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Table of Contents

A COMPLETE SOLUTION TO IPV4 ADDRESSING

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ABSTRACT

Even though IPv6 standards have been developed and all new network operating systems support the use and implementation of IPv6 addresses, still, majority of networks are using IPv4 addressing schemes. Therefore, a thorough understanding of IPv4 addressing, and subnetting concepts is vital for students majoring in MIS.

This paper is focused on developing a computer program called IPv4 Addressing Solutions to allow MIS students design a TCP/IP network with appropriate network address, subnet mask, and range of IP addresses for each subnet. IPv4 Addressing Solutions can provide appropriate addresses for networks using Classful and Classless Inter-Domain Routing (CIDR) IPv4 addresses.

Visual Basic programming language was used to develop IPv4 Addressing Solutions and has been used as a teaching tool to enhance the comprehension of TCP/IP networking concepts and addressing discussed in Telecommunications and Networking courses. The preliminarily results and comments from students who have used this tool have been very positive and encouraging.

This tool can also be used by network administrators and managers with general knowledge of IP addressing and subnetting.

INTRODUCTION

Majority of students who attend school of business programs are not considered to be strong in math and are usually overwhelmed with some rather simple mathematical operations that they encounter in courses such as telecommunications, operating systems, and computer networks. Information technology programs (ITM) or management of information systems (MIS) are typically offered through school of business colleges and universities.

Due to strong demand in computer systems design and related fields (Department of Labor) and relatively high salaries, these programs attract students of all ages.

Industry description		Thousands of jobs		Change	Average annual rate of change
Fastest growing	2002 NAICS	2006	2016	2006-16	2006-16
Management, scientific, and technical consulting services	5416	920.9	1,638.7	717.8	5.9
Individual and family services	6241	973.6	1,687.0	713.4	5.7
Home health care services	6216	867.1	1,347.6	480.5	4.5
Securities, commodity contracts, and other financial investments and related activities	523	816.3	1,192.4	376.1	3.9
Facilities support services	5612	122.8	179.1	56.3	3.8
Residential care facilities	6232, 6233, 6239	1,316.7	1,829.2	512.5	3.3

Industry description		Thousands of jobs		Change	Average annual rate of change
Fastest growing	2002 NAICS	2006	2016	2006-16	2006-16
Independent artists, writers, and performers	7115	46.8	64.8	18.0	3.3
Computer systems design and related services	5415	1,278.2	1,767.6	489.4	3.3

Table 1: Industries with the fastest growing and most rapidly declining wages and salary employment, 2006-16, Bureau of Labor Statistics, Department of Labor

A significant challenge for educators is to teach somewhat technical IT subjects to students who lack the necessary mathematical and technical knowledge of the field and working adult professionals who return to universities to get the knowledge and degree to become more marketable.

Various tools and preparation programs are developed to alleviate some of these concerns. They include real or virtual laboratory environment to provide some hands- on experience and software programs to create and design a virtual network environment and allow students to cross check the solution to their assigned problems by using the developed computer programs.

One of the topics with wide spread application in almost any network environment is the concept of IP addressing. A thorough understanding of concepts such as classless or classful IP addresses, network address, subnetting, subnet mask, and assigning proper IP addresses to each subnet are essential in most networks to properly rout data to its designated recipient device(s) within a network or across the Internet.

USING IPV4 ADDRESSES

An IPv4 address is a 32-bit binary address which uniquely defines the connection of a host or a router/gateway to its network or Internet. Therefore, any router connected to the Internet must have a globally unique address. Internet authorities have reserved a set of addresses from each class (A, B, C) to be used within private networks and Internet routers are configured to drop packets which contain one of these private addresses in their destination field. This has created an unlimited pool of private IPv4 addresses and consequently prolonged the life of IP v4 addresses.

In addition, this concept has given the network administrators the ability to use any group of the so called private IP addresses within their network and obtain one or more globally unique IP addresses to be assigned to the router interface connecting a private network to the Internet. The network address translation (NAT) protocol manages all intricacies required in this process. (Frrozan, 2007)

Except for home networks and some small business networks, majority of private networks are subnetted for various technical and geographical reasons. This requires deciding on the number of subnets for the current and future status of the network, determining subnet ID's and the appropriate range of IP addresses for each subnet. Experience has shown that majority of our students majoring in MIS have difficulties with these concepts and it prompted the idea of developing a teaching tool enhance students' comprehension of the concepts involved here.

As a result, the IPv4 Addressing Solutions tool was developed. This tool is the enhanced version of a program called TCP/IP Configurator (James Aflaki, 2005) with the additional features which incorporates the classless IP addressing solutions, consequently, providing a complete solutions to valid IP addresses for a network that uses IPv4 addresses.

IPV4 ADDRESSING SOLUTIONS FEATURES

Visual Basic programming was used to develop the program. The program has two major components. First feature provides information for a given classless IP address assigned to an organization by internet authorities. It provides network address, network mask and the range of IP addresses in the assigned block. It addition, it checks the compliance of an address to the rules or conditions of a classless IP address.

The first address in the block is found by first converting the IP address to its binary form and then setting the rightmost 32 – *n* bits to 0s and then converting it back to its decimal notation representation.

The last address in the block is found by first converting the IP address to its binary form and then setting the rightmost 32 – *n* bits to 1s and then converting it back to its decimal notation representation.

The second feature has five components which require some user input and produces an output as listed in table1.

Input	Output
IP address Default network mask	Class of the IP address Network ID Host ID
Number of subnets Class of network IP addresses	Network mask Subnet ID's Range of valid IP addresses for each subnet
Source IP address Source network mask Destination device IP address	Whether destination device is local or remote relative to the source device
	IP V4 Address classification Summary
	Reserved IP addresses

Table 1: Summary of program inputs and outputs for classful IP addresses

The validity of any inputted information is checked. If program finds an invalid entry during execution, user is prompted and guided to enter correct information.

DISSCUSSION

This program was used in telecommunications course in which telecommunications concepts as well as their functions related to OSI and TCP/IP models are discussed. Also, it was used in operating systems and computer networks courses where students have to design and set up a subnetted network. After the topics were covered, students were given assignments to do manually

and check their answers using IPv4 Addressing Solutions tool. In all of these cases, students were extremely pleased and viewed this tool as an excellent supplement to reinforce their understanding of IP addressing concepts.

CONCLUSION

After teaching telecommunications and computer networking courses for students majoring in MIS, it was determined that additional instructional tools is needed to improve students' understanding of some mathematical and technical concepts involved in designing and configuring a network using TCP/IP suite of protocols. Consequently, Visual Basic programming language was used to develop IPv4 Addressing Solutions.

This tool allows MIS students to design a TCP/IP network with appropriate network address, subnet mask, and range of IP addresses for each subnet. IPv4 Addressing Solutions can provide appropriate addresses for networks using Classful and Classless Inter-Domain Routing (CIDR) IPv4 addresses.

The preliminarily results and comments from students who have used this tool have been very positive and encouraging and it has helped them gain a thorough understanding of the concepts involved and facilitated their network design projects.

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FACTOR ANALYTIC MODEL OF THE IMPACT OF IT ON THE PERFORMANCE OF PUBLIC ORGANIZATIONS IN NIGERIA

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ABSTRACT

The impact of IT on the public sector of Nigerian economy is studied and findings are presented in this paper. Twenty three decision variables of the impact of IT on the public sectors of Nigerian economy were formulated and an empirical tool for evaluating them is proposed. Questionnaires were administered on many organizations in the public sector and completed questionnaires were received from forty five Federal Ministries, Departments and Agencies; thirty six States; thirty six Universities; forty one Polytechnics and forty three Colleges of Education. The responses were subjected to factor analysis by principal components using Statistical Package for Social Scientists (SPSS). Four factors were extracted and the percentage contribution of each factor to the positive impact of IT was estimated. The total sum of the percentage contributions of all the factors was found to be less than 100. This revealed that there were some extraneous factors whose related performance indices were not considered in the administered questionnaire which were liable to play significant role in the success of IT projects. Moreover, a factor scores coefficient matrix that can be used to estimate and rank the assessment of each Assessor of IT projects was generated.

1. INTRODUCTION

The income from indirect taxes constituted the single most important source of revenue in Nigeria between 1961 and 1971. At the beginning of the oil boom in the 1970s, the contribution of indirect taxes to the revenue of the country fell from 58% in 1970 to 12% in 1980 and 13% in 1990. The oil boom caused a drastic fall in the contribution of agricultural sector to the national economy. The oil boom also brought about the attitude of Nigerians having preference for very high taste of goods and services. The middle class income earners suddenly collapsed, thus leaving a wide gap between the poor and the rich in Nigerian society.

The global recession of the 1980s exposed the structural weakness of the petroleum based economy of Nigeria. As the oil prices dropped, the economy found itself in the throes of chronic disequilibrium. The development compelled the Federal Government to resort into various policies calculated at moderating the deteriorating economic conditions. As part of the government Structural

Adjustment Programme (SAP), a move was made to overhaul the system of indirect taxation with a view to making it more effective and efficient. The ultimate goal was to reduce taxation on income while increasing taxation on consumption of some goods and services. Moreover, there was the intention to reduce government over dependence on the volatile oil driven revenue. The Federal Government consequently introduced Sales Tax in 1986. The success story of the sales tax motivated the Federal Government to set up a study group on indirect taxation in 1991. The study group presented two reports with a strong recommendation for the introduction of Value Added Tax (VAT) to replace the existing Sales tax. In Akinyokun, (1993a) and Akinyokun, (1993b), the framework for the computerization of VAT were presented. The VAT has made tremendous contributions to the national revenue since 1994 and its impact has been felt in major areas of development in the country.

In NEEDS, (2004), the National Economic Empowerment and Development Strategy (NEEDS) which is widely considered as Nigeria's plan for prosperity is legislated as a national road map for economic empowerment and development. NEEDS focuses on four key strategies, namely: re-orienting values, reducing poverty, creating wealth and generating employment. Basically, the major goal of NEEDS is the re-engineering of the growth process of Nigeria by exploring the means of diversifying the national product base away from petroleum products and services. The National Poverty Eradication Programme (NAPEP) has, in past years, emphasized services activities, which is characterized by short term benefit. NAPEP has a challenge to provide projects that would enable the beneficiaries of the programme to produce and create markets for both products and services.

The national policy on IT presented in NITDA, 2001 has created the necessary enabling environment for the growth and development of knowledge economy in Nigeria. The IT hardware sector has benefited from the certification by the Federal Government of the product of some local computer assembly companies such as Zinox and Omatek for public and private procurement. In an attempt to promote an enabling and sustainable environment for Nigerian software industry, a National Software Development Task Force (NSDTF) was inaugurated in August 2004. The NSDTF has the mandate to develop a road map for the development of Nigerian Software Industry so as to attain a level of global exhibition and competition as obtained in countries such as India, Israel and Ireland. There was also the National Software Development Initiative (NSDI) which was private sector driven and had worked in collaboration with the NSDTF in past years. The major goal of the collaboration is to position the software sector in the forefront of Nigerian economy.

The global trend of computer awareness, appreciation and use, and the causes of under-utilization of computer facilities in Nigeria had been discussed in Akinyokun, (1999). In Nigeria, computers are viewed as general support resource for centralizing and integrating the operations of corporate organizations. Emphasis is on the computer model of quantitative variables of the operational data of organizations. In the developed world and some developing countries such as India, Ireland and Israel, computers are viewed as strategic and core resource in corporate organizations. Emphasis is on the computer model of both quantitative and qualitative variables of the operational data of organizations.

