

Information- and Communication Technology (ICT) as a Key Success Factor for the Swiss Federal Institute of Technology (ETH Zurich)

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Abstract

The rapid development of Information and Communications Technologies (ICT) has a direct influence on all fields of education and research. Radical new models of collaboration, knowledge exchange and access to the constantly growing mass of information have become possible. A high-performance and flexible ICT infrastructure is an important success factor in global competition and also relevant to the degree of attractiveness of a university. The ETH Zurich has declared its aim to belong to the leading universities worldwide. The implementation of a matching ICT strategy will help to achieve this aim. This paper describes the ETH Zurich's situation at the outset, the process of strategy development and the direction of impact derived from the ICT strategy for future development.

The ETH's ICT environment is characterised by three components which form a basis for present and future services: a universal, wired network which is complemented by wireless LANs; an Identity Management System for students and employees and ample provision with hard- and software guaranteeing easy access to information sources and electronic services for all ETH members.

The process of developing the ICT strategy was given a wide basis on which to build upon. The impulse leading to the development of the overall ICT strategy came from the recommendations in the interim evaluation of the strategic program "ETH World" at the end of 2003. A project group, with members from the departments and the infrastructure division, has been working intensively on this strategy since March 2004. Particular attention was given to teaching and research needs. The process was carried out under close inclusion of the departments. The strategy will be passed by the Executive Board in fall 2005.

A common understanding concerning the main aims of the university, from which the aims of the ICT support organisation can then be defined, is of decisive importance. A further important success factor is an open and constructive communication/work environment which especially contributes to the "window of opportunity" which in turn can enable the realisation of new ideas.

Keywords: ICT-Strategy, ICT-Infrastructure Projects, Organisation of ICT Services.

1 Introduction to ETH Zurich

Mission Statement

"The ETH Zurich imparts to its students the highest state of knowledge and practical skills. It seeks to enable young people to find their orientation in a complex and rapidly changing world, and to stimulate an understanding of ethical and cultural values so that, upon completing their studies, they will be not only highly qualified professional people but also responsible members of society.

The ETH Zurich is not content with mere participation in solving already known problems. In the context of global civilisation, it must respond to changing conditions, it must identify new problems as a kind of early warning system, and assume a leading role in seeking solutions. In doing so, it depends on the spirit of discovery, innovative force, and flexibility in its members.

As a technical university in a small country, the ETH Zurich can only compete with the world's best by establishing international links, by recruiting its academic and research staff worldwide, and by remaining attractive to students from abroad. The multicultural tradition of Switzerland, its cultural heritage acquired over many generations, provide in our view a strong base for this purpose."

The Swiss Federal Institute of Technology Zurich (ETH Zurich) is an institution of the Swiss Confederation dedicated to higher education and research. Together with the ETH Lausanne and four research institutes, it forms the federally directed, and to a major degree financed, ETH domain. The institutions of the ETH domain uphold their autonomy and identity on the basis of the ETH Federal Law and in the full awareness of their social, economic and cultural responsibility to the nation and its citizens.

The ETH Zurich, which was founded 150 years ago, is very internationally orientated and is ranked among the best universities in various ratings. In 2004 the ETH counted 358 professors, 8,140 technical-scientific employees and 12,505 students. The international orientation is reflected in the

ETH's key data: 40.6% of the personnel is from abroad and 57.7% in the case of the professors.

The ETH Zurich is situated in two main locations, one of which is in the city centre and the second of which is on the city outskirts, about 5 km away from the centre. Due to town planning and budgetary factors, only a very limited growth in premises will be possible in future.

