Progress and Change in Information Technology Educational Services

Comparing 1995 and 1999 Results from the Greater Omaha Business Requirements for Educational Services in Information Technology Studies

A report compiled by
the management of the
Applied Information Management Institute

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I. Executive Summary

In 1995, the Applied Information Management (AIM) Institute completed a major study of Greater Omaha Business Requirements for Educational Services in Information Technology (IT). The study documented areas of greatest demand for IT Educational Services by the business community, and noted where the academic community could strengthen its offerings.

In 1999 a comparable study was completed with only slight modifications to document recent industry developments in E-Commerce, Vendor Certification Programs, and Networking.

Between the 1995 and 1999 surveys much has happened.

- Business and commerce have experienced unprecedented change with the explosive growth of Web-based technologies and the emergence of E-Commerce strategies.
- Greater Omaha post-secondary academic institutions have moved with great vigor and focus to strengthen curriculum and programs.
- Greater Omaha high schools are seeking solutions for relevant curriculums and student preparations.

During this period:

- Enrollments in IT programs have increased.
- Colleges and universities have moved more quickly to introduce new curriculums. To illustrate:
  - strong Client/Server programs now exist
  - vendor certification content is being taught as part of the regular credit courses
  - new Web/E-Commerce courses are being developed
  - a new E-Commerce graduate program will start this year
  - greater choice of location for courses and programs are available.
- Business financial support of Information Technology and Engineering education has been substantial.
- Colleges and universities have re-allocated resources to these high demand programs.
- Non-traditional student interest in Information Technology has been very high as individuals seek to retrain themselves for higher paying, more rewarding careers.

The 1999 study was based on results from 43 Greater Omaha firms with nearly 66,500 employees including over 7,000 IT professionals. Major findings from the two studies were that:

- IT professions were 11.5% of all employees.
- IT and total employment
- All Academic Disciplines and Applied Courses were ranked more important in 1999 than the 1995 study.

- Average training budgets per IT professional continue to increase. They were $1,382 in 1995, $1,871 in 1999 and projected to reach $2,427 per year in five years.
- In 1999 colleges and universities were credited as being more responsive to business needs than four years ago.
- Corporate training budgets in 1999 were greater for Vendor Certification programs than was paid for employee college tuition reimbursements.
- 41% of all IT professionals had less than a baccalaureate degree, down from 58% in 1995. Firms plan to hire even more four-year graduates and individuals with graduate degrees in the future.

These two studies document and measure one of the most profound and dramatic changes in the way business views their organizations, markets, products, competition and processes experienced in modern times, if not forever.

In the emerging E-world, the relevance of IT has changed profoundly.

In recent years, Information Technology was an important "operational issue" for many firms and industries. The MIS department must be soundly and efficiently run. Local and wide area networks were developed to link all computerized workstations in the enterprise to provide reliable and accurate networks and systems essential to sound operations.

In the last 4 years, however, Information Technology has moved from an "important operational" issue to a "strategic" issue. In firm after firm, successful strategic use of computer/network/web-based technology has created enormous opportunity, while frequently restructuring the industry. An example is Ameritrade and other online stock trading companies that have profoundly affected equity markets. Another is Amazon.com, who has lead to the restructuring of books, CD and toy sales industries.

The catalog industry has moved to Web technologies very quickly. Research of any kind - consumer, business, academic, etc. - is now most productive on the Web. Recruiting, real estate and auto sales sites are affecting newspaper strategies. Broadband to the home has created unprecedented merger and acquisition activity in the cable and telephone industry. The list goes on.

Never has there been, in such as short time, such profound and dramatic change in the way business views their organizations, markets, products and processes! In these times, which Academic Disciplines or Applied Areas in Information Technology will be less important than it was four years ago?

As all Information Technology disciplines have become more important, it has been nearly impossible for the academic community to respond with the programs and curriculum to meet the changing needs of employers. Unfortunately, there appears to be no slowing in the rate of change so college and university curriculums will be under intense pressure for years to come. These fast paced changes in business requirements will increasingly be at odds with the more deliberate pace of change in some colleges and universities.

II. Introduction

In 1995, the Applied Information Management (AIM) Institute completed a major study of Greater Omaha Business Requirements for Educational Services in Information Technology (IT). The study documented areas of greatest demand for IT Educational Services by the business community, and noted where the academic community could strengthen its offerings. It also estimated the size of corporate educational budgets and Information Technology employment within the community.

That study was well received by both the business and academic communities as an accurate representation of business requirements.

There were several requests to update the 1995 study to document progress and identify new needs and opportunities. In 1999 a comparable study was completed with only slight modifications to document recent industry developments in E-Commerce, Vendor Certification Programs, and Networking.

Between the 1995 and the 1999 surveys much has happened.

- Business and commerce have experienced unprecedented change with the explosive growth of Web-based technologies and the emergence of E-Commerce strategies.
- Greater Omaha postsecondary academic institutions have moved with great vigor and focus to strengthen curriculum and programs.
- Greater Omaha high schools are seeking solutions for relevant curriculums and student preparations.

During this period:

- Enrollments in IT programs have increased.
- Colleges and universities have moved more quickly to introduce new curriculums. To illustrate:
  - strong Client/Server programs now exist
  - vendor certification content is being taught as part of the regular credit courses
  - new Web/E-Commerce courses are being developed
  - a new E-Commerce graduate program will start this year
  - greater choice of location for courses and programs are available.
- Business financial support of Information Technology and Engineering education has been substantial.
- Colleges and Universities have re-allocated resources to these high demand programs.
- Non-traditional student interest in Information Technology has been very high as individuals seek to retrain themselves for higher paying, more rewarding careers.

This report focuses on the comparisons and developments between the 1995 and 1999 surveys.

III. Conclusions

A. Progress and Change

The 1999 study reaffirms many patterns identified in the earlier 1995 report. Both studies had sufficient numbers of firms with sufficient employment (both All Employees and IT Employees) to fairly represent Omaha employers' needs. There were sufficient numbers of firms that participated in both studies (27) to add confidence that the sample of firms in both studies were relatively consistent. Even though 62 firms participated in 1995 and 43 in 1999, the number of large firms with over 100 employees declined by only two firms from 35 to 33 participants.

