

Transworld Data Case Study

German Universities Deliver Research and Skills Training for System z

Enterprises in Germany are seeking a new generation of IT professionals who enter their doors with the technical knowledge needed for enterprise data centers. Central to these needs is familiarity with System z computing. Accordingly, institutions of higher learning in Germany have been active in initiating and directing enterprise and System z research and education—and they are being instrumental in leveraging these opportunities to other learning institutions throughout the country.

One of these institutions is the Karlsruhe Institute of Technology (<http://www.kit.edu/kat/index.php>) <http://www.kit.edu/kat/english/index.php>. Founded on October 1, 2009, KIT began as a merger of Forschungszentrum Karlsruhe and The University of Karlsruhe. The goal of the Institute was to combine the large-scale research activities of the Helmholtz Association, which conducted program-oriented scientific research on behalf of the Federal Republic of Germany, with the teaching and research tasks of a University of the state of Baden-Wuerttemberg. Today, the Karlsruhe Institute of Technology (KIT) is a leading worldwide engineering research institution. As a member of the Helmholtz Association, the largest science organization in Germany, KIT makes major contributions to top national and international research. Within these missions, over 22,000 students at KIT pursue studies in three strategic fields of action: research, teaching, and innovation.

KIT plays a significant role in scientific research, but the Institute is also committed to being a leading innovative partner for industry. By combining the strengths of a University and a Research Center, KIT provides a sound educational foundation for its students with an emphasis on advanced and directly applicable training for the research and business communities.

A second German university engaged in enterprise and System z education is the University of Leipzig <http://www.zv.uni-leipzig.de/en/>, founded in 1409 and dedicated to a wide selection of disciplines comprising almost all areas of knowledge.

The University of Leipzig's Informatics Department integrates academics with research and works closely with outside enterprises to ensure continued relevancy of technology research and education. Integral to this education is the inclusion of IBM System z training.

"There is an enormous need for mainframe skills in industry," said Professor Wilhelm Spruth of the University of Leipzig's School of Informatics. "This need is so keenly felt that we have had enterprises steadily collaborating with us over a period of years in the design of our System z curriculum."

Professor Spruth feels that the need for enterprise computing-level education on mainframes like System z is still a work in progress for many academic staff. "Colleagues who have spent their careers teaching on other computing platforms and in a laboratory and research context aren't fully aware of the major role

that the System z plays in enterprises, or of enterprises' needs for new mainframe talent," said Professor Spruth.

System z Enterprise Curriculum

At the University of Leipzig, care is taken to align course offerings and training deliverables with what enterprises want. "Because of enterprises' collaborative work with us, we were able to develop System z courses that had a direct skills transfer to the areas of need these enterprises were experiencing," said Professor Spruth. "This was a major step toward meeting enterprise skill needs."

A second challenge that Professor Spruth and his colleagues faced was student awareness and exposure to large-scale enterprise computing. Students were entering the Institute with backgrounds confined to x86 hardware platforms and operating systems like Unix, Linux or Windows. Most of their computing experiences had been limited to exercises completed in isolated laboratory settings. Consequently, the students lacked knowledge and comprehension of the scope and the requirements of an enterprise computing architecture charged with delivering continuous uptime, reliability, scalability and performance to a global business—or of the need for highly robust computing platforms like the IBM System z mainframe

Faced with similar challenges, the Karlsruhe Institute of Technology's Informatics Innovation Center (IIC) focused on Masters and Bachelors degree students at the *end* of their studies. "The IIC is a platform for cooperation between research, academic education and industry in order to exchange knowledge, experience and to provide a higher degree of industry experience for Bachelors and Masters students," said Prof. Dr. Hansjoerg Fromm, who heads the Karlsruhe Service Research Institute (KSRI) <http://www.ksri.kit.edu/>. KSRI is a collaboration of KIT with IBM Germany to develop concepts, methods, and technologies relevant for innovators and decision-makers to create and capture value in an increasingly services-led economy. "The IIC offers partnerships with business companies and offers a platform for them to get access to the best students for later job offerings," said Professor Fromm. "The focus of IIC-related education is on System z platforms and operating systems in order to intensify the knowledge of mainframe platforms and to help companies to find educated students in this area."