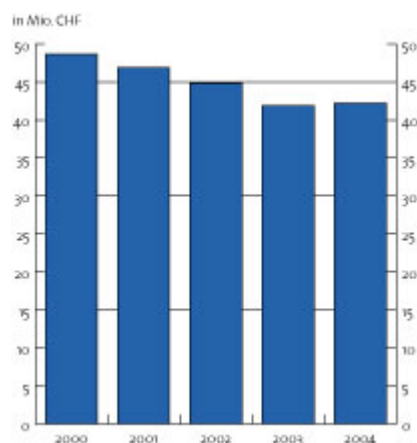
The Executive Board consists of the following members: the President, the Rector, the Vice President Research, and the Vice President Planning and Logistics. The ETH Zurich is bound to a performance mandate from the Federation. The annual budget is 1 billion Swiss Francs (840 million US Dollars). The central ICT Services report to the Vice President Research.

2 Starting Position

The ETH has a longstanding tradition of a well developed ICT infrastructure. ICT is used as a tool and as a means of research.

In the course of general decentralisation and the PC boom in the late nineties, a subsidiary division of the ICT services, which were provided by the central and decentral instances, developed. On the initiative of departments and institutes, electronic services for students - with varying characteristics and quality - such as e-mail, reservation systems and web space were made available. This tendency was accelerated because of the rapid growth of the World Wide Web and the growing number of private internet connections. At the same time the limitations and problems of this concept became apparent.

Under the effect of shortened budgets, the actual situation was assessed with the aim of redetermining task distribution in the ICT sector and redefining priorities.



Innovative and productive employees, flat hierarchies, relatively large decision-making competencies, a central organisation and the stable, high-capacity network were identified as strengths. The weaknesses were recognised as being the following: the underdeveloped ICT services for

students in international comparison; the unclear distribution of tasks between the central service providers and the institutes and departments as well as the organisational structures which no longer were applicable to the changed requirements and possibilities.

3 Key Decisions and Key Projects

About five years ago, in order to keep up with rapid technical development and better be able to fulfil the university's growing requirements, the organisation of the ICT Services was consequently structured according to services and customer groups. The interfaces between the ICT Services and the departments and institutes were also newly defined. This newly formed organisational environment enables the ICT Services to play the role of a central ICT provider and also to play a significant part in shaping the development of new electronic services. Decisions which were thereby made at an early stage have had a lasting effect on the ICT landscape at the ETH. One of the most important points which set the course for the future was the decision to establish an integrated Identity Management System for all ETH employees and students. Two business processes, in the centre of which stand the rectorate (for the students) and the human resources department (for the employees), ensure that all members of the ETH receive a user name and password at their admission and are equipped with the relevant role-based access rights. When this system was being developed, great importance was attached to being able to delegate management functions. The information, saved in an Oracle database and concerning persons, their roles and rights, also serves as a data source for a series of other services.

3.1 ETH World

ETH World is a strategic programme to establish a virtual space for communication and cooperation independent of time and place. The programme aims to make this space widely used and accessible to all stakeholders of ETH Zurich. ETH World supports all members of ETH in their core business - teaching, learning, research and the associated management tasks. The programme enables new forms of networking and cooperation with business, industry and society. ETH World contributes to realizing the vision of a university of the future and thereby strengthens the international competitiveness of ETH Zurich.

ETH World wants to give new ideas a better chance and also wants to accelerate change. A competitive melting pot for innovative ideas was created. All units of the ETH Zurich could apply for these means with their projects. At the same time this strategic programme of the ETH Zurich opened further possibilities of growth, namely in virtual space.

Major building blocks towards realizing the vision of ETH World are contributed by projects, carried out by the departments, laboratories and other units of the ETH Zurich. Also many projects funded by a programme for innovations

in teaching and learning at the ETH Zurich, use new information and communication technologies, thus working towards common goals.

ETH World supports pioneer projects for developing new forms of communication and collaboration in teaching, learning, research and services. Other projects implement the basis for a pervasive information and communication infrastructure - the "infostructure" - of ETH World, which enable new services and bring practical benefit to all stakeholders of the university.

Further information about ETH World can be found on the ETH World Homepage [2].