While average training budgets declined between the 1995 and 1999 studies, IT training, per employee, showed substantial growth from $1,382 in 1995 to $1,871 in 1999, and a projected $2,427 in five years.

Expenditures in internal training programs are the largest component for corporate training budgets. Meanwhile, tuition costs continue at the 12-14% range. Expenditures of training budgets for Vendor Certifications were 14% in 1999 - slightly exceeding college tuition costs.

About 8% of All Employees are taking courses for academic credit, well below the number firms believe should take courses. Seventy percent were on tuition reimbursement in the 1995 study, compared to about 50% in 1999.

Perhaps the most significant finding was the firms' ranking of the various Academic Disciplines and Applied Areas. Every single Academic Discipline was ranked more important in 1999 than in 1995. But even though every discipline was ranked higher in 1999, there was a consistency in rankings between the disciplines. For example, the highest ranked discipline in 1995 (Systems Development and Business Integration) was also the highest ranked discipline in 1999. The lowest ranked discipline in 1995 was also the lowest ranked in 1999.

Two major changes were made in the 1999 study to reflect significant changes in IT in the last four years:

- Networking was made a new Academic Discipline - removing it from Telecommunications.
- E-Commerce was added.

The new Networking discipline was ranked second in importance and E-Commerce was fifth.

In 1995, 8.6% of all IT Employees were in Telecommunications professions. By 1999, the numbers had changed dramatically reflecting the emerging Electronic/Networked world. Total 1999 IT employment for Telecommunications, Networking and E-Commerce represents 21.4% of all IT professionals in this emerging world. These three disciplines are expected to grow to

32.2% in five years. E-Commerce alone is expected to grow from 4.1% to 12.1% of the IT professional workforce in the next five years.

Discipline	1995 Employment	1999 Employment	Employment in 5 Years
Telecommunications	8.6	8.5	9.6
Networking	--	8.8	10.5
E-Commerce	--	4.1	12.1
	8.6	21.4	32.2

These kinds of growth rates for specific disciplines within the IT professional community have probably never been witnessed before. It reflects profound changes in the nature and character of the IT profession and business expectations for Information Technology within the corporation.

Firms were asked to rank 48 Applied Areas. These Applied Areas are equivalent to courses that might be offered within a given Academic Discipline. Once again, every Applied Area in the 1999 study was ranked higher than the comparable area in 1995. The weighted average score for all Applied Areas was 2.32 in 1995 and 1.71 in 1999.

There were 37 Applied Areas ranked in 1995, while 48 were ranked in 1999. The increase occurred when new Applied Areas were added for E-Commerce, Networking and Telecommunications.

In summary, the highest ranked Applied Areas were consistent between the two studies:

- 7 Applied Areas were ranked most important in both the 1995 and 1999 studies.
- 3 Applied Areas rose to the highest rank in 1999 but were not high ranked in 1995.
- 4 high scoring Applied Areas in 1995 did not “make the cut” in 1999.
- 8 new Applied Areas in the 1999 study were highly ranked (coming primarily from E-Commerce and Networking).

Languages, Data, Telecommunications, and Client/Server were high-ranking technology areas in both studies. Microsoft and Oracle were the highest ranked Vendor Certification programs.

B. Profound and Dramatic Change

The major story between these two studies is not the high degree of similarity or apparent inconsistencies between 1995 and 1999. These two studies document and measure one of the most profound and dramatic changes in the way business views their organization, market,

products, competition and processes experienced in modem times, if not forever. That is, perhaps, a brash and unjustified finding from these studies.

To defend the point, however, how prominent were these corporate names in 1995?

- Amazon.com
- E-bay.com
- Autobytel.com
- Ameritrade.com
- E-trade.com

How common were web addresses posted on:

- semi trailer trucks
- TV commercials
- business cards
- cereal boxes

In a short five years…

- the word "web" has taken on new meaning
- E- has become a prefix to numerous unrelated words like mail, commerce, business, sales, education, etc.
- dot com is a suffix on numerous corporate names

Because of the web, it is hard to identify a firm that has not or will not change their view of:

- their product or service offering
- their market
- their method of sales
- their customer relationships
- their supplier relationships
- their pricing
- their business

In the public policy arena:

- New businesses relocating to a region want assurances of no tax on E-sales. If so, they will move their server.
- Geography and distance will become less important.
- Copyright, patent, signature verification, law, ethics, privacy, etc. are in uncharted waters.

In the emerging E-World, the relevance of IT has changed profoundly. For many firms and industries, Information Technology was an important "operational issue." The MIS department

must be soundly and efficiently run. Local and wide area networks link all computerized workstations in the enterprise to provide reliable and accurate networks and systems essential to sound operations. Business is increasingly reliant on a stable electronic platform from which to run corporate operations.

In the last four years, however, Information Technology has moved from an "important operational" issue to a "strategic" issue. In firm after firm, successful strategic use of computer/networked/web-based technology has created enormous opportunity, while frequently restructuring the industry. Ameritrade and stock transactions are an example. Another is Amazon.com and the restructuring of book, CD and toy sales.

The catalog industry has moved to web technologies very quickly. Research of any kind - consumer, business, academic, etc. - is now most productive on the web. Recruiting, real estate and auto sales sites are affecting newspaper strategies. Broadband to the home has created unseen merger and acquisition activity in the cable and telephone industry .The list goes on.

Never has there been, in such a short time, such a profound and dramatic change in the way business views their organizations, markets, products and processes! In these times, which Academic Disciplines or Applied Areas in Information Technology will be less important than it was four years ago?

As all Information Technology disciplines have become more important, it has been nearly impossible for the academic community to respond with the programs and curriculum to meet the changing needs of employers. Unfortunately, there appears to be no slowing in the rate of change so college and university curriculums will be under intense pressure for years to come. These fast paced changes in business requirements will increasingly be at odds with the more deliberate pace of change in some colleges and universities.

Finally, employers' views of staffing may also change. More firms may embrace a "buy" strategy to staff fast changing business demands. This argument is best expressed in a recent Department of Commerce publication.

> *As time has become an increasingly important factor of competitiveness for many employers of IT workers, the time available to retrain existing employees or train new employees in the skills needed for new projects has diminished.*
>
> *In this environment, many companies have concluded that they cannot afford the time penalty and the uncertainty associated with "making" the employees they need (through training or retraining) and are, instead, pursuing a "buy" strategy, seeking the exact skills and experience they need for a particular project and paying a premium for it. Or, as reported by the Gartner Group, "the pace of technological change is making the outside market the best source and repository of intensive technology skills.*

This trend is likely to further intensify the business demand for specific technical competencies. That demand is also likely to be translated back to different and changing expectations from college and university curriculums especially as core technologies change.

