A Multi-campus Industry/Academic Collaboration for Enterprise Systems Internships

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Abstract

This paper is a description of a program that includes 3 Historically Black Colleges to move students into the information technology (IT) industry via internships in "enterprise systems." Enterprise systems is an enterprise-wide perspective of an organization's computational infrastructure- with mainframe technology as the foundation. Mainframe is the often ignored foundation of the global economy and high-transaction Big Data. The problem is this technology has virtually disappeared from undergraduate (and graduate) curricula. This poses a dilemma for the IT industry, in that because of the lack of enterprise systems courses in colleges for the past 10-15 years, most of the mainframe professional are over 50 and nearing retirement. There are not undergraduates being trained to replace them because extended training programs are disappearing from the corporate landscape. The Program described here is an effective solution to this problem. Three Historically Black Colleges with collective enrollment of approximately 22,000 students are engaged in a collaborative enterprise systems program. All three schools have deployed a 4-6 course concentration in mainframe technology. We feel this is a solution for the skills gap and the lack of diversity in the mainframe sector. Industry collaboration and internships are an essential part of this Program's success.

Introduction

The mainframe, that is, the centralized, large scale, high performance architecture developed in the early 1960's by IBM, is still the computational foundation of the global economy. Banking, insurance, large government agencies and large retailers, among others, are wholly dependent upon mainframe technology for their core operations. But for reasons that we will describe later, mainframe technology has virtually disappeared from college curricula.

This paper is a description of an industry/academic collaboration focused on what we call "Enterprise Systems" (ES). While ES has as it foundation mainframe technology, our use of the term includes all technologies that comprise the computing infrastructure of large organizations. This includes all Web and cloud computing, Linux, Big Data, and mobile devices. Mainframe is at the hub of much of this activity, because the unique input/output (I/O) capability of the mainframe provides the required performance for operations like high-volume transaction processing. But due to the mistaken presumption that the mainframe would be replaced with cheaper technologies, mainframe technology has virtually disappeared from academic programs. Languages like COBOL- which still has by far the largest number of active lines of code in operation- have been removed from the requirements of computer science, information systems, and information technology programs (Thibodeau, 2013).

Brief Background of Mainframe Technology

What we now call the modern mainframe is based on an architecture developed in the mid-1960s by IBM. It was the next step in the evolution of business computing. Prior to April of 1964, the roll out of

IBM's System 360, computers were designed for specific implementations to perform specific tasks. Early computers like the NEAC 2203, the IBM 7904, and the Atlas were examples of early computers that were usually custom built to perform a narrow scope of work. Because they were not mass-produced, these computers were expensive to build. In addition, the software produced for them could not be used on other machines (http://www.computerhistory.org/revolution/mainframe-computers/7/166).

In April of 1964, IBM rolled out System 360, which was a mass produced computer that could be applied to a wide spectrum of business and scientific tasks. There was soon a large suite of software products available for the System 360 that could be used by multiple organizations. For example, different companies in the banking industry could use the software. The System 360 was the first general business computer, and was hugely successful (Ebbers, 2011).

Throughout the 1960s, 70s and 80s, not only did System 360 evolve and become more sophisticated, numerous other "mainframes" (a term that referred to the frame the machine was built on) were developed by other companies like Burroughs, Amdahl, Unisys, and Digital Equipment Corporation. What these machines had in common was high I/O capability, high processing capacity, and a high level of security. Mainframes were, essentially, synonymous with computing.

In the 1980s however, with the advent of the personal computer (PC), the mainframe had a competitor for king of the computing world. As the PC became more and more popular, it began to take center stage. A train of thought emerged that if you coupled enough PCs together you could replicate the performance of a mainframe at a much cheaper cost. Of course such thinking belies a fundamental lack of understanding of computer science and mainframe architecture, but this myth grew in popularity. In March of 1991, Stewart Alsop made the now famous prediction that "the last mainframe will be unplugged on March 15, 1996." (Alsop, 1991) It goes without saying that this prediction was incorrect, but nonetheless there arose a sentiment in the business world that eventually mainframes would disappear. Academic programs in computer science and information systems, which had been built upon mainframe technology, began to take mainframe out of their curricula. This removal occurred while actual use of the mainframe did not diminish. Of course some workloads that had been run on mainframes but could run as well on cheaper platforms. Low I/O intensive workloads for example, did in fact migrate off the mainframe. But core business applications- those requiring high I/O, were mission critical, or needed a high level of security- had to be run on mainframes. And those type of workloads have remained on the mainframe until the present day.

