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In Search of 21st Century Mainframers

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Management Summary

As baby boomer mainframe administrators and programmers are beginning to reach retirement age, enterprises have expressed concern about a shortage of younger workers with the skills and interest to replace them. Many vendors stopped making mainframes, turning their attention to smaller scale, more affordable systems. As mainframes were relegated to back-end enterprise processes, they lost the cachet that they enjoyed when they were the only game in town. Undergraduate computing curricula, which rarely focused on the infrastructure and systems aspects of enterprise computing in the first place, have expanded to incorporate modes of openness (Java), connectivity (wireless), and association (Internet), as well as the classic theories and arts of programming. Somewhere along the way, many important aspects of large enterprise computing seem to have slipped out of most course offerings.

In its October 2002 Mainframe Charter, IBM announced numerous proof points of its serious commitment to continue the *zSeries* platform. Fostering the development of mainframe skills was one aspect of this charter that resonated strongly with mainframe customers. Recently, we traveled to Poughkeepsie, NY, home of Marist College, and Potsdam, NY, home of Clarkson University, to talk with present and former undergraduates and graduate students, many majoring in computer science, who have been involved with the mainframe sited on their campus or involved via IBM's zSeries Co-op Program. We also met with faculty at both campuses. What we found in our small sample validates the need for IBM's zSeries university efforts and endorses its move to a larger scale.

Though they grew up very computing-aware, due to the prevalence of PCs during their lifetime, most of the students that we interviewed knew little about the role that mainframes have played, and continue to play, in enterprise computing. In their undergraduate curricula, these students learned much about networks, but very little about large-scale systems. They students that we interviewed admit that their education delivered little exposure to *enterprise systems thinking*. *Scaling* is usually relegated to a senior course on parallel computing, where the emphasis is on scientific problem solving, not scale-up architectures. *Virtualization* might be mentioned in discussions of *Java Virtual Machines* or something for which you used *VMWare* to get old Windows games to run on your new laptop. *Workload management*, *policy-based automation*, *resiliency*, and *enterprise-wide security* meant little to those focused on local machines over which they have total control.

The well-publicized presence of a zSeries on campus sent varying ripples of curiosity through the computer-focused segments of the student communities at each institution. At Marist, Dave Meck, a former IBM software engineer with distinguished mainframe credentials and now a professor, has been teaching large system concepts and z/OS-specific skills. Recently, he has noticed that more large companies were coming to the Marist career fairs and looking for I.T. graduates with mainframe skills. At Clarkson, the Linux-only zSeries runs z/VM and Linux, but not z/OS. As a result, the student engineers' explorations of the possibilities have already produced innovations, like a GUI for z/VM administration that seems to make mainframe administration more compatible with contemporary tooling expectations.

The students we interviewed have found much to value in mainframe computing. Read on to find out what they are up to, what IBM is doing, and what still needs to be done.

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Experiencing the Magic Box

Students and recent graduates that joined us at our "Mainframe Roundtables" had heard of the mainframe in stories about the good old days, and knew that mainframes were inherently different from the PCs on which they worked. The students thought mainframes were like big *magic boxes*, but the nature and relevance of the magic was fuzzy, at best. The first step in clarifying their focus came when they encountered *zSeries* servers sited by IBM at Marist College and at Clarkson University.

Marist College and Clarkson University came by their zSeries magic boxes differently. Marist was given their first mainframe in the 1980s. Currently, a z900 is used as an available resource for zSeries-related education by students and faculty worldwide. Clarkson University won their single processor, Linux-only mainframe in an IBM-sponsored open systems (Linux) contest. Clarkson gave use of the machine to those who won it – undergraduate and graduate students who have seized on z/VM to optimize the Linux environments they run.

The students that we interviewed came from both institutions, plus a co-op student from MIT. Many of the students had received training and experience on zSeries through IBM's Summer Internship Program. Several of them received a more focused training on zSeries through IBM's six-month IT Co-operative Education program in Poughkeepsie[1], where they worked on large system projects. (See box at the bottom of the previous column.) In these IBM-based experiences, they learned a lot about enterprise computing and the related mainframe career opportunities. The students felt that the internship and co-op programs were a pivotal influence in their appreciation of the challenges of enterprise computing and the important role played by zSeries. Some felt it was a cornerstone of their real education.