IV. Recommendations

1. With business and commerce rapidly moving to an electronic platform for historical and new web-based strategies, their fastest growing demand for IT professionals is the Networking, Telecommunications and E-Commerce areas. Colleges and universities should aggressively seek to build courses and academic programs in these three Academic Disciplines.
2. The content within the above courses and programs must change as issues within industry change. While some content may be more stable than others, these fast moving technologies will require easily updated curriculums to remain relevant.
3. Time-based competition is collapsing development cycles and product life cycles. Rapid development cycles place a demand for IT professionals with the specific technical competencies required for a particular project. This suggests that curriculums and courses must become more specific rather than more general, i.e. the specific attributes of a particular operating system rather than general attributes of operating systems.
4. Vendor Certifications are competing for tuition dollars as firms pay for certifications to get employees with specific technical competencies. Some colleges are incorporating vendor certification content into specific courses allowing students to meet credit requirements, while preparing the student to take the certification exam. This practice should be broadened to more schools and vendor offerings.
5. More vendors are making industry protocols and standards plus vendor specific requirements available as curriculum for secondary and post-secondary schools. These vendor programs should be evaluated and considered. Examples include: Cisco, wireless technologies, etc.
6. Processes to implement new programs and courses must be accelerated. Approval processes for programs at major universities now exceed the expected life or "generation" of most hardware, protocols, operating systems and software solutions.
7. Management of IT resources and professionals is increasingly complex. Project Management is a chronic challenge that would benefit from focused academic courses and programs. Other Technical Management type issues include: Quality Assurance; Continuity, Interruption & Recovery; Security, and Business Planning Strategies/Tactics.
8. Rapidly changing technologies combined with short development cycles create shortages of technically skilled professionals in new disciplines. This is equally true for the firm and the academy. Increased use of business technology professionals as adjunct faculty may help alleviate this shortfall.
9. Firms' employment of IT professionals with graduate degrees increased from 7.4% in 1995 to a projected 13.6% by 2005. This near doubling of employees with graduate degrees argues, in part, for a greater variety of Master Degree options plus at least one local IT Ph.D. program.

V. Employment & Training Budgets

The findings in the 1999 study reaffirm patterns detected in the 1995 study. The 1999 study further documented profound changes in the business climate, rapid technological change, and College and University responses in the last five years. (Appendices B and C show averages and totals for 1995 and 1999 studies.)

In the 1999 survey, there were 43 firms compared to 62 firms in the 1995 study. However, total employment and Information Technology employment, reported by those 43 firms, was greater than the 1995 study. While the total number of firms was less, the number of large firms (100 or more employees) declined only slightly from 35 in 1995 to 33 in 1999. Most of these large firms were also in both the 1995 and 1999 studies. A total of 27 firms participated in both studies (Appendix A).

Summary Statistics
1995 and 1999 Studies
All Firms

	1995	1999
Number of Firms	62	43
Total Employment	52,679	66,493
Percent Omaha MSA Employment	14.1%	16.3%

Both studies ask firms to project future total employment and IT employment five years into the future. In 1995, firms projected total employment would grow 10.4% while by 1999, they expect future employment to grow even faster at 23.0% or approximately 5% annually.

Technology employment is also projected to grow nearly 22.6% in the next five years. This compares to a 26.6% projected growth in the 1995 study. These growth rates suggest a strong aggressive demand for IT workers well into the future. IT employees accounted for 13.0% of the participating firms' workforce in 1995, compared to 11.5% in the 1999 study. IT employees will continue to be a major component of any firm's workforce well into the future.

Summary Statistics
1995 and 1999 Studies
All Firms

	1995 (62 Firms)	1999 (43 Firms)
Total Employment	52,679	66,493
Projected Employment in 5 Years	58,154	81,812
Percent Change	10.4%	23.0%
IT Employment		
Total Employment	6,877	7,616
Projected Employment in 5 Years	8,702	9,339
Percent Change	26.6%	22.6%

A. Training Budgets

The total Training Budgets for the 30 firms that reported these data in 1999 were over $14 million and expected to grow to $26 million in five years. This was well below the over $30 million level in the 1995 study in which 41 respondents reported this training information.

The average Training Budget, per firm, was $740,510 in 1995 and $475,227 in 1999. This decline is hard to explain. In 1999, training budgets are projected to increase by 83% over the next five-year period, well above the 23% projected growth in employment. Firm projections for Training Budgets average $868,800 in five years.

Training Budgets – All Employees
1995 and 1999 Studies
All Firms

	1995		1999	
	Current	5 Year Projection	Current	5 Year Projection
Training Budgets	$30,360,900	$45,695,000	$14,256,800	$26,063,600
Number of Firms Reporting	41	41	30	30
Average Training Budget Per Firm	$740,510	$1,114,500	$475,227	$868,800

B. Information Technology Training Budgets

Thirty firms reported Information Technology Training Budgets in the 1999 study for a total of $9,429,371. This averages $1,871 per IT employee. This level is well above the 1995 average of $1,382 per IT employee.

The Information Technology Training Budgets are expected to increase by 72.6% over the next five years, suggesting that training expenses per IT employee will be nearly $2,430.

Information Technology Training Budgets, per firm, show a steady and significant increase as shown in the following table.

Average IT Training Budgets
1995 and 1999 Studies
All Firms

	1995		1999	
	Current	5 Year Projection	Current	5 Year Projection
Average IT Training Budget per Firm	$225,149	$359,580	$314,312	$542,410
Percent Projected Budget Growth	--	59.7%	--	72.6%
Average per IT Employee	$1,382	$1,761	$1,871	$2,427

C. How Training Dollars Are Spent

Internally provided training was the largest part of the total corporate training budgets in both studies, accounting for 45% of the budgets in 1995, and 53% in 1999. The 1995 study projected a decline in internal programs. That decline did not occur and internal programs account for increased parts of the training budget in 1999 and are projected to grow to 58%.

