level
Cuyahoga Community College	Business Technologies	IT: Information Application Specialist	Keyboarding, Introduction to Microcomputer Applications Internet Fundamentals, Introduction to Windows Information Technology, Basic Business Formatting Basic Filing with Microcomputer Applications Business Communications Speed Building Electronic Spreadsheet Electronic Spreadsheet Use and Design	AAB
Kent State University	College of Technology	Applied Business: Business Management Technology	Intro. to Computer Systems Word Processing Database Applications Business Communications Introduction to Management Technology Workgroup Productivity Software Introduction to Web Site Technology	AAB
Kent State University	College of Technology	Microcomputer Applications	Visual Basic Programming, Intro to OS & Networking Technology Intro to Web Site Technology, Introduction to Computer Systems, Workgroup Productivity Software, Application of Technical Mgmt. Software	Certificate
Kent State University	College of Technology	Applied Business: Information Technology for Administrative Professionals	Word Processing, Business Presentations, Data Management for Admin. Prof., Database Applications, Spreadsheet Applications, Desktop Publishing, Administrative Resource Management, Project Management for Admin. Prof. Seminar for Administrative Professionals, Intro to Computer Systems, Intro to Web Site Technology,	AAB Certificate
Lakeland Community College	Business Technologies	Business Management: Business Information Management	Computers & Information Processing, Programming Logic i-Net+ Technologies and Concepts, Using Microsoft Windows Principles of E-Business, Visual Basic.NET Programming Using Windows Applications: Word Processing Using Windows Applications: Spreadsheets Network+ and Networking Essentials Management Philosophy and Practice, Systems Analysis Microsoft Access Relational Database	AAB Certificate
Lakeland Community College	Business Technologies	Information Systems: Microcomputer Specialist	Computers and Information Processing Programming Logic Using Microsoft Windows Network+ and Networking Essentials Using Windows Applications: Word Processing Using Windows Applications: Spreadsheets Using Windows Applications: Database Visual Basic.NET Programming Help Desk Concepts and Management Applied Computer Managing and Optimizing Personal Computers Systems Analysis Visual Basic for Applications Introduction to Oracle SQL Implementing and Supporting MS Windows 2000 Professional	AAB Certificate
Lorain County Community College	Business	Administrative Office Information Systems	Keyboarding Skills Development Records Management Introduction to Windows Administrative Office Technology Business Communications Exploring the Internet Excel Spreadsheets Access Transcription on the Computer PowerPoint and Design Principles Personal and Professional Development Integrated Office Applications	AAB

Lorain County Community College	Business	Office Assistant	Keyboarding Skills Development Keyboarding Skills Development Introduction to Windows Administrative Office Technology Introduction to Business Administration Records Management Business Communications	Certificate
Lorain County Community College	Business	Word Information Processing	Keyboarding Skills Development Introduction to Windows Word Keyboarding, Intermediate Administrative Office Technology Records Management Transcription on the Computer Business Communications	Certificate
The University of Akron	Wayne College	Office Technology: Application Software	Operating Systems, Introduction to Office Procedures, Microsoft Outlook, Microsoft Word, Beginning, Spreadsheet Software, Microsoft Word, Advanced, Introduction to Databases for Micros, Speech Recognition Technology, Microsoft PowerPoint, Introduction to Network Technologies	AAB
Youngstown State University	College of Arts & Science	Computer Science & Information Systems: Information Technology	Beginning Keyboarding. Document Preparation Concepts of Information Technologies Information Technology Management Desktop Publishing Business Communication Advanced Spreadsheets Intranet Database Implementation Multimedia Technology Web Site Development Computer Technology for Digital Image Processing Advanced Multimedia Authoring Information Technology Analysis and Design Integrated Information Systems	BS AAS

VIII. OVERALL PRODUCTION OF IT SPECIALISTS BY INSTITUTION TYPE

	Enrollment 05/06	Graduates 05/06	Enrollment 06/07	Graduates 06/07
Private Four-Year				
Ashland University	100	21	93	20
Baldwin Wallace College	109	19	88	25
Case Western Reserve University	382	125	392	132
Cleveland Institute of Music	3	0	2	1
College of Wooster	44	9	57	8
Hiram College	15	11	17	9
John Carroll University	38	14	26	13
Notre Dame College	27	12	22	10
Oberlin College	32	11	26	10
Ursuline College	65	11	52	4
Total				(232)
Public Four-Year				
Cleveland State University	551	191	731	195
Kent State University	2038	234	2157	239
The University of Akron	1515	229	1504	181
Youngstown State University	841	119	792	96
Total				(711)
Public Two-Year				
Cuyahoga Community College	1097	89	1069	95
Lakeland Community College	842	55	898	65
Lorain County Community College	229	78	453	86
Stark State College of Technology	841	135	864	122
Total				(368)
Grand Total	8769	1363	9243	1311

* 2000/01 data not available by institution.