The National Information Technology Agency (NITDA) is the institution mandated to provide IT standards, guidelines and policy, strategic plan, research and development in Nigeria. NITDA is, currently, developing a national IT strategic action plan. The platform for the strategic action plans is the baseline study of the awareness, appreciation and use of IT in both the private and

public sectors of Nigerian economy. A questionnaire was developed as the instrument for gathering data on the following:

a. Profile of organization.
b. IT policy/strategic plan of organization.
c. Organization budget on IT related programmes.
d. IT infrastructural facilities of organization.
e. Internet facilities of organization.
f. IT hardware, software and consumable of organization.
g. IT personnel of organization.
h. Revenue generated from IT products and services.
i. IT projects of organization and their assessment.
j. Impact of IT on the productivity of organization.
k. Profile of the products and services of the operators of tele-communications industry with emphasis on their performance.

The baseline study takes a holistic view of the practical issues of the conceptualization and implementation of IT in the public sector of Nigerian economy. The objectives of the study are, therefore, multidimensional and consequently multivariate in nature. One of the primary objectives of the Baseline Study is to take stock of the impact of IT on the public sector of Nigerian economy with a view to analyzing the local contents, job creation, wealth creation, connectivity and access to knowledge among many other factors. Twenty three decision variables of the impact of IT were formulated. A questionnaire of the decision variables was designed and administered. Factor analysis by principal components of the surveyed data was carried out for the purpose of estimating the contribution of each factor to the success of IT projects in each cluster of corporate organizations (Federal MDAs, State Governments, Local Governments, Universities, Polytechnics and Colleges of Education). The responses were verified and validated by a follow up with personal interviews and meetings with the principal actors of IT projects. The responses were thereafter subjected to factor analysis by principal components using Statistical Package for Social Scientists (SPSS) Version 13.0 and four factors were extracted. Further statistical analysis was carried out to generate the eigenvalues of the extracted factors. The eigenvalues form the basis for estimating the contributions of the extracted factors to the success of IT projects. Moreover, a system of linear equations which can be used to estimate the assessment of each Assessor of IT projects is proposed.

2. EVALUATION OF THE DECISION VARIABLES OF THE IMPACT OF IT

The decision variables of the impact of IT are many and they relate to one another. The general form of the mathematical model for evaluating the decision variables is presented as:

$$Y_{i,} = \sum_{k=1}^{n} a_{i,k} X_k \qquad i = 1,2,3,4, \ldots\ldots m$$

where Y_i represents the ith assessor's observation of decision variable $X_{k,}$
$a_{i,k}$ represents the assessment of kth. decision variable by ith. Assessor.
This mathematical model can be expressed as:

$$
\begin{array}{lcl}
Y_1 & & a_{1,1}X_1 + a_{1,2}X_2 + a_{1,3}X_3 + a_{1,4}X_4 + \ldots + a_{1,23}X_{53} \\
Y_2 & & a_{2,1}X_1 + a_{2,2}X_2 + a_{2,3}X_3 + a_{2,4}X_4 + \ldots + a_{2,23}X_{23} \\
. & = & . \quad . \quad . \quad . \quad . \\
. & & . \quad . \quad . \quad . \quad . \\
. & & . \quad . \quad . \quad . \quad . \\
Y_m & & a_{m,1}X_1 + a_{m,2}X_2 + a_{m,3}X_3 + a_{m,4}X_4 + \ldots = a_{m,23}X_{23}
\end{array}
$$

The factor analysis by principal components is adopted in the evaluation of the decision variable of the impact of IT. The primary goal is to obtain some factors each of which would load on some decision variable with a view to estimating their contributions to the positive impact of IT projects. The following statistics are generated and used for the purpose of achieving the above stated objective:

a. Descriptive statistics
b. Correlation matrix
c. Bartlet's test and Kaiser-Mayer Olkin (KMO).
d. Communalities.
e. Initial factor loadings.
f. Rotated factor loadings.
g. Factor score coefficient matrix.
h. Eigenvalues.

The descriptive statistics presents the mean and standard deviation of the raw score of each performance indices given by the sample Assessors. The correlation matrix presents the degree of pair wise relationships of the performance indices. The Bartlett's test of sphericity is used to test the adequacy of the sample population. Another measure of the adequacy of sample population is Kaiser-Mayer Olkin (KMO).

In factor analysis, there is a set of factors which is generally referred to as 'common factors' each of which loads on some performance indices and another set of factors which are extraneous to each of the performance indices. The proportion of a variance of a performance indices explained by the common factor is called the 'communality' of the performance indices. The communality of the performance index ranges between 0 and 1, where 0 indicates that the common factors explains none of the variance and 1 indicates that all the variance is explained by the common factors.

The component matrix presents the initial factor loadings. The factor loadings associated with a specific index is simply the correlation between the factor and the standard score of the index. The degree of generalization found between each index and each factor is referred to as 'factor loading'. The farther away a factor loading is from zero in the positive direction, the more one can conclude the contribution of an index to a factor. The component matrix can be rotated by varimax, promax, equamax or quartimax for the purpose of establishing a high correlation between indices and factors. The factor score coefficient matrix which can be used to evaluate the assessment of each Assessor is generated. The eigenvalues and percentage variance of the factors extracted are generated, as well, for the purpose of evaluating the contributions of each factor to the success of IT projects.

2.1 Case Study of the Impact of IT

The questionnaire which serves as the instrument for gathering data presented in Appendix A provides five columns where a respondent can rank each of the 23 formulated decision variables of the impact of IT 'Excellent', 'Very Good', 'Good', 'Average' or 'Poor'. The questionnaire was administered and completed questionnaires were duly received from forty five Federal Ministries/Departments/Agencies, thirty six States and Federal Capital Territory, thirty six Local Governments where each represents a State, thirty seven Universities, forty two Polytechnics and forty three Colleges of Education in Nigeria. The responses were verified and validated by a follow up with some interviews and meetings with the principal actors of the IT projects of some selected organizations. Thereafter, the final data were subjected to factor analysis by principal components using SPSS package Version 13.0.

Variable	N	Mean	Std. Deviation
ATTPTW	154	3.88	1.78
PRDORG	152	3.66	.82
MCOPNL	149	3.44	.95
MCOPRS	147	3.49	.97
MCOREV	128	3.40	1.15
MCOEXP	133	3.45	1.13
MCOFAS	138	3.34	1.04
MCOMAS	137	3.32	1.08
PEVORG	146	3.49	.93
GDVORG	147	3.53	.94
EMPCRN	143	3.23	1.04
WLTCRN	136	3.63	3.49
RESDEP	145	3.90	3.45
HMRDEV	146	3.61	1.05
INFGDV	147	3.32	1.03
WELPSN	142	3.01	1.14
HMNREL	146	3.36	.98
PUPREL	144	3.37	1.03
INDREL	140	3.29	1.01
ACCGKG	152	3.85	1.10
ACCLKG	149	3.63	1.11
ITACVT	140	3.66	4.30
ITECVT	147	3.37	1.25

Table 2.1: Descriptive Statistics

The descriptive statistics of the data collected presented in Table 2.13 exhibits the mean and standard deviation of the rating of the impact of IT on the performance of organization by the Assessors or respondents. For example, the mean and standard deviation of the rating on 'employment creation' are 3.23 and 1.04 respectively. The mean and standard deviation of the rating of 'wealth creation' are 3.63 and 3.49 respectively; the mean and standard deviation of the rating of the 'access to global knowledge' are 3.85 and 1.10 respectively.

The correlation matrix of the performance indices generated and presented in Table 2.14 shows that the correlation of 0.09 exists between the 'employment creation' and 'wealth creation'. The correlation of 0.66 exists between 'employment creation' and 'growth and development of organization'. The implication is that 'employment creation' is not likely to share the same factor with 'wealth creation'. On the other hand, 'employment creation' is very likely to share the same factor with 'growth and development of organization'.

Variable	ATT PTW	PRD ORG	MCO PNL	MCO PRS	MCO REV	MCO EXP	MCO FAS	MCO MAS	PEV ORG	GDV ORG	EMP CRN	WLTC RN	RES DEP	HMR DEV	INF GDV	WELP SN	HMN REL	PUP REL	IND REL	ACC GKG	ACCL KG	ITA CVT	ITE CVT
ATTPTW	1.000	.196	.172	.129	.139	.127	.125	.151	.146	.137	.120	.044	.086	.098	.111	.136	.140	.170	.168	.116	.127	.107	.101
PRDORG	.196	1.000	.519	.546	.462	.518	.423	.457	.583	.580	.407	.172	.508	.466	.438	.337	.468	.561	.566	.586	.602	.489	.450
MCOPNL	.172	.519	1.000	.684	.594	.589	.563	.504	.618	.461	.367	.196	.479	.419	.412	.490	.486	.510	.562	.454	.445	.413	.404
MCOPRS	.129	.546	.684	1.000	.795	.762	.641	.611	.680	.467	.402	.095	.499	.470	.452	.403	.498	.534	.582	.513	.427	.345	.413
MCOREV	.139	.462	.594	.795	1.000	.860	.696	.646	.719	.567	.448	.189	.468	.494	.491	.497	.536	.571	.553	.510	.470	.487	.496
MCOEXP	.127	.518	.589	.762	.860	1.000	.757	.680	.708	.535	.492	.283	.506	.458	.487	.537	.601	.621	.628	.523	.462	.387	.408
MCOFAS	.125	.423	.563	.641	.696	.757	1.000	.915	.669	.553	.469	.290	.460	.507	.589	.513	.549	.550	.554	.428	.422	.297	.353
MCOMAS	.151	.457	.504	.611	.646	.680	.915	1.000	.707	.590	.420	.292	.458	.541	.598	.442	.558	.579	.564	.449	.421	.312	.369
PEVORG	.146	.583	.618	.680	.719	.708	.669	.707	1.000	.715	.539	.215	.593	.667	.550	.536	.676	.640	.704	.593	.543	.536	.512
GDVORG	.137	.580	.461	.467	.567	.535	.553	.590	.715	1.000	.663	.215	.571	.680	.672	.581	.657	.729	.603	.581	.550	.528	.475
EMPCRN	.120	.407	.367	.402	.448	.492	.469	.420	.539	.663	1.000	.090	.558	.581	.604	.612	.544	.596	.604	.507	.454	.420	.343
WLTCRN	.044	.172	.196	.095	.189	.283	.290	.292	.215	.215	.090	1.000	.210	.200	.238	.250	.212	.230	.245	.184	.191	.193	.181
RESDEP	.086	.508	.479	.499	.468	.506	.460	.458	.593	.571	.558	.210	1.000	.825	.676	.451	.547	.587	.657	.660	.581	.474	.468
HMRDEV	.098	.466	.419	.470	.494	.458	.507	.541	.667	.680	.581	.200	.825	1.000	.792	.547	.636	.640	.635	.705	.601	.515	.457
INFGDV	.111	.438	.412	.452	.491	.487	.589	.598	.550	.672	.604	.238	.676	.792	1.000	.635	.591	.643	.569	.592	.574	.401	.394
WELPSN	.136	.337	.490	.403	.497	.537	.513	.442	.536	.581	.612	.250	.451	.547	.635	1.000	.706	.714	.622	.394	.447	.394	.248
HMNREL	.140	.468	.486	.498	.536	.601	.549	.558	.676	.657	.544	.212	.547	.636	.591	.706	1.000	.853	.702	.519	.452	.456	.411
PUPREL	.170	.561	.510	.534	.571	.621	.550	.579	.640	.729	.596	.230	.587	.640	.643	.714	.853	1.00	.760	.551	.561	.496	.441
INDREL	.168	.566	.562	.582	.553	.628	.554	.564	.704	.603	.604	.245	.657	.635	.569	.622	.702	.760	1.000	.606	.692	.595	.545
ACCGKG	.116	.586	.454	.513	.510	.523	.428	.449	.593	.581	.507	.184	.660	.705	.592	.394	.519	.551	.606	1.000	.759	.674	.639
ACCLKG	.127	.602	.445	.427	.470	.462	.422	.421	.543	.550	.454	.191	.581	.601	.574	.447	.452	.561	.692	.759	1.000	.722	.641
ITACVT	.107	.489	.413	.345	.487	.387	.297	.312	.536	.528	.420	.193	.474	.515	.401	.394	.456	.496	.595	.674	.722	1.00	.785
ITECVT	.101	.450	.404	.413	.496	.408	.353	.369	.512	.475	.343	.181	.468	.457	.394	.248	.411	.441	.545	.639	.641	.785	1.00