A recent development is the growth of Vendor Certification programs so the 1999 study added a "Vendor Certifications" category. Vendor Certifications accounted for nearly $2 million training costs for the 30 reporting firms in 1999. This number is expected to grow to over $2.8 million or 43% by 2005.

Vendor Certifications currently exceed tuition and cost for college courses; however, tuition expenditures are expected to grow more rapidly (double) in the next five years. The revenues to fund certificate programs appear to come from the external seminars' and workshops' budgets, which accounted for 42% of the training budget in 1995, but only 17% in 1999.

These data show the distribution of the total corporate training budget. Information on how the IT training budget is allocated among different forms of training is not available in this study.

Training Budget Allocation
1995 and 1999 Studies
% of Total Budget

	1995		1999	
	Current	5 Year Projection	Current	5 Year Projection
Internal Programs	45%	38%	53%	58%
External Seminars/Workshops	42%	45%	17%	15%
Tuition/Cost for College	12%	16%	12%	14%
Vendor Certifications	--	--	14%	11%
Other	2%	1%	4%	2%

D. Employees and Academic Courses

The percent of all employees taking academic courses was nearly identical (8%) for both the 1995 and 1999 studies. For IT employees, 9.8% were taking Academic Courses in 1995, while in the 1999 study 8.1% were enrolled.

In both studies, firms believed that over two to three times more IT employees should be taking courses than are now enrolled. Tuition reimbursement programs continue strong, however, the 1999 study showed that only 53% of the IT Employees enrolled in courses were on a tuition reimbursement program compared to 78% in 1995. For all employees, those on tuition

reimbursement programs dropped from 70% in 1995, to 47% in 1999. The survey data did not provide insight why this decline occurred.

Tuition Reimbursement Programs
1995 and 1999 Studies

	1995		1999	
	All Employees	IT Employees	All Employees	IT Employees
Number of Employees in Courses	4,226	693	5,321	615
Number on Tuition Reimbursement	2,969	523	2,496	323
Percent on Tuition Reimbursement	70%	78%	47%	53%
Number That Should Take Course	5,509	1,434	9,845	1,701

VI. Academic Disciplines

Without exception, TABLE I shows that every *Academic Discipline* was ranked as more important in 1999 than in 1995. As stated earlier, during this period, there has been a profound change in how future business and commerce will be conducted. Global networks supported by the Web and e-mail plus the digitization of the world's knowledge are having a profound impact on all business, commerce, education, social institutions, expectations, market perspective, etc.

During this period, many organizations' views of Information Technology have moved from an "important operational issue" to a "strategic issue for our firm." As one observes the increased reliance upon IT, it is hard to imagine any *Academic Discipline* that would be viewed as less important now compared to 1995.

Table I
Profile of Academic Disciplines for IT Employees
1995 and 1999 Studies
All Firms

Academic Disciplines	1995 Rank*	1999 Rank*
Electronic Engineering	3.07	2.39
Telecommunications	1.93	1.36
Systems Integration	1.72	1.13
Computer Engineering & Systems	2.05	1.72
Systems Development & Business Integration	1.59	1.05
Technology Management	1.88	1.19
Technical Marketing	2.72	2.06
E-Commerce	--	1.25
Networking (LAN/WAN/IP)	--	1.11

**Rank 1=Most Important 4=Least Important*

Systems Development and Business Integration was the highest ranked discipline in both studies. This discipline also accounts for the largest IT employment. Table II shows that employment appears to be trending down for this category. However, this down trend in percentage employment comes as demand from E-Commerce and Communications accelerate. With total employment expected to increase, actual numbers of employees will not decline as much as percentage figures seem to indicate.

Table II
Estimated Percent of Employees by Academic Disciplines
1995 and 1999 Studies
All Firms
% Employees with These Disciplines

Academic Disciplines	In 5 Years 1995	In 5 Years 2000	In 5 Years 1999	In 5 Years 2005
Electronic Engineering	2.2	2.4	1.8	1.0
Telecommunications	8.6	9.1	8.5	9.6
Systems Integration	9.9	11.6	17.2	14.6
Computer Engineering & Systems	13.6	11.4	14.2	13.8
Systems Development & Business Integration	37.0	43.1	35.7	25.5
Technology Management	8.9	10.2	7.8	8.5
Technical Marketing	8.1	8.4	1.9	2.8
E-Commerce	--	--	4.1	12.1
Networking (LAN/WAN/IP)	--	--	8.8	10.5
Other	11.6	3.7	--	--
Sub-baccalaureate	57.9	51.1	41.3	38.2
Baccalaureate	34.7	39.2	47.6	48.3
Graduate	7.4	9.7	11.0	13.6

A. Telecommunications & Networking

The big story in Academic Disciplines appears to be in *Telecommunications & Networking*. In the 1999 study, *Telecommunications & Networking* was listed as separate Disciplines. In the 1995 study, they were combined.

In 1995, *Telecommunications/Networking* accounted for 8.6% of employees with a projection to grow to 9.1%. In the 1999 study, the combined employment in *Telecommunications & Networking* doubled.

	1995 Employment	In 5 Years	1999 Employment	In 5 Years
Telecommunications	8.6%	9.1%	8.5%	9.6%
Networking (LAN/WAN/IP)	--	--	8.8%	10.5%
			17.3%	20.1%

This marked increase in *Telecommunications/Networking* employment is driven by the globally networked world that is emerging.

B. E-Commerce

E-Commerce was also a new Academic Discipline in the 1999 study. It was ranked fourth highest with a score of 1.25. Already, 4.1% of the IT employees are working in *E-Commerce*. That number is projected to grow to 12.1% by 2005. This threefold increase makes *E-Commerce* the fastest growing Discipline.

Once again, this Discipline is at the center of the emerging Networked/Digital world. Academic institutions that wish to keep curriculum and programs relevant with emerging business trends must develop *E-Commerce* courses and programs. It is also the most interdisciplinary topic on the horizon, including many other disciplines such as: law, marketing, public policy, music and arts, language, graphics, all business disciplines, all IT/engineering disciplines, etc.

C. Educational Achievement of Workers

Firms expressed a desire for more employees with baccalaureate and graduate degrees in the 1995 study. That trend continued in 1999. Also, the 1999 study seems to indicate that firms are ahead of their earlier projections. See TABLE II.