Designing a Curriculum

Both KIT and the University of Leipzig concentrate on technical skills development that is value-added for enterprises.

"The main focus of the KIT IIC is education in the field of System z," said Professor Fromm. "This is anchored to the chair of Software Design and Quality, Prof. Dr. Ralf Reussner, who is also the KIT executive for the IIC. In addition, the IIC spans to the chairs of Operating Systems and System Architecture of Prof. Dr. Frank Bellosa, Cryptography and Security of Prof. Dr. Mueller-Quade and Computer Architecture of Prof. Dr. Karl."

KIT IIC summer courses include Virtualization and Security on System z, and Practical Training on Software Quality on Mainframe System z10. During the winter, the IIC offers courses in High Availability and Scalability on System z, and seminars in Commercial Applications on IBM System z.

KIT began offering System z education in 2009 and since 2010, has had an IBM System z10 and DS8700 system storage at its disposal. From the beginning, the IIC was supported by KIT's dean and vice dean of the faculty of computer science. This support has been beneficial for the program.

At the University of Leipzig, enterprise and System z curriculum developers took a two-fold approach:

- To implement and continue to expand enterprise and System z curriculum; and
- To leverage enterprise education so students at other Universities in Germany could also participate.

“Mainframes are a big part of enterprise in the present and in the future, so if you fail to acquaint students with System z technology, they are going to be missing a critical part of being prepared for an industry career in IT,” said Professor Spruth.

As part of the education leveraging efforts, Professor Spruth also teaches System z courses at Tuebingen University, which is 300 miles away from Leipzig. He is able to conduct this education with the help of a two-year-old, innovative e-Learning approach that enables the students at Tuebingen to use Moodle (<http://moodle.org/>), an open-source online learning delivery system. The Moodle system gives students at a remote campus location access to Leipzig-based lectures on System z technologies. They can also perform their lab work on IBM System z9 mainframes located in both Leipzig and Tuebingen.

“The e-Learning experiment is going very well,” said Spruth. “The University of Leipzig’s System z curriculum is designed as a series of building blocks that begins with a firm technical foundation in System z and then builds on that foundation with subsequent System z courses which are focused on specific subsystems.

The first year of course work consists of a fall semester featuring studies in Enterprise Computing and Introduction to z/OS, and a Spring semester that focuses on System z and Internet Integration. The courses acquaint students with the architecture of System z and the z/OS operating system; and then proceed into topics that provide foundational information on how System z integrates with Internet communications and applications, and what its role in enterprises is.

“In the Enterprise and z/OS course, we compare what z/OS does with what other operating systems like Unix do,” said Professor Spruth. “We also compare the System z hardware architecture to x86 architecture, since students are likely to be familiar with the latter....When we advance into second semester topics with the Internet course, we then move into how logical partitions (LPARs) on System z work, and we do exercises that involve Java and WebSphere. These exercises allow students to see the connectivity of System z with these other systems and applications, and how they all work together.” Students also receive an introduction to COBOL in which they write at least one COBOL program. The COBOL introduction enables them to see how COBOL works with other programming languages like Java to provide an end to end application development architecture for an enterprise.

After the first year of courses, students have elective choices that they can make between CICS Transaction Server, MQ Series and WebSphere courses—with a new course offering, ISPF Using Rational Developer, planned to be added to the curriculum in the next fall term.

University Research

Known for its emphasis on research, the KIT IIC chose to incorporate two primary research areas into its educational program that used both IBM System z10 and the DS8700 storage system. These research areas were:

- Measurement based analysis of I/O on large system environments using System z10 and DS8700 to assess performance based on regression analysis and queuing networks; and.
- Prediction of runtime characteristics for middleware infrastructure to ease the deployment of software components in multi-workload environments.