Table 2.2: Correlation Matrix

Variable	Initial	Extraction
ATTPTW	1.000	.592
PRDORG	1.000	.567
MCOPNL	1.000	.599
MCOPRS	1.000	.778
MCOREV	1.000	.794
MCOEXP	1.000	.822
MCOFAS	1.000	.820
MCOMAS	1.000	.758
PEVORG	1.000	.754
GDVORG	1.000	.698
EMPCRN	1.000	.628
WLTCRN	1.000	.375
RESDEP	1.000	.653
HMRDEV	1.000	.771
INFGDV	1.000	.738
WELPSN	1.000	.700
HMNREL	1.000	.719
PUPREL	1.000	.775
INDREL	1.000	.723
ACCGKG	1.000	.764
ACCLKG	1.000	.765
ITACVT	1.000	.787
ITECVT	1.000	.758

Table 2.3: Communalities of Variables

	Component			
Variable	1	2	3	4
WELPSN	.944			
HMNREL	.791			
INFGDV	.751			
HMRDEV	.735			
PUPREL	.720			
EMPCRN	.693			
INDREL	.638			
GDVORG	.470			
MCOPRS		.861		
MCOEXP		.859		
MCOREV		.844		
MCOFAS		.815		
MCOMAS		.760		
MCOPNL		.705		
PEVORG		.571		
ACCGKG			.720	
ITECVT			.681	
ACCLKG			.634	
PRDORG			.560	
ITACVT			.484	
RESDEP				.725
WLTCRN				.446
ATTPTW				

Table 2.4; Rotation by Promax

The Bartlett's test produces a χ^2 of 2018.737, degree of freedom of 253 and a significance level of 0.000, which indicates the adequacy of the population. The Kaiser-Mayer Olkin (KMO) test produces a measure of 0.914, which confirms the adequacy of the sample population. The results obtained from the Bartlett's test and KMO test are good indicators of the suitability of the application of factor analysis as well.

The communalities of the performance indices generated are presented in Table 2.15. The communality of the 'employment creation' is 0.628 (62.80%) which implies that 62.80% of the variance in 'employment creation' can be explained by the extracted factors, while the remaining 37.20% is attributed to extraneous factors. The communality of the 'wealth creation' is 0.375 (37.50%) which implies that 37.50% of the variance in 'wealth creation' can be explained by the extracted factors, while the remaining 62.50% is attributed to extraneous factors.

Applying Social Science rule, which states that only the performance indices with loadings equal to or greater than 0.4 and percentage greater than 1.0 should be considered meaningful, four factors were extracted from the initial principal component matrix generated. In order to obtain realistic and meaningful factor loadings, the initial principal component matrix is rotated orthogonally by varimax, promax and quantimax. However, the result obtained from the rotation by promax which is presented in Table 2.4 was adopted for further analysis and exhibits following factors:

Factor 01 (Capacity Building and Employment Creation) loads on:

a. Welfare of Personnel (WELPSN).
b. Human Relations (HMNREL).
c. Infrastructural Growth and Development (INFGDV).
d. Human Resource Development (HMDDEV).
e. Public Relation (PUPREL).
f. Employment Creation (EMPCRN).
g. Industrial Relations (INDREL).
h. Growth and Development of Organization (GDVORG).

Factor 02 (Monitoring and Control) loads on:

a. Monitoring and Control of Projects (MCOPRS).
b. Monitoring and Control of Expenditure (MCOEXP).
c. Monitoring and Control of Revenue (MCOREV).
d. Monitoring and Control of Fixed Assets (MCOFAS).
e. Monitoring and Control of Movable Assets (MCOMAS).
f. Monitoring and Control of Personnel (MCOPNL).
g. Performance Evaluation of Organization (PEVORG).

Factor 03 (Connectivity and Access to Knowledge and Skills) loads on:

a. Access to Global Knowledge (ACCGKG).
b. Access to Local Knowledge (ACCLKG).
c. Intra-Connectivity (ITACVT).
d. Inter-Connectivity (ITECVT).
e. Productivity of Organization (PRDORG).

Factor 04 (Wealth Creation; Research and Development) loads on:

a. Research and Development (RESDEP).
b. Wealth Creation (WLTCRN).

The generated factor score coefficient matrix presented in Table 2.5 can be used to estimate the assessment of each assessor of the impact of IT on the performance of organization. This can be achieved by formulating a linear equation of the form:

$$C_{i,j} = \sum_{k=1}^{23} b_{k,j} S_{i,k} \qquad i = 1, 2, 3, 4, \ldots\ldots n;\ j = 1, 2, 3, \ldots\ldots, 4$$

where:

$C_{i,j}$ represents the contribution of ith assessor to jth factor,
$b_{k,j}$ represents the factor score coefficient of kth decision variable for jth factor,
$S_{i,k}$ represents the standard score of ith assessor for kth decision variable and
n represents the population of the sampled assessors.

$S_{i,k}$ is estimated by:

$$S_{i,k} = A + (x_i - y_i)/d_i$$

where:

A represents the allowable minimum raw score for decision variable; in this instance, it is 1;
x_i represents the raw score of ith decision variable;
y_i represents the mean of the raw scores of ith decision variable;
d_i represents the standard deviation of the raw scores of ith decision variable.

For each sampled Assessor, the system of linear equations for the four extracted factors can be represented as follows:

$$\begin{pmatrix} b_{1,1}S_{i,1} + b_{2,1}S_{i,2} + b_{3,1}S_{i,3} + \ldots + b_{23,1}S_{i,23} \\ \ldots\ldots\ldots + \ldots\ldots\ldots + \ldots\ldots + \ldots + \ldots\ldots\ldots \\ b_{1,4}S_{i,1} + b_{2,4}S_{i,2} + b_{3,4}S_{i,3} \ldots + \ldots + b_{23,4}S_{i,23} \end{pmatrix} = \begin{pmatrix} C_{i,1} \\ \ldots. \\ C_{i,4} \end{pmatrix}$$

Variable	Component			
	1	2	3	4
ATTPTW	.024	.110	.129	-.336
PRDORG	.065	-.023	.267	-.032
MCOPNL	.061	.197	.177	-.060
MCOPRS	.066	.261	.180	-.063
MCOREV	.069	.250	.030	.028
MCOEXP	.071	.256	-.062	.038
MCOFAS	.071	.237	-.159	.085
MCOMAS	.070	.213	-.157	.091
PEVORG	.075	.107	.040	-.006
GDVORG	.071	-.077	-.039	.141
EMPCRN	.062	-.152	-.122	-.055
WLTCRN	.028	.009	-.178	.385
RESDEP	.025	-.013	.190	.687
HMRDEV	.071	-.219	-.069	.038
INFGDV	.070	-.184	-.135	.048
WELPSN	.065	-.112	-.331	-.189
HMNREL	.074	-.065	-.225	-.151
PUPREL	.075	-.076	-.150	-.135
INDREL	.073	-.133	-.037	-.083
ACCGKG	.067	-.210	.275	.047
ACCLKG	.066	-.214	.209	.027
ITACVT	.019	.000	.309	-.309
ITECVT	.056	-.118	.320	.020

Table 2.5: Factor Score Coefficient Matrix

In an attempt to evaluate the percentage contribution of each factor to the overall impact of IT, the eigenvalue of each factor is generated. The eigenvalue of jth factor denoted by 'E_j' is calculated by:

$$E_j = \sum_{k=1}^{23} X^2_{i,j} \qquad i = 1, 2, 3, 4, \ldots\ldots 23; \; j = 1, 2, 3, 4$$

where $X_{i,j}$ represents the loading of jth factor on ith decision variable.

The eigenvalue is used to indicate how well each of the extracted factors fits the data from the sample. The percentage contribution of each factor to the impact of IT denoted by 'P' is estimated by:

$$P = 100\, E_j/n$$

where n represents the number of decision variables considered in a study. Table 2.5 presents the eigenvalues, percentage contribution and cumulative percentage contribution of the extracted four factors. The four factors contribute a total of 64.29% to the overall impact of IT.

	Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	10.904	47.410	47.410
2	1.626	7.070	54.480
3	1.224	5.322	59.802
4	1.032	4.488	64.290

Table 2.18; Eigenvalue generated by SPSS

The first factor which is described as 'Capacity Building and Employment Creation' contributes 47.41% out of the 64.29 % which translates to 73.74%. The statistic suggests that IT had had tremendous impact on the decision variables which load on this factor. The factor which is described as 'Monitoring and Control' accounts for 7.07% out of the 64.29% which translate to 11%. The statistic exhibits a phenomenon whereby IT is not adequately used for monitoring and control of the resources (money, man, machine and time) of the public sector of Nigerian economy. The impact of IT on connectivity and access to both local and global knowledge is exhibited in this study with a net contribution of 8.28%. The impact of IT on R&D and wealth creation is also exhibited with a net contribution of 6.98%. It is remarked that the decision variable 'Attitude of Personnel to Work' failed to load on any of the factors. This suggests the consequence of public servants' perception of IT tools as a threat to their job security.

The remaining 35.71% is thought to be the contributions of some extraneous factors whose related decision variables were not considered in the administered questionnaire. The following are some of the perceived decision variables that were not considered are:

a. Healthy and purposeful competition.
b. Retraining and skill acquisition.
c. Self reliance and self employment.
d. Gender equality.
e. Growth and development of youths.

f. Growth and development of women.
g. Qualitative and functional education.
h. Qualitative and functional research.
i. Qualitative and functional scheme for knowledge and skills acquisition.
j. Qualitative and functional community development.
k. Redistribution of staff.
l. Value judgment.

3. CONCLUSION

The major resources of a country are man (human), money, material (infrastructure and equipment) and time. The man uses money, material and time to achieve the aims and objectives of the country. The improper procurement, development and evaluation of the human resource have often led to the improper procurement and utilization of the other three resources and poor performance of the country. The rate of growth of the development of a nation depends, largely, on the quality of its human resource. Many countries in the world today are yet to develop, appropriately, because of the poor performance of their human resource in the management of the other resources. Thus, a crucial factor for the capacity building of a country is the procurement of the human resource. This paper has identified software sector as one of the new millennium source of job and wealth creation in Nigeria. In order to achieve the millennium goal, a national re-orientation and intelligent selection of the team leaders and players of software sector is desirable.