With over 41% of all IT employees with sub-baccalaureate degrees in 1999, substantial opportunities exist for non-traditional student educational offerings. Also, one and two year student programs will continue to offer excellent entry opportunities for a career in the IT industry.

VII. Applied Areas

Without exception, all *Applied Areas* in the 1999 study were ranked more important than the same Applied Areas in the 1995 study. The forces at work with Academic Disciplines, noted earlier, appear to also be affecting the *Applied Areas*. These findings also seem to indicate the greater reliance on Information Technology by area firms.

The average score for *Applied Areas* (37 in 1995 and 48 in 1999) are shown below.

Average Rank of Applied Areas
All Firms

	Importance to Your Firm*	Needs Met by Colleges & Universities**	Average Difference
1995	2.32	2.67	0.35
1999	1.71	2.43	0.72

**Rank 1=Most Important 4=Least Important*
***Rank 1=Meets Needs 4=Does Not Meet Needs*

It is interesting to note that the firms also scored the Colleges & Universities higher in terms of meeting their needs. However, the firms' rank of the *Applied Areas* importance was sufficiently higher than their improved ranking of the colleges. The result is that the average difference doubled, suggesting the colleges and universities are falling behind as the speed of change accelerates.

The breakout of Networking and E-Commerce in the 1999 study resulted in 11 additional *Applied Areas* for the firms to consider. (Two) E-Commerce and (Five) Networking *Applied Areas* were ranked between 1.0 and 1.5.

There was a substantial consistency in the highest scoring Applied Areas between the two studies. A total of 22 *Applied Areas* were ranked high in either the 1995, 1999 or both studies.

In 1995, there were 11 *Applied Areas* with high scores between 1.0 and 2.0 when ranked by all firms. In the 1999 study 18 *Applied Areas* with scores between 1.0 and 1.5 were considered the highest ranked issues. TABLE III shows top ranked *Applied Areas* in 1995 on the left columns, while high ranked 1999 *Applied Areas* are shown on the right.

Table III
Highest Ranked Applied Areas
1995 and 1999 Studies
All Firms

1995 Applied Area Rankings **Needs Met by Colleges & Universities Ranked between 1.0 & 2.0	1995 Applied Area Rankings *Rank All Firms		1999 Applied Area Rankings *Rank All Firms	1999 Applied Area Rankings **Needs Met by Colleges & Universities Ranked between 1.0 & 1.5
		Electronic Engineering		
		Telecommunications		
2.66	1.69	← LAN/WAN/Networks		
		Protocols, ATM/TCP/IP, etc →	1.32	2.64
		Systems Integration		
2.51	1.54	Software/Hardware Configuration	1.20	2.63
2.61	1.72	LAN/WAN	1.12	2.11
		Installation/Implementation	1.22	2.94
2.74	1.98	Quality Assurance →	1.39	2.27
		Computer Engineering & Systems		
		Operating Systems/Compilers/Tools →	1.32	2.13
		Architectures/Platforms →	1.34	1.96
		Systems Development & Business Integration		
2.43	1.93	← Methodology		
2.43	1.61	Client/Server	1.38	1.94
2.66	2.00	← Business Planning/Re-Engineering		
2.15	1.86	Design/Programming	1.11	1.87
		Technology Management		
2.59	1.47	Project Management	1.16	2.38
2.64	1.81	← Business Planning Strategies/Tactics		
2.73	1.96	Specific Technical Competencies	1.38	2.67
		Technical Marketing		
	N/A	**E-Commerce**		
	N/A	Development Technologies →	1.41	2.58
	N/A	Security →	1.28	2.92
		Networking (LAN/WAN/TCI/IP)		
	N/A	Protocols (Open & Proprietary) →	1.27	2.19
	N/A	Integration →	1.18	2.60
	N/A	Servers, Bridges, Routers & Hubs →	1.33	2.63
	N/A	Security Encryption →	1.44	2.70
	N/A	Continuity, Interruption & Recovery →	1.36	2.66

N/A *Not included in '95 study*
**Rank* *1=Most Important* *4=Least Important*
***Rank* *1=Meets Needs* *4=Does Not Meet Needs*

TABLE III shows that seven of these *Applied Areas* were ranked most important in both the 1995 and 1999 studies. They were:

- Software/Hardware Configuration
- LAN/WAN
- Quality Assurance
- Client Server
- Design/Programming
- Project Management
- Specific Technical Competencies

The four high scoring *Applied Areas* unique to the 1995 study only were:

- LAN/WAN Networks (This was presented as a separate
- Academic Discipline in 1999. Networking was the
- 2nd highest ranked Academic Discipline in 1999)
- Methodology
- Business Planning/Re-Engineering
- Business Planning Strategies/Tactics

The high scoring Applied Areas unique to the 1999 study included eight that were new areas not included in the 1995 study questionnaire. Seven of these were in the E-Commerce and Networking Disciplines. They included:

- Protocols, ATM, TCP/IP, etc.
- Development Technologies
- Security
- Protocols (Open & Proprietary)
- Integration
- Servers, Bridges, Routers and Hubs
- Security Encryption
- Continuity, Integration and Recovery

The 1999 study had three *Applied Areas* that rose to the highest ranked category even though they were not ranked so high (scored over 2.0) in the 1995 study. These included:

- Installation/Implementation
- Operating Systems/Compilers/Tools
- Architectures/Platforms

VIII. Technology Areas

The two studies send some relatively clear signals in certain technology areas.

A. Languages

Languages continue to be important for firms in 1999, consistent with the trend identified in the 1995 study.

B. Data

Data is projected to have continued increasing importance in the next five years, just as it did in the last 5 years.

C. Telecommunications and Client/Server

Telecommunications and *Client/Server* were ranked high in both the 1995 and 1999 studies, with anticipated further importance in five years.

D. Human Factors Engineering and Educational Technologies Learning Services

Human Factors Engineering and *Educational Technologies Learning Services* were both ranked below average in the 1995 study and for the 1999 study. However, in the future these topics appear to command greater interest.

E. Multimedia–Technology and Multimedia–Presentations

Multimedia-Technology and *Multimedia-Presentations* scored about the same in 1999 as they did in 1995. Given the tendency for higher scores in 1999, this probably represents some loss of interest. These topics have largely been absorbed by the Web and emerging E-Commerce issues.