Key Findings:

- As might be expected, the four public universities (Cleveland State University, Kent State University, The University of Akron, and Youngstown State University) are producing the greatest number of IT professionals. Combined, they produced 711 IT professionals in 2006/07.
- Public two year colleges also have a significant role in the supply of IT workers. In 2006/07 the four community colleges (Cuyahoga Community College, Lakeland Community College, Lorain County Community College, and Stark State College of Technology) produced nearly 400 IT professionals.
- Combined, the ten private universities responding to our request for information produced a total of 232 IT professionals in 2006/07. About half of these graduates came from Case Western Reserve University.

IX. SUMMARY OF SUPPLY & DEMAND BY CAREER CLUSTER

A. Supply Side Patterns by Career Cluster:

- While total *enrollment* in IT specialty has decreased, unique enrollment patterns are observed by IT career cluster. *Enrollment* has decreased in recent years in technical support programs, enterprise systems/programming/software development programs, and office microcomputer programs. However, enrollment in network systems, database administration, and interactive media technology programs has increased in recent years.
- *Graduate production* is actually higher in recent years for the IT career clusters of network systems, database administration, and interactive media technology while *graduate production* of technical support professionals is comparable to what it was in 2000/01. Only production of workers for enterprise systems, programming, and software development combined is down slightly from 2000/01.

2. Matching Supply With Employer Demand:

- Using the survey of approximately 480 employers across a 16 county region of Northeast Ohio, we are able to compare supply of IT workers with market demand. Overall demand for IT workers is *greater* than supply (i.e., not enough graduates are being produced to keep pace with employer needs) for the following IT career clusters:
 - Technical Support
 - Network Systems
 - Database Development & Administration
 - Enterprise Systems Analysis & Programming/Software Development
- The system of higher education appears to be keeping better pace with demand (i.e., the number of graduates being produced is higher than need for workers – at least among the 480 employers surveyed) within the interactive media technology career cluster.

SEE TABLE ON NEXT PAGE

IT CAREER CLUSTERS	DEMAND FOR IT WORKERS BY CLUSTER (Sample of 480 employers in 16 region of NEO)				2000/2001 Enrollment Totals		2000/2001 Graduate Totals		2005/2006 Enrollment Totals		2005/2006 Graduate Totals		2006/2007 Enrollment Totals		2006/2007 Graduate Totals	
	IT Occupations related to IT Cluster	# Hired in 2006	# Full Time Openings at Time of Survey	Anticipated # of Full Time Openings in 2007	#	%	#	%	#	%	#	%	#	%	#	%
<i>Career clusters defined by the National Association of State Directors of Career & Technical Education Consortium</i>																
Technical Support	Tech Support Reps (outside) Tech Support (Help Desk)	0 961	74 668	148 372	674	3%	46	4%	142	2%	46	3%	228	2%	44	3%
Network Systems: Design & Administration	Network Specialists Systems Engineers	961 74	371 446	662 661	315	2%	34	3%	812	9%	131	10%	929	10%	129	10%
Database Development & Administration	Database Administrators	446	965	669	0	0%	0	0%	66	1%	31	2%	89	1%	27	2%
Interactive Media Technology (All Media programs combined):	Digital Media Specialists	220	141	148	1317	6%	222	19%	1997	23%	225	17%	2212	24%	245	19%
A) Digital Media /Media Production	Not Available	NA	NA	NA	NA	NA	NA	NA	1578	NA	160		1808		192	
(B) Web Development & Administration	Web Developers/Administrators	520	816	892	NA	NA	NA	NA	145	NA	17		150		25	
(C) Interactive Media: E-Commerce/E-Bus	Not Available	NA	NA	NA	NA	NA	NA	NA	274	NA	48		254		28	
Enterprise Systems Analysis	Business Application Specialists Product Managers Project Managers Technical Program Managers Info Systems Operators/Analysts Quality Assurance & Testing	1784 148 372 75 297 297	2005 371 72 519 142 594	2453 594 223 142 594 661												
Programming & Software Development	Programmers Software Engineers/Architects Total	1195 742 19095	742 1543 88%	1338 894 83%	967	83%	5507	63%	903	66%	5514	60%	833	64%		
Office & Microcomputer Technology	Not probed				373	2%	109	9%	245	2%	27	2%	271	3%	33	2%
Totals					21774	100	1156	100	8769	100	1363	100	9243	100	1311	100