3.2 ITproETH

The aim of this project was to reshape the basic conditions of ICT support for the main tasks of the ETH in research and teaching. First of all an attempt was made to revise the service palette of the ICT Services and to this end to agree on a mandate with the Executive Board of the ETH. However it soon became apparent that an overall examination of all the needed and rendered ICT services at the ETH was necessary in order to find the right allocation of the tasks and to develop an optimized organisation structure.

The organisation of the project was therefore altered accordingly and the project team was assigned members from the central ICT Services, the departments and the Executive Board. In addition an external consulting company, specialised in questions of organisation, was consulted.

The requirements made on ICT service provision were based on strategic observations and concrete needs (implementation of the ETH mission statement, trends in ICT provision, benchmarks with other universities, written and individual questioning of clients from teaching and research backgrounds, analysis and criticism of the tasks concerning the actual state) and a basic structure of the offered services was derived. The individual services and the responsibility for each of them were then allotted to the involved central and decentral organisations. Much importance was attached to making the costs of the individual services transparent. Cost transparency is regarded as an important management tool even though the recipient of the services is only charged a small part of the effective costs.

An adaptation of the organisation of the central ICT Services and of the ICT support groups of the departments and institutes became necessary due to the new distribution of the tasks.

A vertical organisation structure based on services was chosen for the ICT Services. The structure of ICT support on the departmental level was also restructured. Within the framework of the project three alternative models were developed. The Executive Board made six million Swiss Francs available to the departments for a period of three years in order to set up professional ICT support groups.

In addition to the measures which concerned services and organisation, it was attempted to improve the formal and informal communication between the ICT Services, the departments and the Executive Board. The ITEK (IT Expert Group) was founded to this end. This panel advises the Executive Board in operational matters concerning information technology and, in the context of primary fields of work, carries out or accompanies important IT projects.

ITproETH was an important contribution to the further development of the ICT services for the ETH Zurich. Problems can be recognised at an early stage and joint solutions can be worked out through the intensified collaboration of all concerned parties. New challenges are coming into being at this very moment due to the trend for further centralisation, security questions and the controversial subject of e-Learning.

3.3 Organisation of the ICT Services

The ICT Services are part of the ETH Zurich's infrastructure divisions. They are directly responsible to the Vice-President Research. It is the ICT Service's task to support the ETH in its main duties of teaching, research and administration by providing ICT services. The basis of the services offered by the ICT Services is the mandates given by the Executive Board and agreements with the departments. The ICT Services collaborate closely with the decentral IT organisations of the departments and institutes and maintain national and international contacts with other universities and research institutes.

One result of the ITproETH project was the clear definition of the duties of the central ICT Services. This starting position led to the ICT Services being newly organised according to this definition. An organisation was chosen according to client segments.

The ICT Services are divided into six sections:

Betriebsinformatik, Systemdienste, Basisdienste, Communication, Technology and Information Management and the Helpdesk.

Betriebsinformatik: The duties of the section Betriebsinformatik include the running, support and further development of the central Operative Information System of the ETH, the technical support of the employees of the central organs of the ETH and accompanying informatics projects of the central organs. The main components of the Operative Information System are the central Person and Organisation Database, the Lecture Database and applications, SAP including the modules FI/CO, HR and MM and the applications for the administration of rooms (GIRBS).

Systemdienste: The section Systemdienste is responsible for the running of and the support of the central computers and the backup and storage systems (AFS, Netbackup, SAN, NAS). Based on individual agreements with costs, the Systemdienste takes on the system management and the

running of IT infrastructures in departments, institutes and work groups of the ETH.

Basisdienste: The section Basisdienste is responsible for all authentication and directory services (DB, Radius, AD, LDAP), the entire administration of the users of all services, the central mail server and gateways, web hosting, the public student workspaces, as well as VPP (Versatile Printing and Plotting).