Technology Areas Ranked* between 1.0 and 2.0
1995 and 1999 Studies
All Firms

	1995	5 Year Projected Year 2000	1999	5 Year Projected Year 2005
Languages	2.04	2.05	1.87	1.62
Data	1.60	1.54	1.54	1.31
Telecommunications	1.60	1.44	1.72	1.32
Client/Server	1.74	1.35	1.92	1.70
Human Factors Engineering	2.69	2.24	2.39	1.84
Educational Technologies Learning Services	2.48	2.13	2.48	1.84
Multimedia Technology	2.72	2.13	2.56	1.77
Multimedia Presentation	2.41	1.95	2.55	2.00

**Rank 1=Most Important 4=Least Important*

IX. Vendor Certifications

Since the 1995 study, *Vendor Certifications* have become increasingly popular with firms and employees alike. The range of software/hardware vendors with certification programs has increased. Many employers pay for certification classes, and students who successfully complete certification testing frequently enjoy increased salary and enhanced value to their employer.

One Applied Area - Specific Technical Competencies - ranked in the top quartile of all Applied Areas. This ranking further documents that firms frequently need specific competencies and the Vendor Certificate validates that the employee has the desired knowledge.

Vendors are also making certification content available to secondary and postsecondary schools. Currently, several Omaha/Nebraska/Iowa schools offer Cisco certification classes. One area university offers Cisco certification classes as well. Also, some colleges are starting to include certification content in their courses, allowing the student to receive academic credit plus being prepared to take the *Vendor Certification* exam upon completion of the course.

The table below shows how all 43 firms ranked *Vendor Certifications*. Microsoft and Oracle were the two highest ranked certification programs. Microsoft (1.21) and Novell (2.3) were ranked substantially higher by the 10 small firms.

Ranking* of Vendor Certifications
All Firms (43)

Vendor Certification	1999	5 Year
Microsoft	1.66	1.48
Novel	3.25	3.45
Cisco	2.48	2.56
Lotus Notes	2.49	2.49
Oracle	1.64	1.67
Power Builder	3.21	3.24
People Soft	2.62	2.69
Cold Fusion	3.73	3.55

**Rank 1=Most Important 4=Least Important*

Appendices

Appendix A – Survey Participants

Survey Participants

1995 Only

Acceptance Insurance Company
AMCI
AON Risk Services, Inc.
Applied Communications (ACI/TSA)
Baird Holm Law Offices
BETAC Corporation
Creighton University
Culver Marketing Group
FiServ
Ford Motor Credit
Genesis
HunTel Systems
Hyatt Hotels
Kiewit Engineering Co.
Kirkpatrick, Pettis, Smith, Polian, Inc.
KJS Associates
McMains
Memcom Corporation
Mutual Protective Life Insurance Co.
Network Technologies
Packers National Bank
Prairie Systems
Random Access
Science Applications International Corp.
Shamrock Computer Resources, Ltd.
Synergy
Technical Support, Inc.
The Sampson Firm, P.C.
Training and Consulting Connection
Transterra Company
University of Nebraska Medical Center
Vanguard Research, Inc.
Vickers

Both 1995 & 1999

Advanced American Technologies, Inc.
Bass & Associates
Blue Cross Blue Shield of Nebraska
Central States Health and Life Company
CSG Systems, Inc.
First Data Corporation/Resources
First National Bank of Omaha
Guarantee Mutual Life Insurance
Inacom Corporation
Kiewit Construction
Lyman Richey Corporation
Midwest Computer Products
Mutual of Omaha Companies
Nebraska Furniture Mart
Nebraska Methodist Health Systems
Omaha Public Power District
Omaha World-Herald
Oriental Trading Company
PKS Information Services, Inc.
Richman Gordman
St. Joseph Hospital
The Schemmer Associates
Travel and Transport
U S WEST Communications
Union Pacific Railroad Company
Valmont Industries
Word Data Business Systems

1999 Only

Behlen Manufacturing Co.
CalEnergy Company, Inc.
Carlson Hospitality Worldwide
ConAgra
Corporate Express Doc & Print Mgmt
Double E Computer Systems
Farm Credit Services of America
Great Plains Communications, Inc.
KMS Associates
Kutak Rock
Leopard, Inc.
Omnium Worldwide, Inc.
Pamida, Inc.
PlaNet 2000 Software
Priority Data Systems, Inc.
World Insurance

Appendix B - 1995 Survey Results

Company Employment and Education Operations Summary
Greater Omaha Only
62 Firms

All Greater Omaha Employees	1995	Forecast in 5 Years	Percent Change
1. Number of All Employees (Greater Omaha)	52,679	58,154	10.39
2. Number of All Employees Now Taking Academic Credit Courses	4,226		
3. Number of All Employees You Feel Should Be Taking Academic Courses	5,509		
4. Number of Those Employees Taking Academic Credit Courses Who Are on a Company Tuition Reimbursement Program:	2,969		
5. Education/Training Budget-Omaha Employers Amount of Training Budget for:	$30,360,900	$45,695,000	50.51
a. Internally Provided Training Programs	$13,529,200	$17,495,000	29.31
b. External Seminars & Workshops	$12,657,800	$20,451,000	61.557
c. Tuition & Cost for College Courses	$3,617,000	$7,339,000	102.90
d. Other	$556,900	$410,000	-26.38

Greater Omaha Information Technology Employees	1995	Forecast in 5 Years	Percent Change
6. Number of Information Technology Employees	6,877	8,705	26.58
7. Number of Information Technology Employees Now Taking Academic Credit Courses	673		
8. Number of Information Technology Employees You Feel Should be Taking Academic Courses	1,434		
9. Number of Those IT Employees Taking Academic Credit Courses Who Are On a Company Tuition Reimbursement Program	523		
10. Education/Training Budget - IT Employees Only	$ 9,231,100	$14,743,000	59.71

Profile of Academic Disciplines for Information Technology Employees
Greater Omaha Operations Only
62 Firms
Estimated Percent of Employees by Academic Disciplines

Academic Disciplines	Rank* Importance of Discipline to Your Firm*	% IT Employees with these Disciplines 1995	% Employees with these Disciplines in 5 Years
Electronic Engineering	3.07	2.2	2.4
Telecommunications	1.93	8.6	9.1
Systems Integration	1.72	9.9	11.6
Computer engineering & Systems	2.05	13.6	11.4
Systems Development & Business Integration	1.59	37.0	43.1
Technology Management	1.88	8.9	10.2
Technical Marketing	2.72	8.1	8.4
Other		11.6	3.7
% Sub-baccalaureate		57.9	51.1
% Baccalaureate		34.7	39.2
% Graduate		7.4	9.7