Multiple Masters and Ph.D. students work on these subjects. In addition students are employed by Professor Ralf Reussner, the ICC's chair for Software Quality and Design, as assistant researchers working on and maintaining the IBM System z10. "It is planned to establish a project group to allow students aside from working on Master thesis to work on a longer period on System z10 and to provide them a chance to establish knowledge which is credited for their studies as well as for later employment at companies working with System z," said Professor Reussner.

The University of Leipzig also embeds research and innovation in its Informatics coursework.

It was University of Leipzig students who undertook joint project work as part of their doctoral dissertation work with IBM's developmental lab in Boeblingen, Germany <http://www-05.ibm.com/de/entwicklung/>. "This was precursor work done on the IBM zBX product," said Professor Spruth. "This originally started as a gameframe project, applying an Open Source Lesser General Public License (LGPL) framework to support the creation of browser based multiplayer games with Java and XSL. <http://gameframe.sourceforge.net/>. We attached an IBM System z9 to a BladeCenter using both IBM Power and x86 platforms, and we are continuing to build on our zBX research and development activities by using this BladeCenter."

In another zBX project, a University of Leipzig Ph.D. candidate created a data mining application and developed new algorithms for an insurance company that would help it to evaluate credit risks.

Dr. Martin Maehler, University Relations Manager at the IBM Research and Development Center, says that students pursue work in how to improve the performance of applications and how to maintain and control resources in hybrid System z architectures that are characteristic in cloud deployments. "I'm impressed with what the students have accomplished, and also impressed with their high level of interest in IBM System z architecture and enterprise computing," said Dr. Maehler.

From the Research Center's perspective, Maehler points to three key areas that students bring value to:

- They provide the Research Center with an immediate pool of talent from which to select permanent employees from;
- IBM customers also have the opportunity to see these students firsthand, and to potentially hire them; and

- The working relationship between the Research Center and the German university community enables opportunities for joint research projects.

“As part of the ongoing effort, the Karlsruhe Institute of Technology wanted to build an education lab here that could also serve other academic institutions in Germany,” said Dr. Maehler. “We want to use this platform to engage the approximately 400 universities throughout Germany in IBM System z and enterprise computing training. Within this endeavor, KIT with its e-Learning program is fast becoming a hub of IT education.”

Program Results

Both the KIT IIC and University of Leipzig recognize that it is not enough to just graduate students. The Universities monitor the success of their enterprise computing courses and research by evaluating the contributions and the outcomes of graduating students. “Each year, we have 15 to 25 students graduating from our program,” said Professor Spruth. “About 50 percent of them secure enterprise employment, and a number of them continue the work that they began as graduate students by becoming permanent employees at the IBM Research and Development Lab in Boeblingen. Others secure employment at major German companies such as Daimler and BMW.”

One of these students is Robert Harbach, who graduated with a Masters of Computing (MsC) degree from the School of Informatics at the University of Tuebingen. Harbach attended Professor Spruth's courses on enterprise systems and IBM System z hardware/software architecture during the first year of his Masters studies, and undertook laboratory work ("Praktikum") during the second semester.

Before taking the IBM System z courses, Harbach said that he knew very little about mainframe computing. “I knew that there was a computing world beyond that of personal computers and common operating systems I was already familiar with (e.g., Linux, Windows), but I could have never expected that this mainframe world was so important and so interesting,” said Harbach. “This definitely surprised me, especially the great influence that mainframes have in the enterprises, the national economy and consequently, on our personal lives. Most of us, including many IT specialists, are not aware of this.”