The longevity of people's attitudes towards IT is indeed open to question, especially with the on-going evolution and revolution. The applications of IT in the workplace and home are currently a subject of serious concern because of its likely effects on labour market and job security. In Schofield, (1985), it is expressed that if every instrument could do its own work, if the shuttle should weave of itself and the plectrum should play the harp unaided; then managers would not need workers and masters would not need servants. This is to say that IT creates jobs whereby conventional staff have to be retrained. However, a staff that fails to be retrained shall be made redundant and consequently obsolete.

Any successful new technology, in history, has always created its own set of applications that do not exist at the time it was conceived. For example, at the time electricity, telephone (communications device), automobile (transportation device) and computer were invented, little did one know that they could individually or jointly become essential to the way people live and work today. It is believed that, a similar set generating process with considerable job opportunities and wealth creation will follow the introduction of a national policy on Software Engineering. Given the existing socio-economic status of Nigeria in the African continent, there is no doubt that the country has the potential for a global competition in the IT market with a view to alleviating poverty in Nigerian society. Among the success factors are:

a. Economic strength and viability.
b. High potential in human capital.
c. Existence of a entrepreneurial culture and drive.
d. Command of oral and written English language.

A sizeable and demanding domestic market which can serve as a platform for developing IT tools relevant skills, experience, user feedback on products and services can be the springboard from which to launch into job and wealth creation in the national economy. Moreover, a sizeable domestic market will draw large numbers of multinationals that are involved in software development into collaborative relationships with local partners in order to serve that market. The major challenge for governments in its bid to develop the IT sector is the provision of sustainable environment.

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APPENDIX A: Measurement of the Impact of IT ob Performance of Organization

Description of Indices	**Excellent**	**V. Good**	**Good**	**Average**	**Poor**
Attitude of Personnel to Work					
Productivity of Organization					
Monitoring and Control of Personnel					
Monitoring and Control of Projects					
Monitoring and Control of Revenue					
Monitoring and Control of Expenditure					
Monitoring and Control of Fixed Assets					
Monitoring and Control of Movable Assets					
Performance Evaluation of Organisation					
Growth and Development of Organisation					
Employment Creation					
Wealth Creation					
Research and Development					
Human Resource Development					
Infrastructural Growth and Development					
Welfare of Personnel					
Human Relations					
Public Relations					
Industrial Relations					
Access to Global knowledge					
Access to Local knowledge					
Intra-Connectivity					
Inter-Connectivity					

INTERACTIVE AND ITERATIVE ASSESSMENT AS A TOOL FOR ENHANCED STUDENT LEARNING

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ABSTRACT

During their careers, academic instructors, at one time or another are faced with the challenge of inattentive and careless students. As long as these symptoms are not systemic and are only random occurrences, they do not cause a lot of concern to the instructors. However, when the misbehavior consistently carries over from semester to semester and through courses - one after another, it becomes a matter of great concern. It is even a bigger concern when groups of students start misbehaving in this fashion. The class environment slowly deteriorates and no longer stays conducive to teaching and learning. The paper describes an incident where an instructor was able to reshape the class environment back to that of teaching and leaning using interactive and iterative assessment as a tool.

THE IMPACT OF CULTURE AND COMPUTER SELF-EFFICACY IN AN ONLINE TRAINING ENVIRONMENT

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ABSTRACT

The purpose of this research is to compare the relationships between computer anxiety, culture, computer self-efficacy (CSE), and user performance in an online training environment. To accomplish this, previously validated instruments were used to measure culture, anxiety and computer self-efficacy. A theoretical model was developed and examined using correlation analysis and structural equation modeling. The findings show significant relationships do exist between culture, CSE, and anxiety. One of the more interesting findings was which indicator variables for the culture construct were significant in the online environment. Only Order and Organization and Innovation were found to be significant. In effect, the interactive or emotive characteristics of culture were not significant in the online environment. While structure is an important part of any classroom or training environment, this research shows that it is absolutely critical in an online environment.

INTRODUCTION

As technology becomes more pervasive in the business environment, the need for employees to work effectively with computers becomes more important. As such, it has become more and more important for training methods to be identified that will result in the effective transfer of knowledge concerning these new technologies.

While many studies have been performed examining the role of computer self-efficacy, few have combined multiple factors in a realistic setting with an objective performance measure. Further, the results from these studies have been confusing and conflicting. This study seeks to improve the understanding of roles of CSE, anxiety, and culture in an online environment by combining these multiple factors. This paper relates the findings of that study.

THEORETICAL MODEL AND HYPOTHESES

A review of existing research identified factors that could influence an individual's performance of a computer related task. The following model, seen in Figure 1, depicts the relationships among these factors.

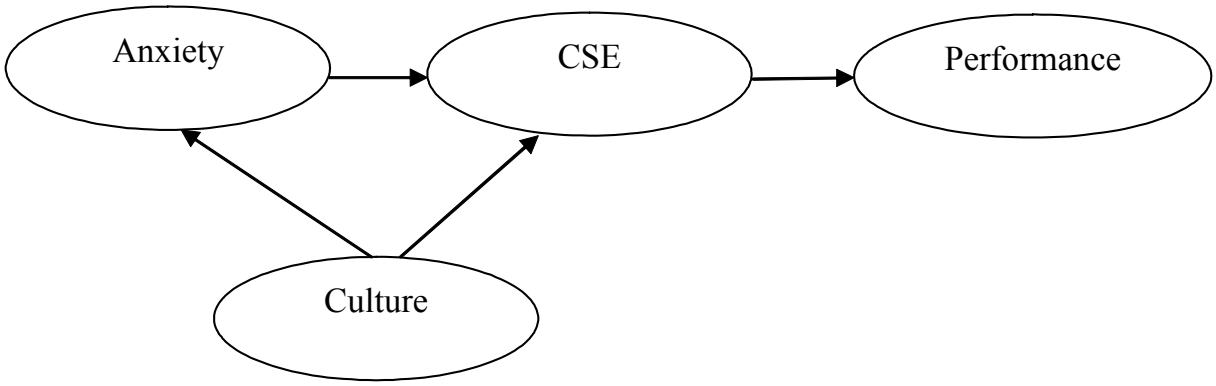

Figure 1. Research Model – Theoretical Model

This model suggests three hypotheses.

H1: Lower anxiety levels will result in higher self-efficacy scores and vice versa.

H2: Higher self-efficacy scores will result in higher performance scores.

H3: Culture influences the perceptions of both anxiety and self-efficacy.

METHODOLOGY

Questionnaires were developed to measure demographics, anxiety, culture, and self-efficacy. The New Classroom Environment Instrument was used to assess aspects of culture. Both general (CSE) and database-specific self-efficacy (DBSE) were measured using Compeau and Higgins' 10 item instrument, modifying it for the database portion. Anxiety scores were measured using the Computer Anxiety Scale.

Data collection took place in three phases. First, the demographic, culture, anxiety and self-efficacy instruments were administered to students in junior level online Management Information Systems courses at the beginning of the semester to establish a baseline. After a classroom culture has been given an opportunity to develop, ten weeks later, the culture, anxiety and self-efficacy instruments will be administered again. Concurrently, students were given a hands-on database test utilizing Microsoft Access to measure their actual performance. The data was analyzed using correlation and structured equation modeling (Partial Least Squares).

FINDINGS

Figure 2 shows the results of the Partial Least Squares (PLS) analysis. All relationships were significant at the .001 level.

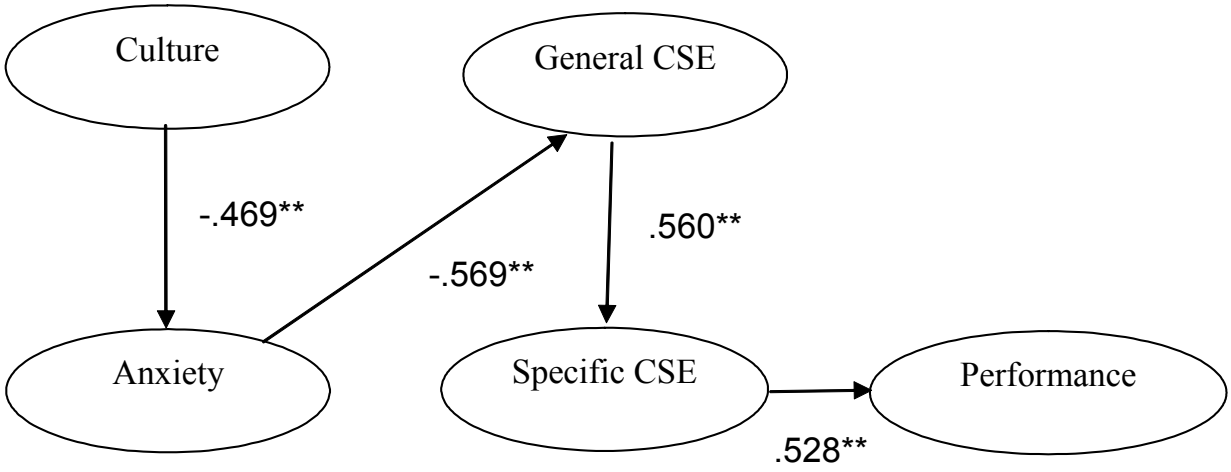

Figure 2. Online PLS Model **sig at the .001 level

Lower computer anxiety levels do seem to be related to higher self-efficacy scores and vice versa. In the online environment significant correlations were found between pre and post anxiety and CSE post. These findings were confirmed by PLS analysis.

Higher computer self-efficacy scores appear to be related to higher performance scores. Specific database self-efficacy was positively correlated with performance post, but not pre. PLS analysis showed a significant positive relationship between general CSE and specific CSE, as well as between specific CSE and performance.

Finally, culture does seem to be related to the perceptions of both computer anxiety and computer self-efficacy. While no significant correlations were found in the online environment, PLS analysis showed that culture actually directly impacts anxiety. One of the more interesting findings was which indicator variables for the culture construct were significant in the online environment. Only Order and Organization and Innovation were found to be significant. In effect, the interactive or emotive characteristics of culture were not significant in the online environment. While structure is an important part of any classroom or training environment, this research shows that it is absolutely critical in an online environment.

(references available upon request from Richard Hauser)

A REVIEW OF COGNITIVE RESEARCH ON THE CORRECTNESS OF REQUIREMENT SPECIFICATIONS

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ABSTRACT

In order to identify the determinants for getting information requirements right, cognitive research has been conducted to study the process of information requirement analysis. As a result, three important determinants for the correctness of requirement specifications have been identified: the knowledge of information analysts, requirement analysis techniques, and problem domains.

In order to identify and explain the important variables for the correctness of requirement specifications, various cognitive models have been built on the basis of different cognitive theories such as normative models, problem solving models, mental models, and comprehension models. However, they are inadequate because they are focused on some rather than all of the three determinants. As a result, two issues related to requirement analysis techniques cannot be accounted for: First, no requirement analysis technique can consistently outperform the others. Second, experienced information analysts use multiple requirement analysis techniques in analyzing complex information systems.

This research suggests that an adequate cognitive model need to meet two requirements: first, it can explicate the interactive relationships among the three determinants of information requirement analysis, and second, it can explain the two unsolved issues for requirement analysis techniques

The importance of an adequate cognitive model can be shown in four aspects: (1) it provides an adequate model for information requirement analysis; (2) it provides a basis for empirical validation; (3) it provides a framework for viewing and comparing important aspects of information requirement analysis; and (4) it provides a theoretical basis for the design of computer-aided software engineering tools.

