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Teach or No Teach: Is Large System Education Resurging?

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ABSTRACT

Legacy or not, mainframe education is being taught at many U. S. universities. Some computer science programs have always had some large system content but there does appear to be resurgence of mainframe related content in business programs such as Management Information Systems (MIS) and Computer Information Systems (CIS). Many companies such as financial institutions have relied on large systems for years. Other companies are turning to mainframe computing as a reliable and economic efficient way of meeting their everyday needs. Additionally, in an ever increasing environmentally conscious environment, "green" solution of computing are sought. In this paper, we sought the opinions of academic members of IBM's Academic Initiative program and the Enterprise Computing Community (ECC) to ascertain the decisions to address large systems content and the future of mainframe education.

Keywords: mainframe education, curriculum

1. INTRODUCTION

Technology and Information Systems curriculum decisions are always challenging as new technologies emerge and older technologies change or no longer provide competitive advantage. In training IS/IT professionals, universities must continually assess what they teach. Graduates must enter the workforce with tangible skills that will add value to an organization from day one. Organizations are less likely to hire based on potential with the intent to provide on the job training for the specific skills needed. Therefore, educators must be vigilant of market demand for IS/IT workers.

Large systems, particularly the term "mainframes" are often thought of as legacy but mainframe computing continues to be the solution for many organizations (Greenemeier, 2002; Lohr, 2008). "Mainframe computers are more reliable, cost effective and in the long run easier to maintain (Murphy, Sharma, Seay, & McClelland, 2010)." Additionally, they offer better solutions in an environmentally conscience community.

Many large systems specialists are reaching or have reached retirement age. If mainframe computing solutions continue to grow and the trained specialists leave the workforce, it stands

to reason that a need for newly trained specialists will increase. So is this claim real and are academics slow to react or is the current interest in mainframe computing short-lived? In this paper, we seek the opinions of the members of IBM's Academic Initiative in an attempt to determine the future of mainframe education.

2. MAINFRAME AND ACADEMICS

Many current mainframe workers were trained in the 60's and 70's and are reaching or have reached retirement. These retirements and increasing interest by companies in large systems solutions will require newly trained mainframe specialists. Many of the current IS/IT graduates do not possess the necessary skills and training to secure even an entry level position in an organization that relies heavily on mainframe computing. The failure to educate students in mainframe technology is leading to a shortage of trained workers (Burt, 2008).

A review of model curriculums in IS, End User Computing and Computing (Brookshire, Hunt, Yin, & Crews, 2007; Computing Curricula 2005, 2005; IS 2009 Model Curricula, 2009) identify the need for courses in operating systems and hardware/software in general but the course descriptions do not recognize mainframe systems. Enterprise system courses are suggested but the descriptions do not specifically recognize that for large organizations these systems are often implemented on a mainframe computer.

The belief that the mainframe is a legacy system translates to little or no interest among current students to seek large systems training. Adding to that notion is the fact that mainframes are largely invisible and implemented behind the scenes as opposed to personal computers that everyone owns. Many people, including students, do not realize that they are using mainframe computing on a daily basis through the use of ATM's for banking transactions or utilities such as their cellular phone. Large systems are viable, powerful and an environmentally friendly computing solution for many industries.

Cloud computing is becoming more available not only on college campuses and universities but organizations such as Google, Apple, Amazon and AT&T are building large computer platforms. The mainframe is a reliable implementation strategy for much of the virtualization world (Murphy & McClelland, 2009).

3. ACADEMIC RESPONSE
IBM Academic Initiative Program

"IBM Academic Initiative is a global program that facilitates the collaboration between IBM and educators to teach students the information technology skills they need to be competitive and keep pace with changes in the workplace ("IBM Academic Initiative Program," 2010)."

Members have access to a variety of hardware and software without cost. Additionally, the program offers professional course content, training, tools and books.

Enterprise Computing Community (ECC)

The ECC was formed as a result of a "National Science Foundation grant received by Marist College and 8 academic partners and 9 industry partners in September 2008. The primary mission is to improve undergraduate education in large systems and graduate a new generation of talent that will provide industries with the ability to secure, sustain, and grow their operations. Filling the skills shortage will stabilize a vulnerable technology environment before the problem reaches crisis proportions ("Marist College," 2008)."