Communication: The section Communication is responsible for the planning, installation and maintaining of all data and language communication networks of the ETH Zurich. On the one hand this involves the campus networks themselves and also the integration of all the external properties in the ETH network as well as the ETH's communication with the Internet. This section is also responsible for the security of the data and language communication networks and the attached end devices as well as for the technical support of multimedia-based tuition.

Technology and Information Management: The section Technology and Information Management supports the quality assurance and the operating efficiency when providing informatics means at the ETH by active identification of innovative concepts, trends and products and also investigates their application in connection with the ETH's aims. The section is responsible for the conception and implementation of IT courses based on ETH needs as well as for the support of hard- and software acquisition. The entire license management of the ETH Zurich is another of her duties.

Helpdesk: The section Helpdesk is the contact point for all matters concerning the ICT Services which cannot be directly dealt with by the responsible instance. The Helpdesk knows all the services of the ICT Services and their operating states such as for example planned and unplanned interruptions of service. The support team of the Helpdesk supports the IT support groups (ISG) of the departments with tricky problems. They are open for all informatics matters and try to find the best possible solution. If required, on-site support is also provided especially in the case of isolating problems.

More information about the organisation of the ICT Services is available on our web site[3].

The communication with the users of our services is very important to us. The following formal committees have been set up with this in mind:

Die Informatikkommission: This committee advises the Executive Board concerning important strategic questions about the application of information and communication technology. It is made up of professors who are leading in their fields of research or teaching in the use of ICT. The ICT Services are also represented in this committee.

The *IT Expert Committee* is made up of the section leaders of the ICT Services and the persons responsible for ICT in the departments. This committee mainly deals with the coordination of technical questions.

4 ICT Strategy

In order to take advantage of the good situation created at the outset and in order to plan the next steps in a target-oriented way, a widespread process was carried out in 2004, which led to an updated ICT strategy at the beginning of 2005 for the years 2006 to 2010.

This new ICT strategy is the basis to consolidate the results of ETH World and IproETH and to guide future developments.

4.1 Process of developing

The process of developing the ICT strategy was given a wide basis to build upon. The impulse leading to the development of the overall ICT strategy came from the recommendations in the interim evaluation of ETH World at the end of 2003. A project group with members from the departments and groups providing infrastructure has been working intensively on this strategy since March 2004. Particular attention was given to teaching and research needs. The process was carried out under close inclusion of the departments. The strategy will be passed by the Executive Board in fall 2005.

4.2 Key Messages

The key messages of the new ICT Strategie are the following:

Encourage individual, flexible Learning: This strategy defines general guidelines and sets strategic aims for the use of ICT in all core processes of the university. Through the adoption of new technologies, the ETH Zurich wants to encourage individual and flexible learning and autonomous dealing with learning matter by the students. ICT resources will be used in situations in which added value arises for learning or teaching. Through the application of these resources, not only study but also work at the university are supported independent of time and place.

Competitive Edge for Research: The application of ICT in research is a decisive success factor in many specialist areas. The ETH Zurich wants to maintain and expand its leading position in this field. It considers ICT as a central component of its excellent infrastructure which at the same time represents an important competitive advantage. This infrastructure must guarantee access to computing power, transmission capacity and information and must be further developed according to need. The large quantities of data, which are produced in many research projects and can be used by the global science community, also present a challenge.

Services for Industry and Society: The ETH Zurich wants to contribute to the further development of the worldwide scientific community and to global access to knowledge and information. According to its national mandate and its claim to global influence, the ETH pursues a policy of the widest possible public availability of its teaching and learning materials, research results and services. In particular the ETH wants to extend its outreach activities and services for

industry and society with the help of new technologies. The ETH wants to serve existing target groups better and reach new ones with ICT-based further education offers.

Communication and e-Services: New technologies also offer ideal possibilities for internal communication and the participation of employees, students and alumni. In order to make its business processes even more efficient, the ETH is establishing e-Services in all fields of infrastructure.