Estimated Number of Employees by Academic Disciplines

Academic Disciplines	Rank Importance of Discipline to Your Firm*	% IT Employees with these Disciplines 1995	% Employees with these Disciplines in 5 Years	Percent Change
Electronic Engineering	3.07	154	208	35.06
Telecommunications	1.93	592	792	33.78
Systems Integration	1.72	679	1,011	48.90
Computer engineering & Systems	2.05	938	994	5.97
Systems Development & Business Integration	1.59	2,545	3,755	47.54
Technology Management	1.88	611	889	45.50
Technical Marketing	2.72	557	732	31.42
Other		800	324	-59.50
% Sub-baccalaureate		3,982	4,445	11.63
% Baccalaureate		2,388	3,417	43.09
% Graduate		507	843	66.27

**Rank 1=Most Important 4=Least Important*

Importance of Applied Areas
62 Firms
Estimated Number of Employees by Academic Disciplines

Academic Disciplines	*Rank of Area	**Need Met by Colleges & Universities	***Differences
Electronic Engineering			
• Computer Systems/Architecture	2.42	2.43	0.01
• Directories, Circuits & Systems	3.33	2.71	-0.62
• Comm's, Control & Signal Processing	3.09	2.61	-0.48
• Other			
Telecommunications			
• LAN/WAN/Networks, Architecture Design, Management	1.69	2.66	0.97
• Wireless	2.49	2.69	0.20
• Telephony	2.17	2.82	0.65
• Fiber Optics	2.35	3.05	0.70
• Other			
Systems Integration			
• Software/Hardware Configuration	1.54	2.51	0.97
• LAN/WAN	1.72	2.61	0.89
• Technical Purchasing (RFI, RFP, ROI)	2.59	3.08	0.49
• Applied Mfg, Production, Operations	3.07	2.85	-0.22
• Installation/Implementation	2.02	2.70	0.68
• Quality Assurance	1.98	2.74	0.76
• Other			
Computer Engineering & Systems			
• Operating Systems/Compilers/Tools	2.16	2.35	0.19
• Language/CASE	2.42	2.51	0.09
• AI/ES/Inference Engines	2.94	2.89	-0.05
• Architectures/Platforms	2.38	2.63	0.25
• Capacity and Performance Planning	2.24	2.82	0.58
• Numerical Computing, Algorithms	3.22	2.50	-0.72
• Operations Research	3.15	2.85	-0.30
• Standards/Documentation	2.25	2.76	0.51
• Other			

Academic Disciplines	*Rank of Area	**Need Met by Colleges & Universities	***Differences
Systems Development & Business Integration			
• Methodology	1.93	2.43	0.50
• Data Warehousing	2.12	2.83	0.71
• Client/Server	1.61	2.43	0.82
• Business Planning/Re-Engineering	2.00	2.66	0.66
• Human Factors Engineering	2.57	2.79	0.22
• Design/Programming	1.86	2.15	0.29
• Decision Support Systems	2.05	2.49	0.44
• Other			
Technology Management			
• Project Management	1.47	2.59	1.12
• Business Planning Strategies/Tactics	1.81	2.64	0.83
• Specific Technical Competencies	1.96	2.73	0.77
• Communications Law, Regulation	2.89	2.88	-0.01
• Legal/Ethical/Human Resource Mgmt.	2.63	2.66	0.03
• Technology & Social/Economic Change	2.83	2.84	0.01
• Other			
Technical Marketing			
• Business Planning, Strategies, Tools	2.06	2.67	0.61
• Technical Competencies	2.20	2.59	0.39
• Marketing Concepts	2.56	2.77	0.21
• Other			

**Rank 1=Most Important 4=Least Important*
***Rank 1=Meets Needs 4=Does Not Meet Needs*
****A positive value suggests needs are not being met. A negative value suggests needs are being met.*

Ranking of Technology Areas All 62 Firms		
Technology Areas	***Rank**	
	1995	**In 5 Years**
Languages	2.04	2.05
Data	1.60	1.54
Telecommunications	1.6	1.44
Client/Server	1.74	1.35
Human Factors Engineering	2.69	2.24
Educational technologies Learning Services	2.48	2.13
Electronic Commerce	2.52	1.91
CAD/CAM/CAE	3.28	3.05
Object-Oriented Design	2.61	2.04
Artificial Intelligence	3.26	2.63
Multimedia – The Technologies	2.72	2.13
Multimedia – Presentation	2.41	1.95
Virtual Reality	3.6	2.98

**Rank 1=Most Important 4=Least Important*

Appendix C - 1999 Survey Results

Company Employment and Education Operations Summary
Greater Omaha Only
43 Firms

All Greater Omaha Employees	1999	Forecast in 5 Years	Percent Change
1. Number of All Employees (Greater Omaha)	66,493	81,812	23.04
2. Number of All Employees Now Taking Academic Credit Courses	5,321		
3. Number of All Employees You Feel Should Be Taking Academic Courses	9,845		
4. Number of Those Employees Taking Academic Credit Courses Who Are on a Company Tuition Reimbursement Program:	2,496		
5. Education/Training Budget-Omaha Employers Amount of Training Budget for:	$14,256,797	$26,063,644	82.82
a. Internally Provided Training Programs	$7,529,858	$15,268,043	114.29
b. External Seminars & Workshops	$2,477,293	$3,819,479	54.18
c. Tuition & Cost for College Courses	$1,954,031	$2,802,047	43.40
d. Other	$574,957	$569,464	-0.95

Greater Omaha Information Technology Employees	1999	Forecast in 5 Years	Percent Change
6. Number of Information Technology Employees	7,616	9,339	22.60
7. Number of Information Technology Employees Now Taking Academic Credit Courses	615		
8. Number of Information Technology Employees You Feel Should be Taking Academic Courses	1,701		
9. Number of Those IT Employees Taking Academic Credit Courses Who Are On a Company Tuition Reimbursement Program	323		
10. Education/Training Budget - IT Employees Only	$ 9,429,371	$16,272,275	72.60