INTRODUCTION

In order to identify the determinants for getting information requirements right, cognitive research has been conducted to study the process of information requirement analysis. One stream of research has investigated the differences in analytical behaviors between novice and expert information analysts. Richer domain knowledge and modeling knowledge have been recognized as the qualities of expert information analysts for better performance in information requirement analysis (Adelson and Soloway, 1985; Allwood, 1986; Koubek, et al, 1989; Schenk, Vitalari, and Davis, 1998; Sutcliffe and Maiden, 1990; Vessey and Conger, 1993; Vitalari and Dickson, 1983). Another stream of research has focused on comparing the effectiveness of various requirement analysis techniques in specifying information requirements. However, the

research results are contradictory (Kim and Lerch, 1992; Vessey and Cogner; 1994; Yadav, Bravoco, Chatfield, and Raikumar; 1988). No requirement analysis technique has shown consistently better performance than the others (Kim and Lerch, 1992; Poti & Ramesh, 2002; Vessey and Cogner, 1994; Yadav, Bravoco, Chatfield, and Raikumar, 1988). In addition, experienced information analysts use multiple requirement analysis techniques in analyzing complex information systems (Littman, 1989). In order to explain the contradictory results, some researchers have suggested that requirement analysis techniques should be matched to types of problem domains (Fitzgerald, 1996; Jackson, 1994; Vessey and Glass, 1994). In addition, several frameworks have been proposed to classify requirement analysis techniques on the basis of problem domains (Davis, 1988; Iivari, 1989; Marca, and McGowan, 1993; Vessey and Glass; Fall 1994).

In order to identify and explain the important variables for the correctness of requirement specifications, various cognitive models have been built on the basis of different cognitive theories such as normative models, problem solving models, mental models, and comprehension models. However, they are inadequate because they are focused on some rather than all of the three determinants: the knowledge of information analysts, requirement analysis techniques, and problem domains. As a result, two issues related to requirement analysis techniques cannot be accounted for: First, no requirement analysis technique can consistently outperform the others. Second, experienced information analysts use multiple requirement analysis techniques in analyzing complex information systems.

Without an adequate model of information requirement analysis, research studies may miss important influential variables in viewing and comparing the cognitive processes of information requirement analysis, resulting in erroneous findings. Therefore, this research argues that an adequate cognitive model can not only explicate the interactive relationships among the three determinants of information requirement analysis, but also explain the two unsolved issues for requirement analysis techniques.

The importance of an adequate cognitive model can be shown in four aspects: (1) it provides an adequate model for information requirement analysis; (2) it provides a basis for empirical validation; (3) it provides a framework for viewing and comparing important aspects of information requirement analysis; and (4) it provides a theoretical basis for the design of computer-aided software engineering tools.

The rest of this article will be organized into two sections. First, I review the cognitive models used in current cognitive research of information requirement analysis. Then, the conclusion is made in the final section.

A REVIEW ON COGNITIVE MODELS OF INFORMATION REQUIREMENT ANALYSIS

In order to identify and explain important variables for the correctness of requirement specifications, various cognitive models have been proposed on the basis of different cognitive theories. Basically, four approaches have been used to derive cognitive models of information requirement analysis: normative models, problem solving models, mental models, and comprehension models.

First, normative models are referred to as the models of information requirement analysis that are built on the basis of the researchers' experiences or opinions. Normative models are often built for comparing or evaluating requirement analysis techniques. Examples can be found in the research papers of Davis (1988); and Yadav, Bravoco, Chatfield, and Rajkumar (1988). This class of models provides a set of criteria about what should be achieved by good requirement analysis techniques. However, without an understanding of the cognitive behaviors of information analysts, those models provide no guideline for how to support information analysts in understanding problem domains and in specifying correct information requirements.

Second, some researchers believe that information requirement analysis is similar to the cognitive process of problem solving (Malhotra, et al., 1980; Schenk, Vitalari, and Davis, 1998; Sutcliffe and Mainden, 1992; Vitalari and Dickson;, 1983). They focus on the reasoning processes that information analysts use to analyze information requirements. Specifically, they focus on "the frequency, ordering, and association with analysts' performance of the clues, goals, strategies, heuristics, hypotheses, information, and knowledge manifested in the thought process of the information analysts" (Vitalari and Dickson, 1983, p. 949). Some examples can be found in the research papers of Malhotra, et al. (1980); Vitalari and Dickson (1983); and Sutcliffe and Mainden (1992). On the basis of the problem solving paradigm, this class of cognitive models provides a framework for understanding the influence of knowledge and reasoning processes on the correctness of requirement specifications. However, these models cannot identify the interaction among cognitive variables in determining the correctness of requirement specifications. In addition, problem domains have not been identified as a variable in these models.

Third, mental models have also been used to identify important determinants for the correctness of requirement specifications. A mental model is a collection of interconnected autonomous objects (Williams, Hollan, and Stevens; 1983, p.133). According to Williams, Hollan, and Stevens, autonomous objects are mental objects that have their own internal rules to guide their behaviors. The interactions among autonomous objects achieve the task of human reasoning. Some mental models for information requirement analysis can be found in the research papers of Adelson and Soloway (1985); Guindon and Curtis (1988); Guindon, Krasner, and Curtis (1990); and Vessey and Conger (1993). On the basis of the mental models, problem statements, domain knowledge of information analysts, and methodology knowledge of information analysts are identified as three sources of knowledge for specifying information requirements. However, those models provide no theoretical basis for explaining the interactive relationships between problem domains and requirement analysis techniques.

Finally, some researchers view information requirement analysis as a comprehension process. They believe that information requirement analysis is a process of translating the knowledge of problem statements into that of requirement analysis techniques. Therefore, good requirement analysis techniques should be able to make the translation process easy for information analysts. For example, Kim and Lerch (1992) focus the required skills for the translation of information requirements. They believe that object-oriented techniques are better than functional-oriented techniques because the required skill for object oriented techniques (symbolic simulation) is easier than that for functional-oriented techniques (test case). Batra and Sein (1994), on the other hand, suggest that the constructs used by requirement analysis

techniques should be close to those of problem domains. By modeling information requirement analysis as a comprehension process, the above two models provide some insights about the required features for good requirement analysis techniques. However, they do not explain the interactive relationships between requirement analysis techniques and problem domains. In addition, the knowledge of information analysts is not included in those models.

In this section I have discussed various cognitive models used by researchers to explain the cognitive process of information requirement analysis. The cognitive models have focused on different aspects of information requirement analysis like knowledge of information analysts, requirement analysis techniques, or modeling behaviors of information analysts. However, due to the lack of an integrated view of information requirement analysis, it is unknown what the interactive relationships between the different cognitive variables are. Even worse, some research studies may reach conflicting or contradictory conclusions because of the negligence of confounding variables.

CONCLUSION

This research argues that an adequate cognitive model of information requirement analysis needs to meets two requirements: first, it can explicate the interactive relationships among the three determinants for the correctness of requirement specifications; and second, it can provide an explanation for the two unsolved issues related to requirement analysis techniques.

An adequate cognitive model is important and deserves further research because it contributes to the research in information requirement analysis in four aspects as follows.

First, the cognitive model provides a more adequate theory of information requirement analysis. In addition to explicating the relationships among the knowledge of information analysts, requirement analysis techniques, and problem domains, the cognitive model can explain two important phenomena in information requirement analysis: (1) no requirement analysis technique can consistently outperform the others; and (2) experienced information analysts use multiple requirement analysis techniques in analyzing complex information systems.

Second, the cognitive model provides a basis for empirical validation. On the basis of this cognitive model, empirical research can be conducted to test the influence of the knowledge of information analysts, requirement analysis techniques, problem domains, and the interactive relationships among the three determinants on the correctness of requirement specifications.

Third, the cognitive model provides a framework to view and to compare important aspects of information requirements. According to the cognitive model, the knowledge of information analysts, requirement analysis techniques, and problem domains are interactive in determining the correctness of requirement specifications. Therefore, effective research studies in the cognitive processes of information requirement analysis should consider interactive relationships among these three determinants.

Finally, the cognitive model provides a theoretical basis for the development of computer-aided software engineering (CASE) tools.

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OBJECTS-FIRST VS. STRUCTURES-FIRST APPROACHES TO OO PROGRAMMING EDUCATION: AN EMPIRICAL STUDY

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ABSTRACT

Software development is a cornerstone of information technology and computer programming is a key element of software development. Teaching computer programming to undergraduates can be challenging. Adding to the challenge is the near universality of the object-oriented paradigm in computer programming courses. A key question facing programming instructors is whether to take an objects-first approach or a structures-first approach in the classroom. Conventional wisdom seems to favor an objects-first approach, but no hard empirical evidence exists on this question. This study performs a field experiment by having two nearly equivalent sections of introductory Java programming test these two fundamental approaches to OO programming education. The results clearly indicate that students who take an objects-first approach to OO programming outperform those who take a structures-first approach.

INTRODUCTION

The teaching of introductory programming is a foundation in many computer information systems (CIS) and computer science (CSC) curricula. In recent years, virtually all introductory programming courses have shifted from the procedural approach to the object-oriented (OO) approach. Most beginning programming courses appear to be teaching Java , C++, or one of the Visual Studio .NET languages (Visual Basic, C#, or J#) as evidenced by the popularity of various computer programming texts. All of these programming languages are OO, as contrasted with the purely procedural languages of Fortran, Pascal, COBOL, and C.

The basis of any type of computer programming involves the three programming ‘structures': sequence (do A, do B, do C, …), selection (if…else decisions), and repetition (while or for loops). The basics of OO programming involve creating classes that serve as templates for instantiating objects in computer memory. Objects have attributes (instance fields) and behaviors (methods) and usually represent things in the real world (such as students, products, or airline reservations). While learning the basics of structured programming (sequence, selection, and repetition) is not always easy for most beginning students of CIS and CSC, it is the general consensus that learning OO programming concepts and techniques may be even more challenging for most students (Sheetz, et al., 1997).

Therefore, one of the most relevant questions regarding how OO programming courses should be taught is whether it is better to teach structured programming concepts first, followed by OO programming concepts, or vice versa. It appears that most authors claim it is better to teach objects first (‘early objects') in order to ingrain the student with OO concepts and techniques early and often, thus ensuring greater success in later OO programming (Thramboulidis, 2003; Ragonis & Ben-Ari, 2005). Although the ‘objects first' (OF) approach may sound more plausible than a ‘structures first' (SF) approach, there appears to be no empirical evidence to support the claim. The purpose of this study is to perform a field experiment to test the claim that OF is superior to SF.

RESEARCH METHOD

The research question driving this study is: What effect does teaching an objects-first approach (vis-à-vis teaching a structures-first approach) have on the performance of introductory programming students in understanding OO concepts and writing OO programs? The hypothesis being tested is that there is no difference in the performance of introductory programming students when provided with an objects-first or a structures-first approach to OO programming. To test this hypothesis, the authors of this study each taught one section of introductory OO programming (CIS 260) to a section of about 25 students during the Fall 2007 semester at Missouri State University (MSU). These instructors had already been scheduled to teach these sections, so it was not possible for the same instructor to teach both sections due to scheduling conflicts. To minimize the differences in course delivery, the instructors selected two different texts written by the same author (Gaddis, 2008a; Gaddis, 2008b). The only significant difference between the two texts is the ordering of the chapters, one presenting objects and classes in the early chapters while the other doing so in the later chapters. The reading material, examples, and end-of-chapter problems throughout the texts are essentially the same with the exception of the ordering of the chapters. The only significant variable in the two sections was whether OO programming concepts and techniques were delivered before basic programming structures (OF) or after basic programming structures (SF).