The Mainframe Workforce

Because the mainframe was the predominant platform of the 1960s, 70s and 80s, finding workers familiar with the platform was a non-issue. All computer science and information systems programs used them in their classes, and most students of computing were familiar with mainframe software and hardware. COBOL, a language prevalent on the mainframe, was taught in all programs as a foundational language. Companies had little problem finding COBOL programmers, in addition to staff to perform networking or database tasks. Even when academic programs began removing mainframe-related classes from their curricula in the 1990s, the mainframe workforce was young enough that there didn't appear to be a problem in finding a mainframe skillset among potential employees.

Almost imperceptibly, however, the mainframe workforce began to age. By the year 2004, the IT industry started to show the first signs of concern that: 1. Their mainframe talent was getting on in

years, and; 2. Most academic programs had moved away from teaching on the platform. IBM, who by this time had become the sole remaining major vendor of mainframe technology, decided it had to do something to address the concerns of its customer base. It created the IBM Academic Initiative (AI) to re-infuse mainframe technology into academic programs. It soon found, however, that there was considerable reluctance to re-introduce mainframe technology into IS and computer science programs. This was for a variety of reasons. For one thing, mainframe was no longer the predominant computing platform. The proliferation of the PC led to there being an overwhelming number of non-mainframe jobs for students to choose from. Another reason was that younger faculty had no exposure to the technology and were ill-equipped to teach it. Few Ph.D. candidates in computer science and IS were focusing on the mainframe, and subsequently were not doing research related to it. When the IBM AI informed the schools of the increasing job opportunities in mainframe technology, the schools would reply that while that may be the case, the burden of re-directing their programs in this direction outweighed the potential benefit derived from doing so. For the more prestigious schools, their students had no shortage of job offers, so in their eyes their gain from bringing the mainframe back into their programs was minimal. And this is the position taken by the overwhelming majority of schools today (Daniel Gillis, 2009).

Current Academic Programs Focusing on Mainframe

Even though the IBM Academic Initiative for System z (IBM's current designation from the mainframe) has faced challenges in getting academic programs to include mainframe technology into their curricula, they nonetheless have had considerable success in this area. Beginning in 2004 with 18 schools, they now have more than 500 schools that participate to some degree in the Academic Initiative for System z. It is commonly accepted that Marist College in Poughkeepsie, NY is the leading school in mainframe education. Located Poughkeepsie, NY, Marist's proximity to IBM's mainframe operations has facilitated their acquiring an extremely high amount of mainframe expertise. This has led to their being the preeminent school in the US in mainframe technology. The National Science Foundation funded a project based at Marist College that led to the creation of the Enterprise Computing Community which has become the leading academic entity in mainframe computing (http://ecc.marist.edu).

But even with these efforts, most IT-related departments resist including mainframe in their programs. The reasons include a reluctance to get faculty to have to learn material they are either not familiar with or have not seen in a while, concern that their students will reject the technology as old and obsolete, and not being convinced that the jobs offered in mainframe are substantively better the jobs their students are already getting. So at the present time, the number of schools that have either full programs or concentrations in mainframe is small. This has led to an increasing concern about having replacements for retiring mainframe professionals.

Addressing the Mainframe "Skills Gap"

I have worked in the mainframe education space for ten years, and have found several factors that both positively and negatively impact the furtherance of inclusion of mainframe in existing IT programs (that is, computer science, information systems and information technology programs). Beginning with the factors that I have found to be impediments, probably the most salient is the department chair not seeing a clear path for including mainframe in her curriculum. Most of the faculty probably have little exposure to the technology. There are very few dissertations that address mainframe specifically, and

few junior faculty include mainframe in their research agenda. And it is this research agenda that is the focus of junior faculty's progressing to tenure.

Another reason for the low adoption of mainframe into curricula is that students have the perception that the mainframe is obsolete. This messaging comes from both IT managers and their own faculty. Non-mainframe IT workers know very little about the mainframe and its very real importance to the global economy. There are few champions of the mainframe in colleges today, hence the importance and sophistication of mainframe technology is communicated poorly.

But much can be done to convey to students that careers in mainframe are highly desirable, interesting and well paying. In fact, the latest version of the mainframe, the z13, can be said to be the most sophisticated commercial computer ever created. Its list of technical innovations and improvements is beyond the scope of this paper, but they are numerous. I have found that all that is needed is to communicate clearly and convincingly to the students that mainframe is "where the action is" and they will see it is a viable career option.

But not only do the students have to buy in to inclusion of the mainframe, the department chair and the faculty have to also. This is problematic for reasons cited above. The lack of faculty expertise in mainframe is probably the biggest impediment for inclusion. The model we have developed directly addresses this, and we will now describe it.