4.3 Implementation

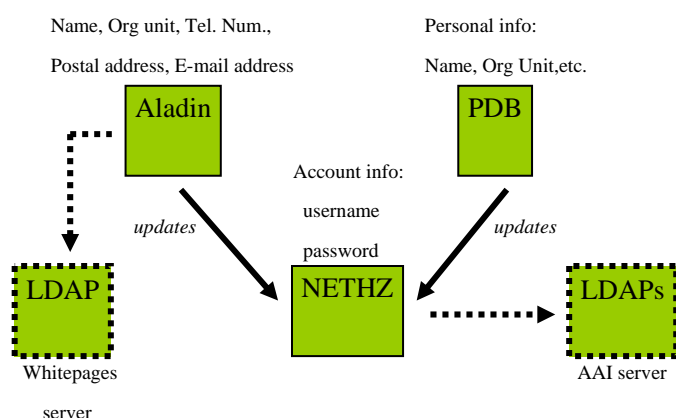
The strategy gives only rough guidelines. These guidelines will be agreed upon easily within the ETH. Prioritised plans and measures will however have to be deduced in order to implement the strategy. These priorities have not yet been definitely decided upon. The implementation cannot simply be a task of the ICT Services alone. The departments and central organs must also be involved. The challenge for the next few years will be to guide and coordinate the resulting projects and services.

5 Major Projects

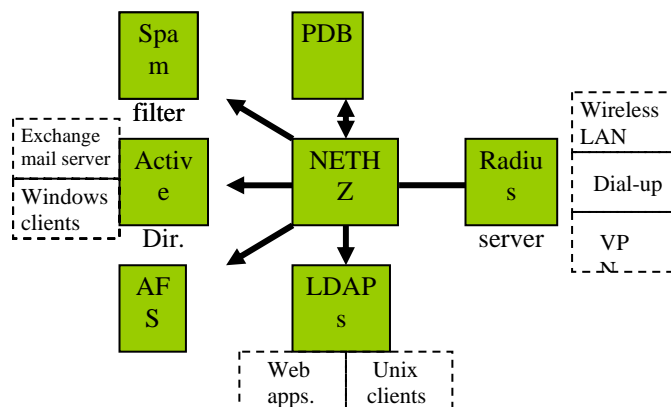
Several concrete and important projects which were realised in the last 3-4 years and are all in operation are described below. They form the main foundation pillars for the upcoming work.

5.1 Identity Management

The core part of the electronic services of the ICT Services is an Identity Management System which covers all ETH employees and students. Business processes of the human resources department (for the employees) and of the rectorate (for students) record and mutate the necessary personal data.



The personal data, saved in an Oracle database, also serves as a data source for other systems and services: AFS home directories, e-mail, spam filter, dialup home access (ISDN, cableTV), laptop docking and wireless LAN, Virtual Private Networks, Message System, iPass roaming access, software distribution, personal web pages and all electronically supported administrative processes.



When this system was conceived, great importance was attached to being able to delegate functions on a decentralised basis. The maintenance of the data is carried out by an in-house developed web application (Perl).

5.2 Wired and Wireless Network

These days the "data freeway" is as normal a part of work place equipment as electricity and water are. A high-capacity technical infrastructure was built up for the data traffic within the ETH and for the Internet. This communications infrastructure connects around 40,000 ports within ETH buildings. The bandwidth of the Swiss Education & Research Network (SWITCH) is 10 Gbit/s and that of a normal work place is 100 Mbit/s. The network is composed of a backbone ring to which the individual local networks are connected in a star topology. The backbone cabling and the cabling right up to the floor distributors is glass fiber whilst the connections between the floor distributors and the work places are copper category 5-7.

In order to meet future security requirements and ensure the stability of the network whilst also not having to give up the openness of the university network, the ETH's network was divided into smaller logical units. Such a unit can be distributed over the entire ETH and is completely transparent in itself (there are no elements of protection within the unit). Each of these units is logically separated from the others and there is no direct outward connection. Basically the present full transparency within the entire network is thus limited to the full transparency within a unit. Potential errors therefore have no more global effect. This concept is realised with MPLS and virtual firewalls. The administration of all these firewalls is the task of the ICT Services whereby the rules can be adapted to the individual needs of the user concerned.