STUDENT BACKGROUND AND DEMOGRAPHICS

Data about the students were also collected during the first week of class to ensure that both groups (OF and SF) were similar in background and ability. Students were given a survey to determine demographic data such as gender, age, college class, major and minor areas of study, background with Java and other programming languages, background in using computers, and desire to learn computer programming. The college GPA and ACT scores were also collected for all students.

PERFORMANCE MEASURES

Three exams were administered to each section of students during the semester (Exam 1, Exam 2, and the final exam). Each exam consisted of 25 multiple-choice questions that covered

programming concepts and one programming problem. Students were asked to write a complete Java program on paper on each exam. The instructors thought it would be better to have the students write programs on paper, instead of on a computer, so that credit could be given for code that was close to correct, although points were deducted for incorrect syntax or program logic. (Incorrect syntax on the computer would result in failure to compile and perhaps lead to students ceasing to write additional code.)

While three exams were administered to both the OF and SF sections, only the first and last exams were used in this study because only these two exams were identical for both sections. Exam 1 was the same for both sections because it covered the first two chapters in both texts (basic Java programming involving variables, simple algorithms, and the sequence structure). Exam 2 was not used in this study because it covered different material for each section. During this middle segment of the courses, the OF section covered two chapters on objects and classes while the SF section was covering decisions, loops, and methods. Toward the end of the semester, the OF section was catching up on programming structures while the SF section was catching up on objects and classes. The final exam was identical for both groups, consisting of multiple choice questions on OO concepts and an OO programming problem.

Thus, each exam had a concepts section (assessed via the multiple-choice questions) and a techniques section (assessed via the programming problem). Grading the multiple-choice items was easy but much more care was required when grading the hand-written student programs. As described earlier, the instructors worked together in grading all programs by their respective students to ensure that a consistent grading method was employed. This required very frequent consultations between the instructors during the grading process.

DATA

Table 1 shows results of various demographic data for the OF and SF groups as well as the results from Exam 1 and the final exam. Where appropriate, small-sample T-tests for equivalent means were performed:

Table 1
Means and hypothesis tests for the objects-first (OF) section and the structures-first (SF) section

		Objects-first	Structures-first	t-value	H_0: $\mu_{OF} = \mu_{SF}$, α=.05
1	# Male	22	20		
2	# Female	3	4		
3	Total students	25	24		
4	Age	20.8	21.0	-0.31	FTR H_0
5	Previous GPA	3.00	2.99	0.12	FTR H_0
6	ACT score	24.1	23.7	0.26	FTR H_0
7	# Freshmen	0	1		
8	# Sophomores	10	14		
9	# Juniors	12	7		
10	# Seniors	3	2		

		Objects-first	Structures-first	t-value	H_0: $\mu_{OF} = \mu_{SF}$, α=.05
11	# CIS majors	15	13		
12	# Non-CIS majors	10	11		
13	Previous college computer courses	1.36	1.29	0.23	FTR H_0
14	I am comfortable using computers	4.13*	4.68*		
15	This course is important to my career	3.43*	3.41*		
16	Exam 1-Multiple Choice Items	83.3%	83.2%	0.04	FTR H_0
17	Exam 1-Programming Problem	90.3%	85.9%	1.18	FTR H_0
18	Final Exam-Multiple Choice Items	74.4%	66.6%	1.66	FTR H_0
19	Final Exam-Programming Problem	87.9%	79.0%	2.98	Reject H_0 $\alpha < .005$

*Used a Likert scale of 1-5 for strongly agree to strongly disagree

DISCUSSION

The data in Table 1 provide several interesting results. Demographically, items 1-15 demonstrate that the two sections of students are extremely similar. The distribution of males and females is nearly identical and the mean ages are statistically the same. Items 5-6 show that the prior abilities of the two groups are also statistically equivalent. Items 7-10 illustrate that the distribution of students by class is nearly the same for both groups while items 11-12 reveal that the distribution of CIS and non-CIS majors is nearly the same. (Statistical tests for equivalent distributions were not performed, but casual inspection largely supports these conclusions.) Items 13-15 point to the fact that both groups have similar backgrounds with computers and motivation for taking introductory Java programming.

The exam results are found in items 16-19. These are the results of the first exam and the final exam for both groups. Recall that both of these exams were identical for both groups of students. Exam 1 covered Java programming basics such as Java syntax, variables, and simple algorithms. The final exam involved object-oriented concepts and programming techniques. The multiple choice items on these exams tested for the understanding of programming concepts while the programming problem tested for knowledge of writing correct code for complete applications. The results show that both groups, OF and SF, were statistically equivalent in all areas except that of actual OO programming. The OF group averaged significantly higher on the programming segment of the final exam.

While these results could be explained by some variation in the delivery of the courses by the two different instructors, such variation was minimized by taking measures to ensure a high degree of consistency. It is much more likely that the early objects approach was instrumental in the higher scores for the OF group on the final exam. If for no other reason, the OF group was

exposed to the concepts and techniques of OO programming for several more weeks than the SF group. It could be the case that over time, the SF group could master OO programming as well as the OF group. However, within the short confines of a first course in Java programming, an OF approach could result in greater success for the student.

CONCLUSION

Learning programming is not an easy task for the novice student. Learning OO programming is an even more daunting task. This study compared the performance of two nearly identical groups of introductory programming students. One group studied objects and classes very early in the semester (the objects-first, or OF, group) while the other group studied the basic programming structures (sequence, selection, and repetition) before objects and classes (the structures-first, or SF, group). Both groups took the same first exam (covering only basic Java programming) before they diverged into either the OF or SF approaches. Then both groups took the same final exam which covered full OO development. The OF and SF groups were statistically identical in their performance on the first exam, but the OF group performed significantly better on the programming segment of the final exam. These experimental results point to the possible superiority of an objects first approach to teaching novice programming students, which may lead to higher performance levels in subsequent programming courses and enhanced career opportunities.

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FORECASTING KOREAN STOCK PRICE INDEX (KOSPI) USING BACK PROPAGATION NEURAL NETWORK MODEL, BAYESIAN CHIAO'S MODEL, AND SARIMA MODEL

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ABSTRACT

In this study, we forecast Korean Stock Price Index using historical weekly KOSPI data and three forecasting models such as back-propagation neural network model (BPNN), a Bayesian Chiao's model (BC), and a seasonal autoregressive integrated moving average model (SARIMA). KOSPI are forecasted over three different periods. (i.e., short-term, mid-term, & long-term) The performance of the forecasting models is measured by the forecast accuracy metrics such as absolute forecasting errors and square forecasting errors of each model.

The findings are as follows: first, between BPNN and BC, BPNN performs better than BC for mid term and long term forecasting, while BC performs better than BPNN for the short term forecasting. The second, between BPNN and SARIMA, SARIMA performs better than BPNN for mid term and long term forecasting, while BPNN does better than SARIMA the short term forecasting. Between SARIMA and BC, SARIMA performs better than BC for mid term and long term forecasting, while the other way around is true the short term forecasting.

In sum, the SARIMA performs best among the three models tested for mid term and long term forecasting, while BC performs best for the short term forecasting.

2. DATA AND METHODOLOGY

2.1 Index Data

The data used in this study are KOSPI for closing prices from the Korean Stock Exchange (KSE) data base. The data series span from 4th January 1999 to 29th May 2006, totaling 390 weeks (89 months) of observations.

The data are divided into two sub-periods, one for the estimation and the other for the forecasting. We use four different forecasting periods to examine the potential impact of forecasting horizons on the forecasting accuracy. Forecasting horizons used are 20% (long range), 13% and 8% (mid range), and 6% (short range) of the total number of observations. For the long range forecasting, the first 313 weekly data are used for model identification and

estimation, while the remaining 77 weekly data (about 20% of 390 weeks) are reserved for evaluating the performance of SARIMA, BC, and the neural network model. Other forecasting periods were defined in the similar way, resulting in mid range (31-50 weeks ahead) and short range (23 weeks ahead) forecasting horizons.

2.2 Neural Network Forecasting

In this study, the back-propagation neural network model (BPNN) is used for time series forecasting. The main reasons for adopting BPNN are twofold. First, BPNN is one of the most popular neural network models in forecasting. Second, BPNN is an efficient way to calculate the partial derivatives of the networks error function with respect to the weights and hence to develop a network model that minimizes the discrepancy between real data and the output of the network model. BPNN can be trained using the historical data of a time series in order to capture the non-linear characteristics of the specific time series.

According to the principle of Ockham's razor, the simplest networks topology yielding satisfactory results is used. The networks are created as '2-1-1': that is, two input layers, one hidden layer, and one output layer. The network is also trained using various other topologies such as 2-X-1, while X = 2, 3, 4, and 5. However, the best results are obtained when there is one hidden layer (i.e., X=1).

2.3 Bayesian Chiao Forecasting

With respect to the sequence of the logistic data having two possible results (i.e. pass, which means "$X_{m-1} < X_m$"; or failure, which means "$X_{m-1} > X_m$), the trends of the central tendency and deviation can be sequentially adjusted. From BC, the posterior distribution X_{m+1} can be calculated.

2.4 Time-series Forecasting

To obtain the KOSPI forecasts from the SARIMA, we adopted the Box and Jenkins' method. Basically, Box and Jenkins' method uses the following three-stage approach to select an appropriate model for the purpose of estimating and forecasting a time-series data.

Identification: we used the SARIMA procedure in SAS statistical software to determine plausible models. The SARIMA procedure uses standard diagnostics such as plots of the series, autocorrelation function (ACF), inverse autocorrelation function, and partial autocorrelation function (PACF).

Estimation: Each of the tentative models is fit and the various coefficient estimates are examined. The estimated models are compared using standard criteria such as Akaike Information Criteria and the significance level of coefficients.

Diagnostic checking: SARIMA procedure is used to check if the residuals from the different models are white noise. The procedure uses diagnostics tests such as ACF, PACF, and Ljung-Box Q-statistics for serial correlation.

Applying these steps, SARIMA (110)(12) for the KOSPI price series, and SARIMA(011)(12) for the KOSPI return series are selected as forecasting models for both weekly and monthly data.

3. RESULTS

Descriptive statistics of forecast errors (FE) from BPNN, BC, and SARIMA using weekly KOSPI price data are presented in Table 1. Those statistics of FE for four different forecasting horizons such as 77 weeks ahead (long), 50 weeks ahead (upper middle), 31 weeks ahead (lower middle), and 23 weeks ahead (short) are presented in Table 1. Mean, standard deviation, minimum, and maximum of FE for four different forecasting horizons are also presented in Table 1. The SARIMA provides smallest mean FE for forecasting horizons of 31 weeks ahead or longer, while BC provides the smallest MFE and SFE.

This may indicate that the, among the three models, SARIMA is the most effective in mid-term and long-term forecasting while BC is the best in short-term forecasting, which is consistent with the findings of Wang et. al. and our prediction.

The mean forecast errors from the above-mentioned three forecasting models, Kruskal-Wallis χ^2 statistics, and the corresponding p-values are presented in Panel A of Table 2. Kruskal-Wallis χ^2 statistics of all four forecasting horizons are statistically significant at 0.001 significance level, indicating that, overall, forecasting errors from the three models are significantly different each other.

Results from pair wise comparisons between BPNN and BC, between BPNN and SARIMA, and between BC and SARIMA are presented in Panel B of Table 2.

