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Alive and Kicking: Making the Case for Mainframe Education

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Abstract: As universities continually update and assess their curriculums, mainframe computing is quite often overlooked as it is often thought of as "legacy computer." Mainframe computing appears to be either uninteresting or thought of as a computer past its prime. However, both assumptions are leading to a shortage of IS professionals in the mainframe computing area. First, most large companies such as financial institutions have relied on mainframe computing for years and as many baby boomer mainframe workers reach retirement there is a growing need to fill these positions. Additionally, there is growing interest in many companies to turn to mainframe for their computing solutions. The mainframe technology is more reliable, cost effective and in today's environmentally conscience world, mainframes provide a "green" solution to the increased computing needs of many organizations. In this paper we make the case for adding mainframe content to the IS curriculum.

Keywords: mainframe education, curriculum

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Alive and Kicking: Making the Case for Mainframe Education

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Abstract

As universities continually update and assess their curriculums, mainframe computing is quite often overlooked as it is often thought of as "legacy computer." Mainframe computing appears to be either uninteresting or thought of as a computer past its prime. However, both assumptions are leading to a shortage of IS professionals in the mainframe computing area. First, most large companies such as financial institutions have relied on mainframe computing for years and as many baby boomer mainframe workers reach retirement there is a growing need to fill these positions. Additionally, there is growing interest in many companies to turn to mainframe for their computing solutions. The mainframe technology is more reliable, cost effective and in today's environmentally conscience world, mainframes provide a "green" solution to the increased computing needs of many organizations. In this paper we make the case for adding mainframe content to the IS curriculum.

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1. INTRODUCTION

Curriculum development is and must be an ever moving target for information systems programs at colleges and universities. As technology changes and organizations struggle to remain competitive, educators must be continually aware of what industry looks for in IT/IS workers. 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.

Although seen as an "older" technology, mainframe computing continues to be the solution for many organizations (Greenemeier, 2002; Lohr, 2008). Mainframe computers are more reliable, cost effective in the long run and easier to maintain. Additionally, they offer better solutions in an environmentally conscience community. As such, the technology has survived in many transaction dominated industries such as financial institutions. Further, more and

more companies are looking to mainframe computing solutions. Therefore, as "older" mainframe specialists retire and more companies turn to mainframe computing, there is a growing need for IS/IT professionals who have a basic understanding of mainframe computing. The failure to educate students in mainframe technology is leading to a shortage of trained workers (Burt, 2008).

Many IS/IT graduates are unfamiliar with the mainframe and are ill equipped to secure even an entry level position in an organization that relies heavily on mainframe computing. Mainframe computing is a forgotten area in many information systems curriculum. 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. Banks and telecommunications providers who hire IS business analyst desire at least a minimal understanding of such mainframe concepts as job control language (JCL).

The low priority of mainframe computing skills in information systems programs and the need for business analysts to have a minimal set of mainframe computing skills and/or understanding is leading to a shortage of such workers. This gap will continue to grow as baby boomers reach retirement and more organizations rely on mainframe computing for a good portion of their computing needs.

In this paper we describe the importance of mainframe computing and its relevance in IS education. Additionally, we summarize the curriculum review process in a mid-sized university computer information systems program. This process led to the addition of three mainframe computing courses. Finally, this paper describes several universities programs as well as suggestions for implementing mainframe computing content in an IS curriculum.

2. MAINFRAME COMPUTING TODAY AND TOMORROW

Visibility

Mainframe computing is largely invisible to the general public, the academic community and even some experienced IT professionals, and yet, mainframes are a dominant paradigm in the business world (Fagen, 2009; Singh, Moh, & Corridori, 2009). In terms of visibility and public awareness other forms of computing such as personal computers (PC) attract more attention and meet the needs of most users at home and at work. However, a PC and/or PC Client/Network distributed systems are limited in their ability to handle large volumes of processing and mixed workloads needed for critical business transactions.

The mainframe has been and continues to be the system of choice for large-scale computing (Lohr, 2008). Although most people may be unaware, 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.