We surveyed 85 members of this community to ascertain their opinions on mainframe education. A copy of the survey is on Table 1 of the Appendix.

Survey Data collection

In order to ascertain the direction of mainframe education in traditional academic setting, we conducted an online survey of 85 members of the academic community from 81 distinct schools.

Of the 81 distinct schools and colleges that were contacted, 20 responses were received with a response rate of approximately 25%. This percentage is a representative sample that is sufficient to capture the key dynamics and highlight current trends in mainframe education. The survey respondents are coded using letters A through T to represent the 20 responding schools.

As is consistent with most exploratory qualitative studies most of the questions on the survey are open ended. The data was analyzed by coding the survey responses and identifying underlying themes and trends in current mainframe education by the authors.

Survey Results and Findings

Key findings of the survey are presented in Tables 2, 3 and 4 of the appendix. Table 2 highlights the current and future trends in teaching mainframe content. Table 3 provides insight into the proposed expansion of the current mainframe curriculum, perceived student interest in mainframe courses and industry demand for mainframe programs. Table 4 presents a summary of the quotes from the respondents on the future of mainframe education at their school.

Fifty five percent of the responding schools are currently teaching mainframe content and will continue to do so in the future too. This suggests that there is a market for their students in which mainframe skills are in demand. Such schools are also able to generate student interest as students perceive mainframe courses to be stepping stones to a future job.

Seven of the eleven schools in our sample that currently teach mainframe related courses plan to expand their current curriculum and add new content. The respondent from school K shares the underlying reason for their inclusion of Mainframe related content "We have plans to continue with our 2 COBOL classes. They are a major incentive for three Fortune 100 companies to target our graduates as well as include many students in their formal internship programs".

Two schools (C and E) currently offer mainframe related content but do not wish to do so in the future. The primary reason for the discontinuity is that their students are not hired by companies needing mainframe skills. Two schools (F and Q) do not currently offer mainframe related content but plan to do so in the future. However, they expressed concern in their ability to generate student interest.

Five schools that responded to our survey do not presently teach mainframe content and do not intend to do so in the future. Of these five schools, two schools (A and R) consider mainframe a niche market of which they do not consider themselves a part of. Three schools (D, L and S) perceive high demand and need for mainframe skills but cite lack of student interest as the reason for not having a mainframe related course offering.

The survey results indicate that 70% of our respondents feel that the current large systems training and skills imparted to undergraduates are insufficient compared to the demand for such skills in the industry. As one of the respondents mentioned, "There is a large demand for students that understand large systems and enterprise level technologies. We see many companies looking for students that can understand large complex problems. Having students only work on small computers and small problems does not adequately prepare the students for the issues that most organizations are facing. There will be an increase demand for students that can view problems from a large system perspective." Another respondent indicated the lack of student interest and a widening gap between supply and demand for such skills. "Its (sic) a dying art with little interest by students. Too bad because it is a needed skill." The quotes from the respondents are summarized in Table 4 in the Appendix.

Programs of Study

Regardless of whether mainframe education is resurging, a niche market or insignificant, some universities have felt the need to create and/or expand their programs.

The Information Systems Department in the School of Business at the University of Arkansas has an Enterprise System program. The success of this program is evident by the student enrollment from 5 to 50 students (Douglas & Davis, 2009). A significant element of the program's success is its focus on bridging the learning styles of baby boomers and Gen-Y students through the introduction of Rational Developer for System z and Linux Web Development into their courses.

The School of Computer Science and Mathematics at Marist College offer programs in Computer Science, Information Systems and Information Technology. The school is extensively involved in increasing undergraduate education in large systems.

For universities who want to gradually add large systems content joining the IBM Academic Initiative can be quite beneficial. Members can invite experts to teach classes, guest lecture and/or lead class discussions on large systems. Additionally, schools could introducing large systems topics into other courses such as Operating Systems and Hardware/Architecture (Corridori, 2009).

North Carolina Central University

North Carolina Central University (NCCU) is primarily a liberal arts school with approximately 8,300 students. The Computer Information Systems (CIS) discipline in the school of

business began investigating the introduction of mainframes to the students in 2005. An introduction to mainframe course was first offered in 2006 and every semester through 2009 as a Special Topics elective. The introduction of this course led to numerous internships and placements.

Based on an intensive curriculum review in 2008 and 2009 that included review of our market and opinions of our advisory board, large systems became a required CIS course and two other courses were added to the curriculum as electives.