Comparisons between BPNN and SARIMA show that SRIMA produce smaller forecasting errors than BPNN for mid-term and long-term forecasting horizons (i.e., 31 weeks, 50 weeks, & 77 weeks), while BPNN produce smaller forecasting errors than SARIMA for short-term forecasting horizon (i.e., 23 weeks). All differences in forecasting errors between BPNN and SARIMA are statistically significant at the significance level of 0.01. This indicates that SARIMA performs better than BPNN in mid-term and long-term forecasting while BPNN performs better than SARIMA in short-term forecasting.

Comparisons between BPNN and BC show that BPNN produce smaller forecasting errors than BC for 77 weeks and 50 weeks forecasting horizons. And the differences in forecasting errors between the two methods are statistically significant at the significance level of 0.01. This indicates that BPNN produce more accurate forecasts than BC for these relatively longer-term forecasting. On the other hand, BC produce smaller forecasting errors than BPNN for 31 weeks and 23 weeks forecasting horizons but the differences in forecasting errors between the two models are statistically significant only for 31 weeks forecasting horizon at the significance level of 0.05. This may indicate that BC performs better than BPNN in 31 weeks

ahead forecasting but no meaningful conclusion can be drawn for the 23 weeks ahead forecasting.

Comparisons between BC and SARIMA show that SRIMA produce smaller forecasting errors than BC for mid-term and long-term forecasting horizons (i.e., 31 weeks, 50 weeks, & 77 weeks), while BC produce smaller forecasting errors than SARIMA for short-term forecasting horizon (i.e., 23 weeks). All differences in forecasting errors between BC and SARIMA are statistically significant at the significance level of 0.01. This indicates that SARIMA performs better than BC in mid-term and long-term forecasting while BC performs better than SARIMA in short-term forecasting.

In sum, regarding weekly forecasting, SARIMA is the best forecasting model for mid-term and long-term forecasting, while BC is the best forecasting model for short-term forecasting.

4. CONCLUSIONS

The purpose of this study is to compare the forecasting performance of back-propagation neural network model (BPNN), a BC (BC), and a seasonal autoregressive integrated moving average model (SARIMA) in forecasting Korean Stock Price Index. Forecasting performance is measured by the forecast accuracy metrics such as absolute forecasting errors and square forecasting errors of each model.

KOSPI data over the 390 week (89 month) period extending from January 1999 to May 2006 are analyzed. We find the followings: regarding weekly forecasting of KOSPI, the SARIMA provides most accurate forecasts among the three models tested for mid term and long term forecasting, while BC provides the most accurate forecasts for the short term forecasting. Between BPNN and BC, BPNN provides more accurate forecasts than BC for mid term and long term forecasting, while insignificant difference in forecasting errors exists between the two models for the short term forecasting.

These results are robust across different measures of forecast accuracy. Since the accuracy of forecasting values is dependent on the developing process of forecasting models, the results of this study may also be sensitive to the developing process of the BPNN, BC, and SARIMA.

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UNDERSTANDING THE LACK OF MINORITY REPRESENTATION IN GRADUATE PROGRAMS IN COMPUTER SCIENCE AND INFORMATION TECHNOLOGY: A FOCUS GROUP STUDY OF STUDENT PERCEPTIONS

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ABSTRACT

This paper is an effort to delineate factors impacting lack of representation of minority students at the graduate level education in information technology fields: computer science and computer information systems. The research was conducted in three Virginia institutions Hampton University (HU), Norfolk State University (NSU), and Virginia State University (VSU). The paper examined basic factors impeding interest of undergraduate computer science and information technology students in graduate education. Based on our findings a few strategies are suggested which could possibly lead to higher interest, hence, better recruitment and retention of minority students in graduate programs in these fields.

The research shows that students' lack of interest in graduate education was due to four basic factors. These factors were 1: lack of information about graduate school and admission process to the graduate programs, 2: perceived value of graduate education, 3: financial considerations and 4: perceived educational preparedness. It was also found that undergraduate school supervisors (teachers, advisors, and administrators), family and friends have a direct impact on the students' intention and interest in graduate education. Furthermore, students' interest level decreases as they move from underclassman status to upperclassman status. Based on these findings, a few basic recruitment strategies are proposed.

INTRODUCTION AND LITERATURE REVIEW

There is a growing concern over the under representation of women and minorities in the natural sciences and engineering including computer science. There is a large body of research material which documents this fact. The focus of this research was to look beyond undergraduate education and to investigate on the lack of representation of minorities in graduate and post graduate education in the field of computer science/information technology. Some of the relevant research is included here in the following section.

Grandy (1994) conducted a study among the college seniors who registered to take the Graduate Record Examination (GRE) and who were majoring in natural sciences, mathematics,

computer sciences, and engineering (NSME.) A stratified sample of 1,651 such college students was collected. The goals of the survey were to identify some of the factors that may lead NSME majors to change fields for graduate school, analyze differences among ethnic groups remaining in NSME, and analyze differences between male and female NSME majors who plan to remain in NSME. The research mainly focused on the gender and ethnic differences in NSME majors planning graduate study in their fields. Results showed that the decision to leave NSME was uncorrelated with gender, race, or GRE scores. Detailed analysis of gender and ethnic differences among NSME majors planning to continue in their fields showed small to moderate differences on many dimensions. There were gender and ethnic differences in salary expectations, importance on making a contribution to society, and preferences for various job activities.

The under representation of women and minorities in information technology (IT) professions is also well documented (National Science Foundation [NSF], 2000). In fact, recent statistics show that the IT workforce is comprised of less than 30 percent female and less than five percent minority professionals (Council of Higher Education Accreditation [CHEA], 2000). The Computing Research Association survey on graduate students shows that, between 1993-2003, African American enrollment in Ph.D. programs in computer science/computer engineering remains 1% or 2% of total Ph.D. enrollment in these majors (Vegso, 2005). Several recent research studies have been done to determine the reasons why such an employment gap exists despite the relatively high demand and attractive salaries for IT workers (Houston-Brown, 2002; Baylor, 2003), and many more studies have documented the underlying reasons for a similar gap that exists in science, math, and engineering professions in general (Landis, 1985; Cohoon, 1999; Thom, Pickering, & Thompson, 2002; and Armstrong & Thompson, 2003). In a recent publication, Cohoon, & Aspray (2006) reviewed the existing literature for the causes of the gender gap in the information technology field and possible strategies to rectify this problem. These studies point to the well documented "digital divide," which limits minorities' access to computing technology; inadequate K-12 preparation, especially in math and science; and a critical lack of counseling and mentoring as key reasons for lack of recruitment and retention of minority students in IT majors.

Gates, Teller, Bernat & Cabrera (1999) studied the affinity research group model which provides students with opportunities to learn, use, and integrate the knowledge and skills that are required for research with the knowledge and skills that are required for cooperative work. Membership in affinity groups is dynamic, i.e., members graduate and new members join, and students come to the groups with different levels of knowledge and skills. Because of this, an annual orientation is needed for new members to facilitate their understanding of the philosophy and goals of the affinity model, understanding of the research goals of the projects to which they are assigned, learning of the basis of the cooperative paradigm, and awareness of group expectations. More importantly, the orientation develops new members' basic understanding of the research process and provides information about available resources. The orientation is also important for established members. It provides them with an opportunity to renew their commitment to the group, improve their research and cooperative group skills, and processes within the group with the goal of improving the group's effectiveness. The orientation also allows faculty mentors to become aware of members' misgivings and expectations of the affinity

group experience. It also provides a chance to the faculty member to reevaluate the goal of the model and its success.

Eide & Waehrer (1998) examined the expectations of attendance in a graduate program and its payoffs affect in the selecting the undergraduate major. Results explain why some students choose to major in fields associated with poor job prospects for undergraduate degree holders. The option to attend graduate school is not a significant factor in choosing to major in computer science/engineering. Women are significantly less likely to select majors associated with higher future wages. The research effort is generally concentrated on undergraduate college education, hence, focus is recruitment and retention of K-12 students to science and technology related majors in college.

In addition, a number of research studies have identified "best practices" in programs that seek to address these gaps. Model programs at institutions as diverse as the California State University, Northridge (Landis, 1985), Case Western Reserve University (Boulding, 1985), Texas A&M (Graham, Caso, Rierson & Lee, 2002), Arizona State University (Fletcher, Newell, Anderson-Rowland, & Newton, 2001), the University of Maryland (Armstrong & Thompson, 2003), and the Oklahoma Alliance for Minority Participation in Science, Mathematics, Engineering, Technology and Education (Mitchell, 1997), as well as an ongoing studies at several institutions in different programs that are successful at recruiting and retaining women, have incorporated a number of strategies: summer bridge programs; academic enrichment activities; tutorial services; ongoing peer, faculty, and professional counseling and/or mentoring; and cooperative and internship experiences both on and off campus. However, while all of these studies offer valuable insights into the underlying reasons and possible solutions to the lack of minorities in the IT workforce, few of these programs specifically target African-American students, and most are broadly focused on science, math, engineering, and technology majors. There are also efforts made to educate teachers and councilors about causes of lack of representation of minorities and women technology related fields (Nicholson, Hancock, & Dahlberg, 2007.) This research focuses on altering teachers' and counselors' perspectives that could bring change in the attitude of minority and woman students towards technology related fields.

RESEARCH MOTIVATION

All of the above studies are pointing to one fact that there is a shortfall of minority students in the field of science and technology including computer science. This shortfall increases substantially as one starts to look beyond the undergraduate level to the masters and doctoral levels. It is, therefore, imperative to understand the underlying factors that impede the progress towards graduate education among minority students in the field of the computer science/information technology. Furthermore, it is important to identify some strategies that encourage minority students to pursue graduate education in these fields.

This study as is an attempt to understand the factors which hinder students from pursuing graduate and post graduate education in computer science related fields. Also an attempt is made to provide some possible paths to design strategies to reduce this shortfall. The study was conducted in the three Historically Black College and Universities (HBCUs) in Virginia that

offer an undergraduate computer science program. The institutions involved were Hampton University (HU), Norfolk State University (NSU) and Virginia State University (VSU.)

DATA COLLECTION

Two different methods were used to collect the data. This study utilized focus groups in the first phase of data collection and a written survey in the second phase of data collection. In the first phase, two focus groups were conducted in each institution involved with the project in the fall and spring semesters of 2004-2005 academic year. It was not possible for logistical reasons to invite a random group of students for 30-40 minutes of discussion on graduate education. Focus groups consisted of junior or senior level classes in which 25-35 minutes of class time was devoted to an open ended discussion of graduate education: its need, its value, their perceptions, etc. The role of the faculty member was limited to ask a probing question, whenever, there was a general pause in the discussion. No audio or video recording was made. The faculty member took notes about the discussion. Total of six informal focus groups were conducted in three institutions. The participation in the focus group was voluntary, students were told the purpose of the research and were given the option to opt out of the discussion if they so desired. The results of these focus groups were summarized to identify the underlying themes.

A written survey was conducted in the second phase of data collection. The survey instrument was developed based on available research and the experience gathered from the focus groups. The main objective of the survey instrument was to determine the influence of family members, friends, teachers, mentors and student's background on their interest and intention to attend graduate school. The survey was administered using clustered sampling technique in all three participating institutions in the Spring 2005 semester. That is, the survey was administered among randomly selected junior and sophomore classes. As with the focus group, students were given the option not to participate if they so desired.