Viability

Many authors refer to the famous 1991 quote of the former editor in chief of InfoWorld, Steve Alsop, "I predict that the last mainframe will be unplugged on March 15, 1996." And yet, mainframe sales are viable and lucrative market (Lohr, 2008). Additionally, mainframes are still the back-office engines behind the world's financial markets and much of the global commerce (Lohr, 2006).

Mainframe vs. Distributed: With the advent of inexpensive x86 processors in the 1980s and the 1990s, attempts were made to aggregate these processors in a "distributed" computing model to replicate the performance of a mainframe. Although successful in some cases, there are areas where the performance of the mainframe cannot be successfully duplicated (Botelho, 2009).

One issue is the proprietary nature of some of the mainframe subsystems (underlying parts of the mainframe operating system). Two examples are Job Entry Subsystem (JES) and Customer Information Control System (CICS), both of which give the mainframe its spectacular performance. Some

products seek to mimic this performance but are often not thought as reliable.

Another issue is the sheer volume of mainframe applications in use, for example, much of the estimated 240 billion lines of code written in COBOL run on a mainframe (Swaine, 2008). The commitment that IBM has made to complete backward compatibility has allowed customers to deploy the same high performance applications for decades, and migrating them off a mainframe platform is a risk that the purported cost savings do not support (Botelho, 2009; Swaine, 2008).

In spite of these issues, distributed computing environments have risen in many organizations as it has a faster implementation and initial costs are lower. Additionally, in case of a failure of one system or resource, another can carry the load. However, distributed systems are costly to maintain and over time are much more expensive (Corridori, 2008).

Some organizations have set up server farms as large scale computing solution. Because these implementations require running multiple machines simultaneously, a large amount of space and energy is needed. The mainframe is economically more viable than the server farm solution as it needs less space, requires less maintenance and is more reliable and energy efficient (Corridori, 2008).

Immense power: Reliability and power are major components of the thriving mainframe platform. This immense power is necessary to support the needs of businesses where large amount of data is processed (Lohr, 2008). And when rapid and accurate processing of this data is critical for an organization, downtimes cannot be tolerated. There is very little mainframe downtime and the mean time between failures is in decades as opposed to hours or days (Greggo, 2009).

Environmental: Finally, every person and every industry is becoming increasingly aware of our environmental footprint. As a community, individuals and companies are trying to find environmentally friendly solutions. The mainframe is a "green" technology. Up to 85% of computing capacity in a distributed environment sits idle and yet it requires enormous energy resources (Curtis, 2009). The mainframe runs more efficiently and has numerous operational advantages. See Table 1.

IBM Simplification Strategy

In 2006, IBM announced its cross company effort to make the IBM System z mainframe (the world's most sophisticated business computer) easier to use for a greater number of computer professionals. IBM is investing $100 million in order to "enable technology administrators and computer programmers to more easily program, manage and administer a mainframe system -- as well as to increasingly automate the development and deployment of applications for the mainframe environment" (*IBM Announces Five-Year March to Mainframe Simplification*, 2006).

Cloud Computing and the Mainframe

Cloud computing is a form of virtualization whereby computer resources are shared by a community of users in a virtual environment or cloud. These clouds are becoming more available not only on many college campuses and universities but by such players as Google, Apple, Amazon and AT&T. The mainframe may be a more reliable implementation strategy for much of the virtualization world.

IBM's z/VM operating system is much more mature than other virtualization products. z/VM has almost as long a track record as the z/OS operating system, and takes full advantage of the security, performance, and scalability of the mainframe architecture (Seay, 2009). It provides a much lower total cost of ownership for the same workload, and will, in our opinion, become a major virtualization strategy in the foreseeable future. Because virtualization and cloud computing implementations are increasing, the inclusion of mainframe content in the IS curriculum is vital.

3. INDUSTRY AND HIRING TREND

Mainframe Professionals

Mainframe use in the IT industry is pervasive; many Fortune 1000 companies and almost all (95%) Fortune 500 companies use them (Robb, 2006). This trend does not appear to be going away as predicted.