Placements and Internships: The Business School at NCCU has approximately 100 CIS majors and graduates approximately 20 per year. Four graduates were placed in mainframe positions in 2007, 5 in 2008, 5 in 2009 and 7 in 2010. The average salary was $60K and many had an additional $5K sign on bonus. Additionally, 7 students in 2009 and 4 in 2010 received mainframe summer internships paying $26 per hour.

Who is hiring: For an IS program of our size, we have had a significant number of placements in mainframe positions. Many of our placements are in the banking industry, however recent graduates have also been placed in both the insurance sector and among independent software vendors (ISVs, or companies that develop software to support and/or run on mainframes). A major ISV has shared with us that they plan to hire 1,000 mainframe professionals over the next 10 years.**CONCLUSIONS**

A primary goal of an IS/IT program is to provide students with the opportunity to obtain jobs. Therefore, every school must be aware of the target market for their students. Research clearly indicates that the need for mainframe specialists is increasing. This fact is readily seen by many respondents. Even those schools which do not currently offer mainframe related courses at least recognize that organizations are seeking students with exposure to large systems.

None of the responding schools including those that have active mainframe related programs were able to provide information on the number of graduates who were placed in mainframe shops. A better tracking of placements is needed to ascertain who are getting jobs and where.

Some of the schools that do perceive demand from the industry but find low student interest for mainframe related courses may benefit by tracking mainframe related placements and by making a stronger case for mainframe skills to students. In many cases the students may be unfamiliar with the technology or may perceive it as being distant or legacy. However, an example of their continued relevance combined with information on potential job opportunities may significantly increase student interest.

In this paper, we investigate the academic response to the need for large systems specialists. Our survey targeted a section of the academic community that presumably had an interest in large systems as indicated by membership in the IBM Academic Initiative and/or the ECC. Regardless, at least in this survey, there is a trend to increase large system content in the curriculum.

In future research, we plan to expand our survey to a wider group of academics. At least some in the academic community see mainframe education as a very small niche market at best. Perhaps the issue is not the market of mainframe specialists but in the educators as noted by respondent D ("need to educate the educator"). The only way to truly answer this question is to track the job trend.

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Editor's Note:

This paper was selected for inclusion in the journal as an ISECON 2010 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2010.

Appendix

Table 1: Large Computer Systems Survey

Large Computer Systems

What undergraduate programs do you offer in your department/area? Check as many as apply.
Computer Information Systems   Management Information Systems   Computer Science   Information Technology/Systems   Other

If other, please describe.

How many mainframe related courses do you offer in your department/area? Enter number of courses (0, 1, 2, 3...).

List the names of all of your courses that you offer which have mainframe content.

If you currently do not offer courses with large system content, do you intend to in the future? Please explain.

How many students in all programs offered by your department/area graduated in 2009? If you do not know this information, please check "I don't know."
I don't know

Enter number (0, 1, 2, 3...) of 2009 graduates for all programs (approximation is ok)

How many of your total graduates for all programs in your department/area in 2009 were placed? If you do not know this information, please check "I don't know."
I don't know

Enter number (0, 1, 2, 3...) of 2009 graduates for all programs placed in a position (approximation is ok)

How many of your total 2009 graduate placements for all programs in your department/area received jobs related to large systems or in a mainframe shop? If you do not know this information, please check "I don't know."
I don't know

Enter the number (0, 1, 2, 3...) of 2009 graduate placements for all programs that are working in large system related jobs (approximation is ok).

How many students in all programs offered by your department/area graduated in 2010? If you do not know this information, please check "I don't know."
I don't know

Enter number (0, 1, 2, 3...) of 2010 graduates for all programs (approximation is ok)

How many of your total graduates for all programs in your department/area in 2010 were placed? If you do not know this information, please check "I don't know."
I don't know

Enter number (0, 1, 2, 3...) of 2010 graduates for all programs placed in a position (approximation is ok)

How many of your total 2010 graduate placements for all programs in your department/area received jobs related to large systems or in a mainframe shop? If you do not know this information, please check "I don't know."
I don't know

Enter the number (0, 1, 2, 3...) of 2010 graduate placements for all programs that are working in large system related jobs (approximation is ok).

How do you see the future for mainframe/enterprise systems/large systems content in undergraduate programs at your university? Please explain and provide as much detail as possible.