RESULTS AND ANALYSIS

Patterns within the focus group results were identified after tabulation of all major points from the three participating institutions. The results of the focus group indicated four major themes for lack of representation and interest among students in the graduate education in computer science /information systems. These major themes were, graduate school admission process and awareness, job and financial issues, perceived value attached to graduate education, and perceived level of preparedness.

At the next step survey analysis was performed. A total of 153 surveys were collected. 18 surveys were excluded from the analysis as nothing was filled on those surveys other then the college name and other demographic information. The statistical analysis was done using SPSS 12.0.1. Most of the survey participants (68%) were junior level students. There was no significant difference in the sample composition according to classification of the students from three institutions. Over 90% of the sample respondents were between 20-24 years old. The majority of students were from urban areas (58%) and there was no significant difference based

on urban-rural mix among three schools under study. Gender distribution (approximately 50% male and 50% female) was very homogenous. 38% of students reported their GPAs between 2.51-3.50; approximately 28% reported GPAs below 2.50 and 29% reported above 3.51 GPA. GPA distribution among the participating schools was very similar as well, however, VSU's students reported slightly lower overall GPAs.

This indicated that samples from the three different schools under considerations were very similar according to age, gender, urban background and GPA. Hence, it can be assumed that overall sample was homogenous for statistical purposes.

Earlier focus group gave us some indications that students showed a lack of confidence in their preparation for graduate school. To further investigate this, we added four questions in the survey about their interest and understanding of the mathematics and pure sciences and their relationship with computer science and related fields. Approximately 55% of students responding saw no relevance of mathematics courses with computer science courses. 90% of the responding students saw no relevance between pure sciences and computer science/information technology courses. This was very high proportion of students who saw foundation courses (mathematics and physical sciences) for computer sciences being irrelevant to the curriculum. Although it is also clear from this fact that mathematics and physical sciences were not contributing to their perceived lack of preparedness. It needs further investigation to better understand the causal relationship as to why student feel they are not well prepared for the graduate level education with various curriculum components.

To establish relationship between attitudes of different group members with students' interest in computer science/information technology graduate education, Pearson's bivariate correlation coefficients were calculated. Every peer group (siblings and friends) and every superior group (parents, and school officials) have statistically significant relationships with the students' interest in the computer science/information technology graduate education, except the college-graduate siblings. The result in the college graduate sibling subgroup may be influenced by the small sample size of that group (18% of surveyed students indicated having a college graduate sibling.) Detailed results are included in the full paper.

CONCLUSIONS AND FUTURE RECOMMENDATIONS

Based on the results of the focus group and survey, several factors were identified that influence students to consider or not consider graduate education in computer science/information technology. These factors include both positive and negative factors. The positive factors include attitude of college superiors (teachers, advisors, and administrators), peer groups and family, especially father. The negative factors include a strong job market and highly compensated jobs in computer science/information technology, lack of information about graduate schools including the process of application, lack of perceived preparedness and poor market value (perceived or real) of graduate education. It was also found that factors like grade point average, age, gender, urban background, interest in mathematics or science do not have strong relationship with graduate education plans. Furthermore, the interest in graduate education drops significantly from sophomore level to junior level. Data showed significant drop at senior level as well but sample size was too small to confirm it.

It is evident from the data analysis that graduate education in computer science /information technology currently faces stiff competition from a strong job market in the IT sector. However, there are strong indications for possible steps which can be taken to increase students' interest in graduate education. We can make several recommendations. These recommendations include that schools should provide more information on graduate schools and admission process, organize frequent information sessions for family and if possible, simplify the graduate admission process. The graduate schools should facilitate aggressive mentoring programs through teachers, advisors, and administrators. These mentoring programs should start early like sophomore year. The schools should increase interaction with "peer-group" role models to alleviate the fear about preparedness and to enhance confidence level. It is important that students learn about graduates from their own schools or areas succeeding in graduate school to put to rest.

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USING PORTAL WEB SITES IN THE PURCHASING FUNCTION

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ABSTRACT

This paper outlines the use of Web portal sites by businesses in their online purchasing operations. It includes some definitions and a structured classification of the types of online portals currently used in purchasing activities.

INTRODUCTION

One of the earliest uses of the Internet by businesses in business-to-business electronic commerce was to establish information hubs for each major industry. These industry hubs would offer news, research reports, analyses of trends, and in-depth reports on companies in the industry. These hubs were designed to serve the same purpose as and provide much the same type of information resources as industry trade magazines had provided in print format for years (Brook, 1998).

In addition to information, these hubs would offer marketplaces in which companies in the industry could contact each other and transact business. Because these hubs would offer a doorway (or portal) to the Internet for industry members, and because these hubs would be vertically integrated (that is, each hub would offer services to just one industry), these planned enterprises were called vertical portals, or vortals. This article presents an outline of how business-to-business (B2B) portals are operated today.

TYPES OF PURCHASING PORTALS

The emergence of industry online marketplace hubs in the mid-1990s gave way to the development of several different models for purchasing portals, including independent industry marketplaces, private company operated marketplaces, industry consortia-sponsored marketplaces, customer portals, and private stores (Raisch, 2001).

The first companies to launch industry hubs created trading exchanges that were focused on a particular industry (Roberts-Witt, 2001; Stundza, 1999). These portals are also known collectively as independent industry marketplaces. Ventro opened its first industry marketplace, Chemdex, in early 1997 to trade in bulk chemicals. To leverage the high investment it had made in trading exchange technology, Ventro followed Chemdex with other Web marketplaces, including Promedix in specialty medical supplies, Amphire Solutions in food service, MarketMile in general business products and services, and a number of others. SciQuest founded an industry marketplace in life science chemicals (Taylor and Terhune, 2001).

By mid-2000, there were more than 2200 independent exchanges in a wide variety of industries (McAfee, 2000); there were 200 exchanges operating in the metals industry alone. Virtually none of these marketplaces were earning profits, so many of them were unable to obtain continued funding for their development and many of them closed (Clark, 2001; *Purchasing*, 2001). By 2002, there were fewer than 100 industry marketplaces still operating (Schneider, 2006). Some of the industry pioneers who closed their industry marketplace operations, such as Ventro, began selling the software and technology that they developed to run their marketplaces. Their new customers were operators of other B2B marketplace models that arose to take business away from the independent marketplaces.

Some companies do still operate independent industry portals with some success. For example, ChemConnect runs a commodity exchange that offers trading in natural gas liquids, aromatics, oxygenates, olefins, and polymers. Other companies that developed software and specific industry knowledge creating these portals found that they could be more profitable if they sold the software they had developed to the industries they had served. Companies such as SciQuest now sell a range of software and procurement management products to the industries in which they had operated independent industry portals.

Established companies became concerned that independent operators of hubs would take control of transactions in their supply chains. This control was something that the established companies had spent large amounts of money and many years developing (Jap and Mohr, 2002). Large companies that buy from many relatively small vendors can exert great power in negotiating price, quality, and delivery terms with those vendors. These sellers feared that industry marketplaces would dilute that power (Osmonbekov, Bello, and Gilliland, 2002).

These companies can invest in procurement software from companies such as Ariba that allows a company to manage its purchasing function through a Web interface. Recent procurement software has begun to include other marketplace functions, such as request for quote posting areas, auctions, and integrated support for purchasing direct materials (Cronin, 2001).

Companies that implement a private company portal usually require suppliers to bid on their business. When industry marketplaces opened for business, larger companies were reluctant to abandon their investments in e-procurement software or to make the software work with industry marketplaces' software. These companies use their power in the supply chain to force suppliers to deal with them on their own terms rather than negotiate with suppliers in an industry marketplace.

As marketplace software became more reliable, many of these companies purchased software and technology consulting services from companies, such as Ventro and SciQuest, that had abandoned their industry marketplace businesses and were offering the software they had developed to companies that wanted to develop their own private marketplaces. United Technologies was one of the first major companies to open a private company marketplace, launching its site in 1996. In its first four years of operation, United Technologies purchased more than $10 billion in goods through its private marketplace at an estimated savings of $2 billion through lower prices and transaction cost savings (Grzanka, 2000).

Some companies have relatively strong negotiating positions in their industry supply chains, but do not have enough power to force suppliers to deal with them through a private

company portal (Jap and Mohr, 2002; Raisch, 2001). These companies began to form consortia to sponsor portals. An industry consortia-sponsored portal is a portal formed by several large buyers in a particular industry. One of the first such marketplaces was Covisint, which was created in 2000 by a consortium of DaimlerChrysler, Ford, and General Motors (Kerwin, Stepanek, and Welch, 2000; Moozakis and Joachim, 2001). Other industry consortia-sponsored marketplaces followed. In the consumer packaged goods industry, Procter & Gamble joined with Sara Lee, Coca Cola, and several other companies to launch the Transora marketplace (Schneider, 2006).

In many cases, these consortia-based marketplace portals have replaced the independent industry marketplaces that appeared to be so promising early on. One concern that suppliers have when using an industry marketplace is its ownership structure. In some cases, such as in the aerospace industry, the consortia-sponsored portal provided valuable services that kept it beneficial to all parties. Exostar (in the aerospace industry) helps designers collaborate on the engineering of new airplanes and component parts (Teschler, 2000).

Large companies that sell to many relatively small customers can exert great power in negotiating price, quality, and delivery terms with those customers. These sellers feared that industry marketplaces would dilute that power. This power structure is the opposite of the structure that exists in industries where private company marketplaces have arisen (that is, industries in which large buyers purchase from many relatively small vendors).

Many of these large sellers had already invested heavily in Web sites that they believed would meet the needs of their customers better than any industry marketplace could. For example, Cisco and Dell each offer private stores for their major customers within their selling Web sites (Dearstyne, 2001). Other companies, such as Grainger, provide additional services for customers on their selling Web sites.

The software used by companies to establish private stores and customer portals is often called customer relationship management software rather than procurement management or supply chain management software because it focuses on the needs, interests, and buying patterns of the customers who visit the portal.

SUMMARY AND CONCLUSIONS

Independently operated industry marketplace portals tend to arise in industries where there are many buyers and many sellers and these buyers and sellers have approximately equal power in the supply chain. Private company marketplace portals arise in industries where the buyers have the greatest power in the supply chain. In industries where buyers have considerable, but not overwhelming power, the emergence of industry consortia-sponsored portals is likely. Private stores and customer portals arise in industries where supply chain power is centered in sellers. It is not clear which of these models will dominate B2B electronic commerce in the future; however, industry consortia-sponsored marketplaces appear to be the most successful at this point. These provide a balance not offered by the private company marketplace, yet reassure participants who worry about independent control of the marketplace by entities outside the industry supply chain.

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PROVIDING EFFECTIVE IT SUPPORT: EVIDENCE FROM TWO FIRMS

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ABSTRACT

Information Technology organizations are challenged with supporting large, distributed networks of hardware, software, and applications. To better understand how to effectively provide IT support, two different firms that were successfully providing support for such complex environments were studied. The two case studies made it apparent that dynamic and flexible IT leadership coupled with team cohesion contributed to the firms' abilities to provide effective IT support in a distributed diverse cultural environment.

FUNCTIONAL REQUIREMENTS: THE REFERENCE MONITOR AND USE CASE

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ABSTRACT

Information assurance, data security, and corresponding issues are traditionally presented in Systems Analysis and Design textbooks as non-functional requirements. Systems analysts can enforce secure design and code as one of the essential goals of systems analysis and design by using the Reference Monitor concept as a means of requirements and design specification. The application of the Reference Monitor during the early stages of systems requirements specification via the Use Case emphasizes (reveals) that information assurance is a critical functional requirement.