APPENDIX: SURVEY QUESTIONNAIRE

SECTION A

**Northeast Ohio
Information Technology Initiative
Survey of Institutions of Higher Education
2007**

The following data collection form will be used to determine the capacity of the Northeast Ohio's system of higher education to meet current demand for IT professionals and skilled workers within the region. This assessment will improve our understanding about the talent related factors that contribute to our region's ability to build a strong and vibrant Information Technology industry cluster. Our goal is to ensure that we have the proper education and training resources in place to produce a world class IT workforce for our region.

INSTRUCTIONS: PLEASE READ CAREFULLY

1. The first three columns include the department/college, degree or certificate title, and level of award as indicated by your institution's online catalog. Please examine these columns carefully and add any other information technology programs offered by your institution that might have been overlooked.
2. The next 4 columns ask for numbers of students who were enrolled and graduated from each program in 2005/2006 and 2006/2007.
3. The next 5 columns pertain to detailed information about each educational program offered by your institution. Use the key provided in section C to answer these questions. Numeric codes contained in the key can be used to complete these columns of information (see the example provided in Sec. B).
4. The last 3 columns ask whether or not the IT program has work-based learning and if so, whether or not it's a paid opportunity for students.
5. Please attach detailed program descriptions for any programs added and return them along with the completed questionnaire.

Please complete and return questionnaire no later than May 30th to:

Visobe Welch
Joint Center for Policy Research
Lorain County Community College
1005 N. Abbe Rd
Elyria OH 44035

Phone: 440-366-7416
FAX: 440-366-4159
vsimfukw@lorainccc.edu

KEY FOR COLUMNS 8-12 IN SECTION B.

SECTION C

IT Professions		Programming Skills		Database Skills		Distributed Database applications		Other IT skill Development Emphasis	
1	Business Application Specialists/Technologists	1	Active X	1	Oracle DB programming	1	Database warehouse applications	1	Windows NT
2	Database Administrators	2	ADA	2	Sybase programming	2	Applications using AI	2	UNIX
3	Digital Media Specialists	3	Assembler	3	Informix	3	Data mining applications	3	Structured analysis methods
4	Info. Systems Operators/Analysts	4	Basic	4	Other IDE: _____	4	Web-based programming	4	OO methods
5	Generalists (IT)	5	Borland c++			5	GUI (Windows/Motif) development	5	UML
6	Network Specialists	6	C			6	Graphics - Visualization	6	Written communication
7	Programmers	7	C++			7	Client Server programming	7	Verbal communication
8	Product Managers	8	COBOL			8	Concurrent/Distributed programming	8	Grammar
9	Project Managers (IT)	9	FORTTRAN			9	Mainframe programming	9	Teamwork
10	Quality Assurance & Testing	10	HTML			10	Scientific engineering programming	10	Creativity
11	Software Engineers-Architects	11	Java			11	Embedded/Real- Time programming	11	Public speaking
12	Systems Engineers	12	MSJ++			12	programmng	12	Business etiquette
13	Technical Program Managers	13	MS VC++			13	Other DB: _____	13	Time management
14	Technical Support Reps. (outside)	14	Oracle Developer 2000			14	Other DB: _____	14	Other: _____
15	Technical Support (Help Desk)	15	PERL					15	Other: _____
16	Technical Sales	16	PHP						
17	Technical Writers	17	RPG						
18	Web Developers/Administrators	18	SQL						
19	Other:	19	Symantec C++						
20	Other:	20	Visual Basic						
		21	Visual C++						
		22	Visual J++						
		23	XML						
		24	Other Language_____						