Furthermore it is planned that the network will be considered as a resource in future. To this end all computers - respectively their users - must identify themselves to the network as valid users before they can use network services.

In addition to the wired network there is a wireless network with around 250 access points. This is presently mainly used by the students but more and more by the employees. It is (presently) not the intention to cover the entire campus

completely with a wireless network. It is rather the aim to equip the public areas, the lecture theatres and other classrooms. The wireless network is regularly used by more than 6,000 people during the term.

5.3 Laptops for Students and Staff

Today the computer is one of the most important tools for technical-scientific studies which is why the ETH offers students permanent computer work places. The number of these work places is however limited and the working environment is obviously different to that at home. In addition it has become clear that the future increasingly belongs to mobile computers.

For this reason ETH Zurich students and employees have been given the possibility to buy carefully selected notebooks at excellent conditions through the NEPTUN project. Thereby and also thanks to accompanying measures, a personal environment of learning and knowledge shall be realised which encourages studying, learning and research independent of time and place.

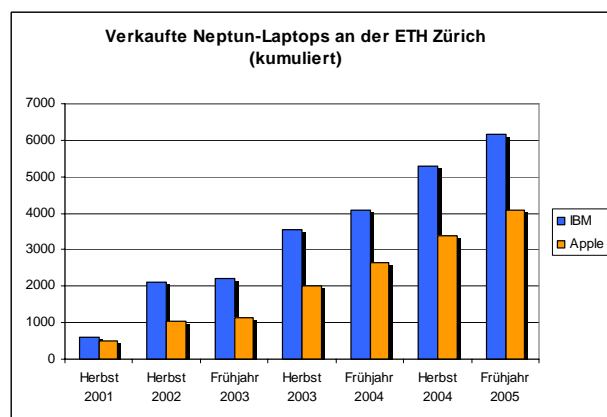
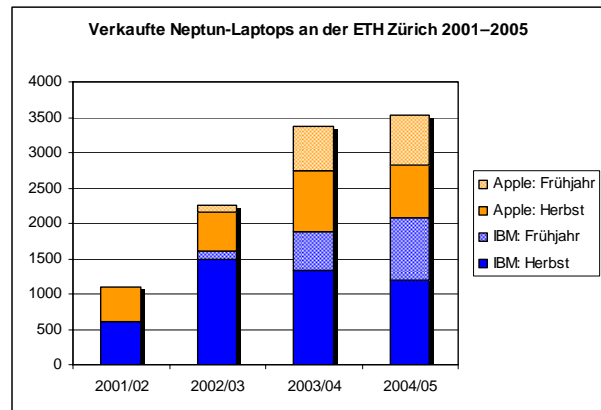
During the four years of this project ETH students and employees have bought more than 10,000 laptops altogether. With a total volume of over 18,000 units sold in the whole of Switzerland, NEPTUN has developed itself to a market factor in the education sector.

NEPTUN is however not merely a sales programme with good devices at attractive conditions. The success is based considerably on additional infrastructure services (wireless LAN, software distribution and updates, printing facilities and support) which upgrade the laptops to mobile work places.

The accumulated sales figures speak for themselves that the pervasion of laptops at the ETH has become very high in the meantime. During the four years of this project ETH students and employees bought over 10,000 laptops. It is estimated that around three quarters of all students possess a laptop.

The distribution of the purchases between IBM and Apple has levelled off at a ratio of 60:40. In the other participating educational institutes, the Apple slice outweighs by far. It should be noted that since 2004 there have been more orders from other institutions than from the ETH.