For his Masters thesis, Harbach has been working on a CICS JVM server project. “We are trying to give an overview of the issues related to application isolation in CICS JVM servers, and to show how these issues can be avoided,” said Harbach. “You would think that Java in connection with CICS would be a very safe environment for applications but that is unfortunately not the case. This is because each Java application in a CICS JVM server is represented by a Java thread. This leads to a situation where all applications within the JVM server are running within the same address space and are also sharing one heap. As a result, one application can interfere with another in an undesired way if both applications are not threadsafe.” Harbach hopes that his research will benefit System z research, in addition to earning him his MsC degree.

Harbach was asked if his System z coursework at the University helped him to get prepared for the enterprise job market. “It did and it didn't,” he answered. “On the one hand, I know that I have learned a lot, especially in some of the theoretical background such as address space management of z/OS, LPARs and Sysplexes. I have also developed some practical skills, such as the usage of ISPF, CICS, QMF and SDSF...On the other hand, I have learned that mainframes and all technologies connected to them, are very complex. I know that there will be even more to learn once one is in a daily enterprise setting, running mainframes in a production environment.”

Harbach credits Professor Spruth and the University of Leipzig staff for being able to describe mainframe features and capabilities by making comparisons to more familiar systems such as Linux and Unix. “These comparisons really helped me to understand and value mainframe technology,” said Harbach. “Since then, I have focused on CICS, which is my most important System z skills area.”

“Students in general are surprised and extremely interested when they start learning about the IBM System z and its many capabilities,” said Professor Spruth. “For a young guy in the computer sciences, System z is a new world. He is likely to be amazed that many of the security problems he is accustomed to seeing on other computing platforms really don’t exist on System z. He expects to see a continuous stream of system updates to fix security issues, because this is what he has experienced on other platforms. I then ask him, “Have you ever seen a security update on System z?” This is when he takes notice. The security on System z is so robust that the constant security update cycle is non-existent. At this point, he begins to appreciate the robustness that System z provides to enterprises—and why it is so important.”

Fikret Demirci is in the fifth semester of his Master's degree studies at the Wilhelm-Schickard Institute Department of Computer Science at the University of Tuebingen (<http://www.uni-tuebingen.de/fakultaeten/mathematisch-naturwissenschaftliche-fakultaet/fachbereiche/informatik/fachbereich.html>). Demirci took the Enterprise Computing course from Professor Spruth in the 2010/11fall semester. “Before the course, I didn't have much knowledge about mainframe computing,” said Demirci. “I had given a presentation about cloud computing, but distinguishing between cloud computing and mainframe computing was still a question mark for me. It was at this point that Professor Spruth emphasized the importance of mainframe computing. I began to understand the role of mainframes at crucial points of enterprise business.” Today, Demirci works on his Masters thesis at Daimler (www.daimler.com). The title of his thesis is "Consolidation of user accounts through deployment of z/OS Identity Propagation on the Daimler Global Ordering example.”

At KTI IIC, students also attend lectures, seminars and practical training sessions. The IIC is working collaboratively with customers in Germany like Fiducia, which is the service computing center for German Credit Unions; and SUSE, which is well known for providing a Linux distribution which is highly acknowledged on System z. “German customers have an increasingly strong focus on finding students with as much skill as possible for System z and students with the background of the IIC are highly valued by them,” said Professor Fromm. “In the longer term, these customer collaborations will be extended....The IIC is also open to provide services to other colleges and Universities in Germany and potentially beyond.”

Advancing the Mission

Karlsruhe Institute of Technology and the University of Leipzig have uniquely positioned their enterprise computing and System z education to not only develop new talent for industry, but also to make meaningful contributions to critical areas of enterprise computing research. Establishing partnerships with outside enterprises and research institutions enables these Universities to fulfill important research and education missions. Just as importantly, graduating students take enterprise and IBM System z technology education with them and become attractive new hires for enterprises.

These Universities are committed to expanding the reach of enterprise and System z education to Universities throughout Germany—and this is news that enterprises highly welcome.