The name of your university will not be collected or identified.

Table 2: Current and Future Trends in teaching mainframe content

	Currently Teaching Mainframe content and will continue to teach in future	Currently Teaching Mainframe content but will stop teaching in future	Currently not teaching mainframe content but plan to teach in the future	Currently not teaching mainframe content and do not intend to do so in future
Schools	B,G,H,I,J,K,M,N,O,P,T	C,E	F,Q	A,D,L,R,S
Number	11	2	2	5
Percentage of respondents	55%	10%	10%	25%

Table 3: Expansion, Student Interest and Industry Demand for Mainframe Programs

	Currently teaching and will expand the current mainframe curriculum	Currently not teaching and perceive low student interest in mainframe content	Currently not teaching and perceive high industry demand for mainframe skills
Schools	G,I,J,N,O,P,T	F,L,Q	D,L,S
Number	7	4	3
Percentage of respondents	35%	20%	15%

Table 4: Summary of respondent quotes on the future of Mainframe program in their School

School	Program	# of current mainframe related courses	Quotes from respondents
A	Information Technology/Systems	0	Mainframe, enterprise systems, and large systems content are all different topics depending on your view. We teach students how to build clusters and grid computing structures which can be large systems and enterprise systems without the knowledge or inclusion of a mainframe. We do not at this point foresee anytime (sic) in the near future teaching our students details about mainframe structures or OS but we do teach our students about enterprise systems and large systems from a modeling perspective, support perspective, etc.
B	BS in Information	3	There is a large demand for students that understand large systems and enterprise level technologies. We see

	Management & Technology		many companies looking for students that can understand large complex problems. Having students only work on small computers and small problems does not adequately prepare the students for the issues that most organizations are facing. There will be an increase demand for students that can view problems from a large system perspective.
C	Information Technology/Systems	1	We will be eliminating them in favor of Windows administration
D	Computer Science	0	There is a need for such graduates; there is a need to educate the educators
E	Computer Science Computer Programming and Database	1	Not good. First we are a Community College, and second most of the jobs we are asked to fill are not mainframe jobs.
F	Management Information Systems	0	I doubt that large systems courses will be in demand. Plan to offer course in future but unsure
G	Computer Science, Information Technology/Systems	7	Growing Rapidly!
H	Information Technology/Systems	1	there doesnot (sic) seem to be much interest at this time
I	Computer Science	3	We plan to continue our approach of having this platform included in the core of the major plus the elective. Assembler is likely to change to no longer be required and may be folded into another course and be no longer mainframe based.
J	Information Technology/Systems, High performance, mainframe	6	Will increase, share content with HPC, cloud
K	Computer Information Systems	2	We have plans to continue with our 2 COBOL classes. They are a major incentive for 3 "Fortune 100" companies to target our graduates as well as include many students in their formal internship programs.
L	Computer Information Systems, Computer Science, Information Technology/Systems	0	its (sic) a dying art with little interest by students. too (sic) bad because it is a needed skill. no interest from students couldn't fill a class if we paid them
M	Management Information Systems	3	We will continue to develop students in mainframe technologies - we have many companies that specially come here just for our mainframe students.
N	Management Information	1	need to change the CIT 327 Structured Cobol course into a more general "enterprise systems" course

	Systems, Computer Science		
O	Computer Science	1	Where (sic) are currently infusing zOS technology into a set of eight (8) courses.
P	Computer Information Systems, Computer Science	1	This was our first year offering a complete mainframe course. In other years, we offered a seminar course. All students are required to take the course and I plan on adding another class soon.
Q	Management Information Systems, Computer Science, Information Technology/Systems	0	IBM is still offering training for our undergraduates in the area of mainframe. But due to the small number of students, it is difficult to attract students in this area. Moving to cloud computing, call it a new mainframe
R	Computer Information Systems, Computer Science	0	Mainframe is at best a niche market.
S	Computer Science	0	Needed. Those in the 50plus age range are about to retire and thus new employees need to have knowledge of large systems to maintain current applications/systems.
T	Information Management & Technology, Global Enterprise Technologies	6	The content will continue to get more detailed. We have just scratched the surface and plan to bring the content down a number of levels especially with operating systems. We also plan to integrate more content in other courses like including enterprise thinking into the systems analysis courses.