Doug Kimball, a Marist graduate, said the co-op was "more helpful than [the classroom] education. More real world – more real options. You don't learn what a job is like at college." The co-op program was also their most compelling exposure to large systems concepts like scaling, virtualization, synchronization, and workload management. More importantly, what they learned, they took back to campus, used, and shared.

Clarkson Activities

At Clarkson, engineering students ported *Gentoo Linux*[2] to zSeries, produced a publicly-available bug server, and published *Hipersocket Definitions on VM*. They are also active in posting to the mainframe-related web site that Marist College supports.

Jason Herne, a Clarkson graduate student, describes the current flagship project run at Clarkson out of the COSI Lab[3]: "We thought VM's command line interface was a real problem. So we decided to create a GUI to translate the arcane stuff, and to reduce the learning curve to actually being able to fool around with it, and to save time spent on administration. This led me to a summer internship on z/VM in Poughkeepsie, where I developed a virtual network manager for z/VM."

Work at Clarkson continues on the z/VM GUI. The zSeries has stimulated litanies of student questions that might not come up in a more fully-structured, fully-supported systems environment.

The IBM IT Co-Operative Program

The zSeries IT Co-op Program was started to expose students to large IT system disciplines and specialties and, of course, to get familiar with students that would be seeking fulltime jobs in a couple of years. The current zSeries program started with the fall semester of 2003. Introductory education is followed by a 20-week rotation through various skill areas, including:

- Build and Integrate
- Solution Test, Integration Test
- Service
- IBM Global Services

Students have the opportunity to work with career professionals, learn competitive job skills, and become familiar with the larger mainframe environment.

[1] There are other co-op programs in other geographies.

[2] Gentoo Linux is an easily customized Linux distribution (see gentoo.org).

[3] The Clarkson Open Source Institute is a project and team based opportunity that, as Clarkson senior Kyle Smith put it, "is more than a class, though you can get some credit for it. It is where those interested in Linux can wander in and ask questions." It is where most of the programming on the Clarkson mainframe is done.

- *Why do I need a tape drive?*
- *What is a virtual tape drive?*
- *They cost how much?*
- *That's a heck of a lot of bake sales…*

The COSI Lab activities have generated a lot of enthusiasm and interest, but that enthusiasm needs to be supported at Clarkson by more classroom discussion of large system issues. As Herne put it, "I would have built the VM GUI differently had I known more. A little knowledge never hurt innovation."

Finding room in the existing curricula is difficult, according to all of the faculty that met with us. At Clarkson, the curricula for Information Systems and Business Processes, Computer Science, and Software Engineering cover all kinds of computing. They teach time-tested theory, not bleeding-edge developments, and not brand-specifics. Almost all curricula must meet college, university, and accreditation standards. Moreover, almost all curricula are built around the self-contained nature of a PC. The faculty does not have much latitude to improvise, and most have little time or desire to develop and integrate large-system curriculum elements into already overstuffed class time. They need pre-packaged modules, crafted for a variety of learning styles.

Undergraduate computer experiences are focused on assignments using skills learned from textbooks. They are carefully crafted to be challenging but achievable in a reasonable time frame, with limited resources. Open-ended assignments are available to graduate students, should they choose to go that route. Time for "playing around" is not part of the formal educational process. COSI fills the gap for those who find it and make the time to participate, but it leaves a lot of opportunity under-served.

Marist Activities

Marist College has the advantage of the presence of Dave Meck, a long-time IBM mainframer with impressive credentials, who now teaches Information Technology at Marist, and is focusing on large system topics, including zSeries. Meck credits Marist Dean Roger Norton with getting these courses into the curriculum. Meck notes that the emphasis must be on concepts rather than specifics, supported with hands-on activities, using zSeries and other platforms. He agrees with the Clarkson faculty that the curriculum must cover more than one vendor's large system, and that the real need is for well-developed modules that can be inserted into existing courses.

Marist Professor David Meck's Large-Scale Elements Curriculum

- Workload Management (WLM)
- Sysplex (as contrasted with clustering)
- Partitioning
- SMF/RMF and Data Collection
- Multi-tasking, multi-processing, multi-function
- Large System J2EE Issues
- USS (UNIX System Services), JVM, TCP/IP
- Large Scale Optimization
- Serially-reusable Programming
- Security

Large systems are more difficult to describe as conceptual elements, and developing modules of learning in an area where the students have little previous experience is a lot of hard work and difficult to pace. As Meck put it, "How many tablespoons of an elephant do you take before you're full – and then what do you do with what's left?" There are many large, complex concepts to be learned in a fixed amount of course time, plus the students have to reach a critical level of understanding before what they have learned begins to be useful, and that is only the beginning of the journey.