Profile of Academic Disciplines for Information Technology Employees
Greater Omaha Operations Only
43 Firms
Estimated Percent of Employees by Academic Disciplines

Academic Disciplines	Rank Importance of Discipline to Your Firm*	% IT Employees with these Disciplines 1999	% Employees with these Disciplines in 5 Years
Electronic Engineering	2.39	1.8	1.0
Telecommunications	1.36	8.5	9.6
Systems Integration	1.13	17.2	14.6
Computer engineering & Systems	1.72	14.2	13.8
Systems Development & Business Integration	1.05	35.7	25.5
Technology Management	1.19	7.8	8.5
Technical Marketing	2.06	1.9	2.8
E-Commerce	1.25	4.1	12.1
Networking (LAN/WAN/IP)	1.11	8.8	10.5
% Sub-baccalaureate		41.3	38.2
% Baccalaureate		47.6	48.3
% Graduate		11.0	13.6

Estimated Number of Employees by Academic Disciplines

Academic Disciplines	Rank Importance of Discipline to Your Firm*	% IT Employees with these Disciplines 1999	% Employees with these Disciplines in 5 Years	Percent Change
Electronic Engineering	2.39	137	96	-29.93
Telecommunications	1.36	642	894	39.25
Systems Integration	1.13	1,296	1,369	5.63
Computer engineering & Systems	1.72	1,066	1,290	21.01
Systems Development & Business Integration	1.05	2,686	2,381	-11.36
Technology Management	1.19	583	791	35.68
Technical Marketing	2.06	146	262	79.45
E-Commerce	1.25	308	1,126	265.58
Networking (LAN/WAN/IP)	1.11	661	979	48.11
% Sub-baccalaureate		3,149	3,565	13.21
% Baccalaureate		3,626	4,506	24.27
% Graduate		841	1,268	50.77

**Rank 1=Most Important 4=Least Important*

Importance of Applied Areas
43 Firms
Estimated Number of Employees by Academic Disciplines

Academic Disciplines	*Rank of Area	**Need Met by Colleges & Universities	***Differences
Electronic Engineering			
• Computer Systems/Architecture	2.83	3.22	0.39
• Directories, Circuits & Systems	2.51	3.19	0.68
• Comm's, Control & Signal Processing	2.60	3.19	0.59
• Other			
Telecommunications			
• LAN/WAN/Networks, Architecture Design, Management	1.32	2.64	1.32
• Wireless	2.08	2.69	0.61
• Telephony	1.74	2.58	0.84
• Fiber Optics	1.66	2.70	1.04
• Other			
Systems Integration			
• Software/Hardware Configuration	1.20	2.63	1.43
• LAN/WAN	1.12	2.11	0.99
• Technical Purchasing (RFI, RFP, ROI)	1.62	2.66	1.04
• Applied Mfg, Production, Operations	1.68	2.31	0.63
• Installation/Implementation	1.22	2.94	1.72
• Quality Assurance	1.39	2.27	0.88
• Other			
Computer Engineering & Systems			
• Operating Systems/Compilers/Tools	1.32	2.13	0.81
• Language/CASE	1.70	1.96	0.26
• AI/ES/Inference Engines	2.08	1.77	-0.31
• Architectures/Platforms	1.34	1.96	0.62
• Capacity and Performance Planning	1.58	2.47	0.89
• Numerical Computing, Algorithms	2.12	1.56	-0.65
• Operations Research	2.26	2.17	-0.09
• Standards/Documentation	1.61	2.46	0.85
• Other			
Systems Development & Business Integration			
• Methodology	1.61	2.24	0.63
• Data Warehousing	1.72	2.08	0.46
• Client/Server	1.38	1.94	0.56

Academic Disciplines	*Rank of Area	**Need Met by Colleges & Universities	***Differences
Systems Development & Business Integration			
• Business Planning/Re-Engineering	1.77	2.45	0.68
• Human Factors Engineering	2.34	2.80	0.46
• Design/Programming	1.11	1.87	0.76
• Decision Support Systems	1.75	1.81	0.06
• Other			
Technology Management			
• Project Management	1.16	2.38	1.22
• Business Planning Strategies/Tactics	1.67	2.35	0.68
• Specific Technical Competencies	1.38	2.67	1.29
• Communications Law, Regulation	2.22	2.50	0.28
• Legal/Ethical/Human Resource Mgmt.	2.14	2.37	0.23
• Technology & Social/Economic Change	2.27	2.87	0.60
• Other			
Technical Marketing			
• Business Planning, Strategies, Tools	2.09	2.51	0.42
• Technical Competencies	1.82	2.49	0.67
• Marketing Concepts	2.30	2.43	0.13
• Other			
E-Commerce			
• Development Technologies	1.41	2.58	1.17
• Legal/Public Policy Issues	2.15	2.74	0.59
• Business Opportunity/Risk	1.90	2.69	0.78
• Management & Control	1.74	2.69	0.95
• Security	1.28	2.92	1.64
• Other			
Networking (LAN/WAN/IP)			
• Protocols – Open and Proprietary	1.27	2.19	0.92
• Integration	1.18	2.60	1.42
• Unification, Convergence	2.15	2.66	0.51
• Servers, Bridges, Routers and Hubs	1.33	2.63	1.30
• Security Encryption	1.44	2.70	1.26
• Continuity, Interruption & Recovery	1.36	2.66	1.30
• Other			
Overall Average	**1.71**	**2.43**	**0.72**

**Rank 1=Most Important 4=Least Important*
***Rank Meets Needs 4=Does Not Meet Needs*
****A positive value suggests needs are not being met. A negative value suggests needs are being met.*

Ranking of Technology Areas All 43 Firms		
Technology Areas	***Rank**	
	1999	**In 5 Years**
Languages	1.87	1.62
Data	1.54	1.31
Telecommunications	1.72	1.32
Client/Server	1.92	1.70
Human Factors Engineering	2.39	1.84
Educational Technologies Learning Services	2.48	1.84
CAD/CAM/CAE	3.36	2.87
Object-Oriented Design	2.04	2.14
Artificial Intelligence	3.03	2.55
Multimedia – The Technologies	2.56	1.77
Multimedia – Presentation	2.55	2.00
Virtual Reality	3.17	2.25

**Rank 1=Most Important 4=Least Important*