# ACADEMIC HOSPITAL

## Transforming the Responsiveness, Quality, and Efficiency of Patient Care

# FREE UNIVERSITY OF BRUSSELS

In recognition of the fact that information technology is transforming medical organizations, AZ-VUB planned to move from a client server to a multi-layered system embedding the complexity of the medical environment. By standardizing on BEA WebLogic Server™ 8.1, the hospital has integrated all patient and hospital administrative information into a single Web-based clinical information system. Besides improving the responsiveness and quality of patient care, the unified system is transforming the efficiency of hospital operations.

### OVERVIEW

AZ-VUB is the teaching hospital of the Free University of Brussels and one of the larger hospitals in Belgium. In common with almost all medical organizations, AZ-VUB is using information technology to transform the way it operates. IT improves the acquisition and assessment of medical data, helps support patient care, and fosters the ongoing generation and integration of new medical knowledge.

AZ-VUB is committed to providing patients with the best possible care—within its finite, valuable resources. Until recently, the hospital relied on client server based systems and multiple, disconnected medical satellite systems such as ECG, EEG, and pneumology, to administer care. This silo-based approach meant physicians and nurses were devoting a disproportionate amount of time to sifting through different paper-based and electronic systems in order to understand patients' needs. This silo-centric, client server approach was also expensive to maintain and wholly inflexible.

On the other hand, many IT professionals in the medical environment advocate that there is a software crisis. Software systems become less responsive to change over time, and permanently lag behind the problem domain. The kind of solutions that the professionals are asked to deliver becomes more sophisticated and complicated. Any advances in ease of use are matched by the demands of a richer, more varied, complex technological environment. But the primary condition that will guarantee

all these advantages is a consistent and carefully designed component architecture. Composition needs a framework for configuring applications entirely out of component parts. Binding is part of the configuration, so every component can be replaced, and entirely new subsystems can be integrated as a matter of configuration.

With new, ever more complex healthcare systems continually being launched, it was apparent that AZ-VUB's environment would become even more complex and more difficult to run unless a radical clinical information system was introduced. The result was a decision to deploy a component-based, multi-tier J2EE portal-based environment. By creating a common framework—or backbone—for the hospital's applications, AZ-VUB would be able to seamlessly integrate hospital application, re-use many components, and effectively manage change.

BEA WebLogic Server 8.1 integrates all patient medical and administrative information into a single Web-based clinical information system. It resides on a cluster of two multiprocessor Fujitsu-Siemens servers, running a Sun Solaris operating system. This showcase, multi-tier infrastructure provides 2,000 health care actors (physicians, nurses, technicians, and other hospital staff) with instant, comprehensive access to patient and administrative information.

The adoption of the BEA/J2EE platform was a way to continue their OO-experience. J2EE primarily targets multi-tier application development. It includes:

> A clean separation of business from presentation logic. The business logic tier encapsulates the business logic of the hospital implemented as Enterprise Java Beans (EJB) components, using BEA Weblogic Server 8.1. Entity beans are the backend of the middle tier; JSP and Swing are the Front-End of the middle tier.

> A supporting infrastructure of J2EE-based applications that has a complex multi-tier architectural style composed of client machines, BEA-load balancers, firewalls, Web servers, application servers, security servers, transaction servers, database servers, and network links between these components.

> Creation of a services framework with generic components that could be reused in other applications. They can access the system from any one of the hospital's 2,000 PCs, in a browser-based menu.

This next-generation clinical information system provides staff with real-time insight into six core applications:

> Patient Identification System
> Electronic Medical Records
> Patient Activities
> Resource Scheduling
> Knowledge Base - Decision Support
> Authorization

The hospital's in-patient and out-patient clinics use the system for almost all their activities, including order entry, scheduling radiology, pathology, surgical and other activities, reporting, medication administering, and admission. It captures a total of 300,000 data base updates each month. The system is used to schedule 70,000 appointments every month and capture and record 68,000 medical reports monthly.

As a result, AZ-VUB is able to schedule appointments more efficiently, and reduce the number of 'no-show' rates. It has cut the paperwork, time and resources associated with admitting and treating patients. Physicians have an up-to-the-second understanding of a patient's diagnosis and treatment progress. The integrated patient understanding allows the hospital to treat more people

as effectively as possible and, when an in-patient returns as an outpatient, physicians have a complete picture of the patient's medical history at their fingertips. It has also reduced the error in billing patients' insurers to less than one percent.