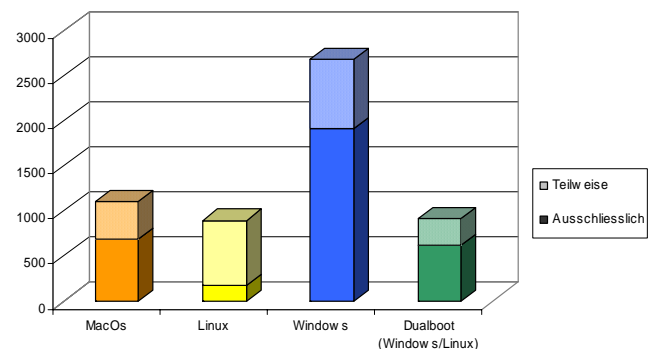
The wireless LAN is an integral component of the NEPTUN concept and is very popular. The growing number of laptops at the ETH is reflected in the increased usage of the wireless LAN. For instance the number of users in the (up until now) peak month of November 2004 increased by 20% in comparison to summer 2004. Online time has established itself at a level of around 200,000 hours per month.



High level name recognition and wide acceptancy

A laptop survey was carried out amongst the ETH students in January 2005 in which 3,826 students participated. This very positive high participation of 30.6% reflects the students' great interest in the subject.

Operating systems used on laptops of ETH students:



The most important results:

- The NEPTUN project is very well known (98%) and popular: 90% of the respondents recommend it to others.
- The share of NEPTUN laptops is very high at 60%. However this project did not lever IBM and Apple into a monopoly position. Devices from other manufacturers are still well represented.

- The laptops are heavily used. Nevertheless few major problems have arisen. The students often solve simple problems themselves or with the help of acquaintances. The NEPTUN helpdesk is consulted in complicated cases and is very much appreciated.

- The number of Windows users outweighs by far, followed by MacOS and Linux.

NEPTUN's success factors

The NEPTUN project team has analysed the project and identified seven success factors: low priced, top quality devices, a complementary infrastructure, an attractive software range, effective communication and well aimed marketing, professional support, flexible training possibilities as well as an intensive collaboration of all participants

5.4 Software Procurement

Software is procured via a central point at the ETH. The centralisation of software acquisition strengthens the ETH's position in negotiations with software suppliers and enables a good overview of the software products in use. The ETH buys software for 6 million Swiss Francs per year. Software products can be ordered by the user via a central software distribution system (IDES). The software distribution system enables the user to download the products he has ordered and, if necessary, also covers the financial aspects of the order. The users are only partially charged for the software products. Products which are needed by all users are centrally financed.

5.5 Web Content Management

Up until 2000 there were no generally binding rules concerning the handling and design of web sites. The "digital goldrush" mood was prevalent. Demands on quality and work methods were very individual. Unfortunately most of the pioneers have left the ETH in the meantime and their successors tried to keep the many and very differently constructed web servers running.



Gradually it became clear that this way of handling web sites would not work in the long run. Web content management systems appeared on the market which promised a drastic simplification of the handling of web sites. For this reason a project was begun which aim was "the construction and launch of an enterprise level web content management system at the ETH including the appropriate process model, support processes and services". After an analysis of the commercial products available on the market, it was decided for cost and security reasons to extend the evaluation to Open Source products. Finally the choice fell on the product "Silva" from the Dutch company called Infrae[4]. In the meantime over 120 web sites have been constructed using Silva including the ETH homepage.

5.6 e-learning

E-Learning is not yet in widespread use at the ETH. The optimal use of e-Learning is still being controversially discussed amongst the professors. Presently WebCT/CE is being used as a central system. There is also a close collaboration with the University of Zurich, which has developed its own system – OLAT[5].