Student Experiences

Students at both Marist and Clarkson are impressed with the mainframe and what it can do, but learning about it is not like learning Linux or any of the microcomputer platforms with which they have grown up.

- *The learning comes in such big pieces!*
- *You have a question, and you have to read at least 75 pages telling you far more than you want to know.*
- *You know, it is NOT organized well as components.*
- *All those acronyms! Even for things that are almost universally known as something else – like DASD!*
- *The shell alone in VM is unlike anything I've ever seen. Tab does real weird things.*

- *Every part of implementing something is so complex – and there are no short cuts – or at least none that we can easily find out about.*
- *It lacks traditional features like Bash[4], which has been around since the '70s.*

Such challenges have not dampened the enthusiasm. Marist graduate Michael Jutt said, "You have to know about the power of mainframes and multiple processors with OSes on top. With multiple OSes sharing a processor and cool things like that, you can take 10 processors and run 20 OSes as fast as in a PC." Graduate student Eli Dow of Clarkson said, "I love that you can make a zillion Linux guests, but spawning them off to VM is a pain. Last year we worked on a system for rapidly provisioning Linux guests on zSeries. The power of VM is unreal." Doug Kimball admired the ability to kick off 500 Linux images on one machine, giving each student their own space. Marist Graduate and IBM employee Anthony Sofia summed it up: "Software that runs on a mainframe is more complex than anything on *pSeries* or *iSeries*. You'll never get bored. This makes it a good career choice."

Careers were on the minds of all of the students that we interviewed. All viewed mainframe skills as something that would differentiate them from their peers. Many saw the mainframe environment as something that would provide a job that could be enduringly interesting and that would let them innovate on a large scale.

They all want more of zSeries; lots more. The educational role of the mainframe may differ between these two campuses, but the *more* that students and faculty crave is similar. They want more educational tools; better, quicker access to the information; and a way to consult with each other and experienced mentors. Unanimously and adamantly, *they all want more time to fool around on zSeries*. They feel it is a better way to learn about what the platform can do and the only way to get the knowledge needed to begin to think about what else one might be able to do with the platform.

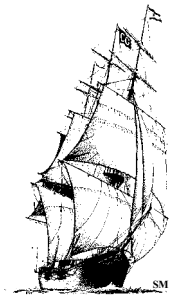
Large systems processes, in general, and mainframe processes, in particular, tend to seem (or be) non-modular, because of their integration and/or large scale. As one student put it, IBM's documentation assumes, "That you are working full time on mainframes and have been for years." This massive and highly-evolved oneness is at odds with the modularity of classroom deliverables (small, contained projects) and the modular PCs with which most students and faculty are familiar. Still, new ways to teach large system skills and explore large system issues must be found and time must be allowed for curricular changes to be approved and implemented.

And the students are waiting. The Clarkson students would love to play on a z990. As Eli Dow put it, "I like to play with operating systems. I would like to play with them all."

Conclusion

Forty years after the mainframe's creation[5], IBM has done a very good thing by placing zSeries computers at Marist and Clarkson. The availability of the zSeries co-op program and summer internships enriches this goodness, and IBM would like to see its customers do the same. The word is out and more than 70 colleges and universities from around the world have approached IBM to learn more about bringing large systems studies to their campuses. IBM is working on a textbook for zSeries, and has other educational initiatives in place, like the *zSeries Scholars Program*, where faculty can apply for grants of up to $40,000, to be used in the development and testing of zSeries curricula and materials.

IBM's new mainframe skills initiatives have caught the tinder of enthusiasm for zSeries, z/OS, z/VM, and Linux on zSeries. The students and faculty have many ideas on how to expand the efforts. This bodes well for the future. IBM is on the right track to find 21st Century mainframers.



[4] *Bash* is a GNU (open-source) shell, or command language interpreter.

[5] See *The Beginning of I.T. Civilization - IBM's System/360 Mainframe* in **The Clipper Group** *Captain's log* dated March 30, 2004, and available at http://www.clipper.com/research/TCG2004028.pdf.

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