The typical mainframe professional in the past decade is from the baby boomer generation. These professionals are reaching or have already reached retirement age. Unless something is done there will not be enough qualified workers (Wallis & Rashed, 2007). Additionally, data centers in industries that rely on large systems have dramatically increased causing a further demand for professionals skilled in large systems (Wallis & Rashed, 2007; Wong, 2009).

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

The current hiring is dominated by users of the z/OS operating system, the operating system for DB2 (relational database), IMS (hierarchical database), Job Control Language (JCL) and other mainstays of the architecture. But with an eye to the future, we also believe that mainframe virtualization will create additional job opportunities for IS graduates.

4. MAINFRAME EDUCATION

Although the model curriculums do not identify specific courses dedicated to mainframe computing, several universities have added these courses to their curriculum.

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.

Angelo Corridori (Corridori, 2009) suggests ways for colleges and universities to include mainframe computing content in the current curricula. Introducing large systems topics into Operating Systems and Hardware/Architecture is a good start. Additionally, as part of the IBM Academic initiative, professors can invite experts for guest lectures and or class discussions on large systems versus other forms of computing.

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.

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 and 5 in 2009. The average salary was $60K and many had an additional $5K sign on bonus. Additionally, 7 students received 2009 mainframe summer internships paying $26 per hour.

Curriculum Review: An extensive review of the CIS curricula was performed in 2008 and Spring 2009. This review included the investigation of marketing trends, survey of the CIS Advisory Board, placement of our students and several model curricula. As a result, many changes were made.

Although a review of our peer schools and the model curriculums did not indicate any mainframe content, our placements as well as the input from our advisory board suggests a different story.

Students who took the mainframe special topic course were highly sought in the market for jobs with large corporations. At least 25% of our graduates, all of whom took the elective course, were offered mainframe IS positions primarily as business analysts.

Even during this difficult economic cycle, our students with mainframe experience are receiving jobs offers and internships.

Our advisory board is made up of representatives from many large US corporations. It was their unanimous agreement that continuing with an introduction to the mainframe course as well as adding additional courses would greatly increase the likelihood of our students receiving placements and internships at their organizations. And in fact, they agreed that it is difficult to fill many IS positions because many applicants lack exposure to mainframe concepts.

Therefore, an Introduction to Large Systems course was added to the CIS curriculum as a required course for all CIS majors. Additionally, two other courses were added as electives for students pursuing careers in the mainframe industry.

5. CONCLUSIONS

Mainframe computers can no longer be thought of as legacy systems that have outlived their usefulness. These systems have survived in spite of the growth of distributed systems because they are more reliable and are better equipped to handle large volumes of transactions and data. Additionally, in the long run, these systems are more cost effective and more efficient to run making them a "green" solution for computing.

The continued reliance on mainframe computing and the expectation that many mainframe professionals will be retiring in the coming years is leading to an increased demand for these IS mainframe professionals. This shortage is further exacerbated by the apparent lack of mainframe content in many business school CIS and IS programs.

In this paper, we described the needs and benefits of including mainframe topics and courses in the IS curriculum. Additionally, we provide suggestions for including this content in the current curriculum.

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APPENDIX

Table 1: Mainframe efficiency (Greggo, 2009)

Mainframe Systems

The operational efficiency of the mainframe

Near-linear scalability	up to 900,000+ concurrent users; TBs of data
"Mean Time Between Failure"	measured in decades versus months
¼ network equipment costs	virtual and physical connectivity
1/25th floor space	400 sq. ft. versus 10,000 sq. ft
1/20 energy requirement	$32/day versus $600/day
1/5 the administration	< 5 people versus > 25 people
Highest average resource utilization	Up to 100% versus < 15%
Capacity Management & upgrades	On demand; in hours, not weeks/months
Security intrusion points	Reduced by z architecture and # of access pts.
Higher concurrent workload	hundreds of applications versus few

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