The hospital has also deployed 'wifi' PCs and PDAs among physicians and Palm 3Com mobile personal digital assistants (PDAs) among nurses to enable instant access to patient and clinical information anytime, anyplace, anywhere. Medical histories, patient profiles—even comparatively large image files—can be downloaded at the point of care, and treatment details entered, thereby ensuring patients receive faster, more accurate treatment.

A secure Internet portal as part of the AMIS-project has also been developed to provide external referral physicians and GPs (General Practitioners) with access to their patients' records. They have a comprehensive view of validated medical data, including laboratory results, radiology reports, history of patient visits, and discharge letters. It means physicians and GPs are able to follow the course of each patient's hospitalisation, and keep abreast of their condition. This extended relationship also means they effectively become part of the hospital network. At a later stage, patients will be given secure access to the system to self-administer their profile, book appointments, and provide feedback.

## CUSTOMER BRIEF

AZ-VUB is the teaching hospital of the Free University of Brussels. With more than 2,700 staff and over 700 beds, it is now one of the larger hospitals in Belgium. The hospital admits more than 27,000 inpatients a year, receives over 300,000 visits in the outpatient clinic, and 55,000 in the emergency department. Besides the University Hospital itself, several highly specialized centers have been developed: a cancer center, a center for medical imaging, and a children's hospital. AZ-VUB occupies a prominent position in Belgian healthcare.

## BUSINESS PROCESS CHALLENGE

A fundamental challenge for medical informatics is the design and implementation of evidence-based careflow management systems, to improve productivity while balancing costs with quality of health care. Like any hospital, AZ-VUB is committed to providing patients with the best possible care. It also needs to operate as efficiently and as effectively as possible. Historically, the hospital was relying on multiple, disconnected medical systems to administer care, for almost every medical service, including multimedia digitized x-ray, ECG and EEG images. This meant that physicians and nurses were devoting a disproportionate amount of time to sifting through disconnected paper-based and electronic systems in order to understand patients' needs. This silo-centric approach to hospital administration was also expensive to maintain and was wholly inflexible.

"Most hospital systems have traditionally been 'vertically' oriented: with different systems deployed for almost every individual service," says Professor Rudi Van de Velde, CIO at AZ-VUB. "New systems were introduced in isolation of one another. As a result, most medical organizations rely on different islands of information with minimal interaction between each one.

It was apparent that as new state-of-the-art, next-generation healthcare systems were launched, the environment would become even more complex and more difficult to run unless a radical clinical information system was considered. The result was a decision to move ahead with a component-based, multi-tier J2EE portal-based

environment. By creating a common framework—or backbone—for the hospital's applications, AZ-VUB would be able to seamlessly integrate hospital application, re-use many components, and effectively manage change.

## SOLUTION

Mr Van de Velde and his team evaluated several platforms to underpin the hospital's clinical information system framework. According to Professor Van de Velde, only BEA had the breadth of technology, experience, and vision to meet AZ-VUB's actual and future requirements. "We were confident that BEA WebLogic Server 8.1 would simplify our enterprise computing environment by enabling a smooth evolution from a data-driven to knowledge-based organization," he says. "The standards-based BEA platform possesses unrivalled performance, scalability, and availability. It is also very well documented. Furthermore, we were impressed by BEA' global experience in deploying end-to-end business processes on behalf of healthcare organizations."

BEA WebLogic Sever 8.1 integrates all patient and hospital administrative information into a single Web-based clinical information system. It resides on a cluster of two Fujitsu Siemens servers, running four processors, and a Sun Solaris operating system. A Sybase database underscores the infrastructure. With an annual production of 3TB data the hospital needs an extremely functional and sound system that is stable and mature enough to accommodate over 2,000 users 24 hours per day, 7 days a week.

This showcase, multi-tier infrastructure provides 2,000 doctors, nurses and other hospital staff in Radiology, Pathology and 28 other medical services with instant, comprehensive access to patient and administrative information. They can access the system from any one of the hospital's 2,000 PCs, in a browser-based menu. Specifically, staffs have real-time insight into six core applications:

> **Patient Identification:** This is used to issue and manage each patient's temporary or permanent identification moniker. All patient information resides within this registration reference.