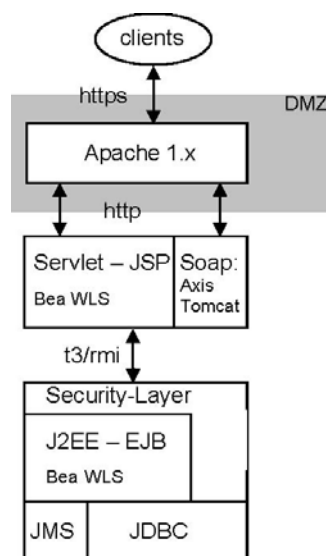
5.7 e-Services for Teaching and Research

In summer 2000 we launched the reengineering of the old terminal oriented administrative applications. By then, only the student data had been moved to a modern database-system. Moreover, the ETH-Management had decided that the Bologna implementation should be completed by autumn 2005. This and the vision of ETH-World required the ICT-services to build the infrastructure needed in order to render many of the fundamental academic activities location independent: this was clearly not compatible with the old, centralised, paperbased administrative processes. We basically had five years time to re-implement data repositories and applications, not knowing exactly how the ETH would organise its teaching in the post-Bologna era nor what the related administrative processes would look like. The challenge for the ICT-Services was big indeed. This project is described in detail in [6].

Our IT-environment consists of an integrated operational information system (OIS) with a central data repository also serving the authentication and authorisation infrastructure (AAI) (c.f 5.1), and several applications accessing it. Whereas for finance-, HR- and facility-management we deployed standard applications (SAP R/3, Planon), we decided to develop the "Core-Components" (handling of names and addresses of ETH-members as well as organisational data), the AAI, and the academic operations applications as individual software solutions, since none of the available commercial products met the requirement of implementing full, detailed support for the ETH-specific processes.

The essential academic operational processes requiring interaction between students or teaching staff members and the administration (term registration, selection of a degree course and choice of classes within it, change of addresses or other personal data, planning-workflow for each course schedule, handling of course and exam related data, room reservation etc.) are supported by comprehensive webapplications that we implemented according to the J2EE standard. A further development in this group is the ETH course catalogue (www.course-catalogue.ethz.ch).

The choice of a technology for the development of the web application has been determined by the requirement of supporting 200 concurrent users or more with acceptable performance.



SQLnet

OIS - Oracle DB

Since we expected very strong load peaks at the beginning and at the end of each term, the technology of choice had to be scalable and established. Additionally, in order to achieve a reasonable independence from hardware and software producers, we opted for an architecture based on the Java 2 Enterprise edition (J2EE). We decided to implement the full 3-tier architecture with the Oracle OIS DB as persistence tier, the EJB container as business-logic tier and the Servlet/JSP frontend as presentation tier. After a careful evaluation of commercial products we opted for BEA Weblogic Server (WLS) with Apache as a Web-Frontend and as SSL-Encryption engine. The JSP and EJB containers are deployed in separate WLS instances.

Another fundamental requirement that determined the general architecture of our applications was that of delivering data on-line to external environments without opening the DB to external users. For the standardisation and quality control of the data that are needed for the Diploma Supplements, the ETH decided to collect and store the course descriptions in the central DB. These data had been traditionally managed by the departments and published on paper. In order to guarantee

their availability for the departmental environments, a Web service is offered, which permits the periodic download of the catalogue data. Our implementation is based on the SOAP technology, whereby the Apache Axis implementation is used as a supporting Tool5. This technology will also be used for data exchange between the OIS-environment and applications run by other ETH and external organisations.

6 Conclusions

Organisational and technological requirements on the one hand and strategy development on the other influence each other mutually. The statement "structure follows strategy" also seems to be valid at a university even when the processes of strategy development take place differently to the way they do in private industry.

A common understanding concerning the main aims of the university, from which the aims of the ICT support organisation can then be defined, is of decisive importance. A further important success factor is an open and constructive communication/work environment which especially contributes to the "window of opportunity" which in turn can enable the realisation of new ideas. The "human factor" must not be neglected on any account. Also the danger should not be underestimated that one unsuccessfully tries to treat subjects which, in fact, have nothing to do with the ICT strategy. Finally it can be concluded that in our view there is no "golden bullet" when implementing the strategic guidelines for concrete ICT services.

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