The Multi-Campus Model for Mainframe Education

The model we present is a culmination of 20 years of experience in mainframe education, 10 years by the co-author of this article and 10 by the author. The co-author was an IT executive for over 25 years with a major technology company, the author was in the IT industry in various capacities for 20 years and has been an academic for the past 11 ½ years. The author started one "enterprise systems" (mainframe) program at an Historically Black College/University (HBCU) in 2004, and another at a larger HBCU in 2009. Both programs were successful, putting over 140 students in mainframe or mainframe-related positions over a 10 year period. The co-author has acted as a private consultant at 4 HBCUs and 1 non-HBCU and has helped place over 30 students in mainframe positions.

But in both cases the constraint has always been the size of any given department. For the author, his first department had only 125 students and his second has approximately 300 total (graduate and undergraduate). The size of these programs limits the impact they can have on the problem of a mainframe skills shortage throughout the industry.

The author and co-author, primarily through the efforts and contacts of the co-author, collaborated on a multi-campus model beginning in the spring of 2015. The key component is a collaboration with approximately 30 companies that hire former mainframe students from the participating schools into internships and entry level mainframe jobs. The companies inform us of the specific skills they need and we teach them in the semester long course.

The schools involved in the multi-campus model are all HBCUs. As cited above, one of the roadblocks for IT programs to adopt mainframe technology is that there students already have abundant placement opportunities. HBCUs, on the other hand, generally have less resources, smaller numbers, and are seen as less prestigious by industry. This has led to an acute need for a "niche" area where the playing field is more or less equal and they can excel. Mainframe is perfect for this in many ways.

There are initially 3 schools involved in the project, all publicly funded HBCUs: one in North Carolina (enrollment approximately 11,000); one in Tennessee (enrollment approximately 8,000) and one in Mississippi (enrollment approximately 4,000). We will refer to the schools as MS, TN, and NC respectively.

NC and TN both have Colleges of Engineering. MS does not. One major success factor (success measured strictly by student placement, which has occurred at all three schools) is highly effective collaboration between the College of Engineering and the College of Business in TN and the Computer Science Department and the Department of Advanced Technology in MS. At NC, the home of the program is in its School of Technology, and though students from both College of Engineering and the School of Business take mainframe courses, there is no effective collaboration between the departments there. This is the norm, as academic departments seldom engage in multi-departmental collaborations (though there are exceptions, to which our project can attest). This causes the numbers of students in mainframe classes to be limited. This project has proven that it is possible to grow the numbers in mainframe classes by inter-departmental collaboration.

In the Spring of 2015, we had 81 students enrolled in NC in 3 classes, 15 enrolled in TN in one class and 12 enrolled in one class MS. In NC there was an intro to mainframe undergraduate course, and intro to mainframe graduate course and an intermediate undergraduate course. All of the undergraduate courses use the same material. The author taught the undergraduate courses in MS and NC using the online teaching tool Blackboard Collaborate. The online courses included real time lectures and online videos, exams and labs.

In the fall of 2015, there were 4 courses at TN (total 55 students), 4 courses at MS (total 68 students) and 1 course at NC (29 students) for a total of 152 students for all 3 schools. The fall semester had a couple of interesting components. One was our project's inclusion of IBM's Master the Mainframe Contest included as course content (site). Master the Mainframe (MtM) is an industry standard exercise where student solve problems using mainframe technology. This year it had over 5,000 participants in the US and Canada. We used MtM for a course we developed especially for this project we call "IT 101" (each school gives the course a course listing appropriate for their school). Between the three schools, there were over 200 students registered for Master the Mainframe (many students participated that were not in a mainframe course). Course content also included basic IT material (database, networking, Web, and programming). After an assessment of the IT knowledge at all three schools we found serious gaps in the students' grasp of IT fundamentals. The course was taught online at TN and MS simultaneously. Numerous placements were obtained from these courses. The semester ended with a COBOL "bootcamp" held at TN between fall and spring semester which was attended by 22 students.

Conclusion

In the view of the authors, the past two semesters of this project were a complete success and exceeded our expectations. Many students from these classes have received offers for internships and entry level positions, and we expect many more to receive offers before May 2016. We are discussing expanding this project to another public HBCU in Georgia for all 2016.

This model has proven to be a solution to the mainframe "skills gap" in that it is scalable and can be extended to any school that wants to include mainframe in its curriculum. Because we have the

capability to teach the course remotely, a school not having mainframe skills in house does not prevent them from implementing this model.

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