> **Patient Activities:** This manages the collaborative activity between different groups in the hospital and includes a record of prescriptions, diagnoses, previous treatments, medical insurance, and payment details. For instance, a physician can email a patient's medical report to a hospital consultant for advice with triggers to monitor and control activity.

> **Medical Record:** A deletion-less central repository contains multimedia medical patient data covering information within the medical record. Data is also gathered from various departmental/satellite feeder systems such as ECG and EEG. As there is no physically unique electronic medical record, the medical server provides tools for clustering and presenting medical data, aggregated in different structures according to user needs. It further incorporates all medical images collated from the various departments, including digitized scans, biopsies, and ultrasounds. These can be viewed in a clustered, aggregated environment, dependent upon the patient's needs.

> **Resource Scheduling:** This application supports the hospital's management activities and includes appointments scheduling, drug consumption, bed availability and human resources.

> **Decision Support:** This rule-based application is used to optimize resource scheduling, monitors the effects of different treatments (adverse drug reactions) on patients, and undertake patient invoicing.

> **Patient Authorization:** This provides a unified system for the definition, declaration, and secure access right of individuals according to the hospital's legal, medical, and organizational requirements.

## RESULTS

The hospital's in-patient and out-patient clinics use the system for almost all their activities, including order entry, scheduling radiology, pathology, surgical and other activities, reporting, medication administering, and admission. It captures a total of 3000,000 data base updates each month. The system is used to schedule 70,000 appointments every month and capture and record 68,000 medical reports monthly. Physicians and nurses on a monthly base generate over 150.000 medical orders.

And this scope of service is matched by the performance: 90 percent of classic interactions are completed in less than one second, and even CT scans comprising as many as 50 separate scan 'slices' can be viewed in just two seconds.

"BEA WebLogic Server 8.1 is a cornerstone of the clinical information system," explains the Professor. "We have replaced scores of disconnected paper- and electronic-based systems with a single, integrated system for managing patient welfare. This provides significant advantage at every stage of the patient lifecycle management. More than 95 percent of physicians are reported to be 'satisfied' with the system."

"Today, appointments can be scheduled more efficiently, and we reduce the number of 'no show' rates. We have cut the paperwork, time and resources associated with admitting and treating a patient. Physicians have an up-to-the-second understanding of a patient's diagnosis and treatment progress. The integrated patient understanding allows the hospital to treat more people as effectively as possible; and, when an in-patient returns as an out-patient, we have a complete picture of their medical history at our fingertips. Finally, we have reduced the error in billing patients' insurers to less than one percent."

The hospital has also deployed 'wifi' PCs and PDAs among physicians and Palm 3Com mobile personal digital assistants (PDAs) among nurses to enable instant access to patient and clinical information anytime, anyplace, anywhere. Medical histories, patient profiles—even comparatively large image files—can be downloaded at the point of care, and treatment details entered, thereby ensuring patients receive faster, more accurate treatment.

"AZ-VUB is continually striving to make optimal use of its finite resources," Professor Rudi Van de Velde concludes. "BEA WebLogic Server 8.1 has a crucial role to play here. It has created the framework for a high performance, resilient infrastructure to which we can add applications as they are developed. It overcomes the complexity associated with traditional integration, and creates the blueprint for a highly effective healthcare environment."

*A book by Rudi Van de Velde and Patrice Degoulet with more detailed information on the hospital's IT infrastructure is available. It is titled "Clinical Information Systems. A Component Based Approach". It is published by Springer-Verlag NY Berlin Heidelberg (ISBN 0-387-95538-0).*

## ABOUT BEA

BEA Systems, Inc. (Nasdaq: BEAS) is the world's leading application infrastructure software company, providing the enterprise software foundation that allows thousands of companies to benefit from service-oriented architectures. With more than 15,000 customers around the world, including the majority of the Fortune Global 500, BEA and its WebLogic® and Tuxedo® brands are among the most trusted names in business. BEA has 75 offices in 34 countries and is on the Web at www.bea.com.

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