

# Multi-level modelling for faculty educational program development in global networks

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**ABSTRACT.** The University of Zwickau is a medium-sized university, with a significant regional orientation. Because of globalization of knowledge transfer, it will be forced to become a part of national and international networks of training and education. The Institute of New Kinds of Education developed different models for opening the university to global co-operation and competition. Especially the Faculty of Management and Business Sciences will strive for the realization of a MEM-Multichannel Educational Model, in order to be prepared for the challenges of next decade.

The analyses of the existing activities and opportunities are the precondition for the development of special models. Especially the adaptation of course offers to the requirements of the markets, in accordance with the future potentialities of the faculty, is necessary. Multichannel educational models have to be developed.

The opportunities of the multi-level modelling strategy will be explained both, in the first approach, as an abstract modelling theory, and, in the second approach, as a case study, by the Institute of New Kinds of Education, in the Faculty of Management and Business Sciences, at the University of Applied Sciences, Zwickau, Germany.

**KEYWORDS:** *BSC-Balanced ScoreCard, Granulation, MEM-Multichannel Educational Model, Modularization, Multilayered modular-design*

## The University of Zwickau and its standing

### *General information*

As a West Saxon centre of industry and trade, and particularly as an important location in the automobile industry, Zwickau has enjoyed a long tradition as a home of technological education.

Founded in 1992, the University of Applied Sciences of Zwickau continues this long-time tradition in education and research. To this day, it has expanded to include locations in Reichenbach,

Schneeberg and Markneukirchen.

The program contents reflect both the tradition in the field of the automobile industry in West Saxony, and modern, innovative ideas and trends, using the latest technologies. Programs in the fields of engineering and economy include Mechanical and Automotive Engineering, Physical Technology/Computer Sciences, Electrical Engineering and Economics in Zwickau, as well as Textile and Leather Engineering in Reichenbach. The academic departments of Applied Arts in Schneeberg, Architecture in Reichenbach, as well as Languages, and Healthcare & Nursing Sciences in Zwickau establish the third profile of life quality at the University of Applied Sciences.

#### History of technological education in Zwickau

1290	Latin School established in Zwickau
1519 - 1522	Agricola taught at and directed the Greek and Latin school
1828	Sunday School established for merchants
1862	Mining School established, 1949 renamed Mining Engineering School of Zwickau
1897	Engineering School of Zwickau established
1965	Technical College for Mechanical and Electrical Engineering of Zwickau
1969	Engineering University of Zwickau
1989	Technological University of Zwickau
1992	University for Engineering and Economics of Zwickau (designated Fachhochschule)

#### ***Strengths and weaknesses of the University***

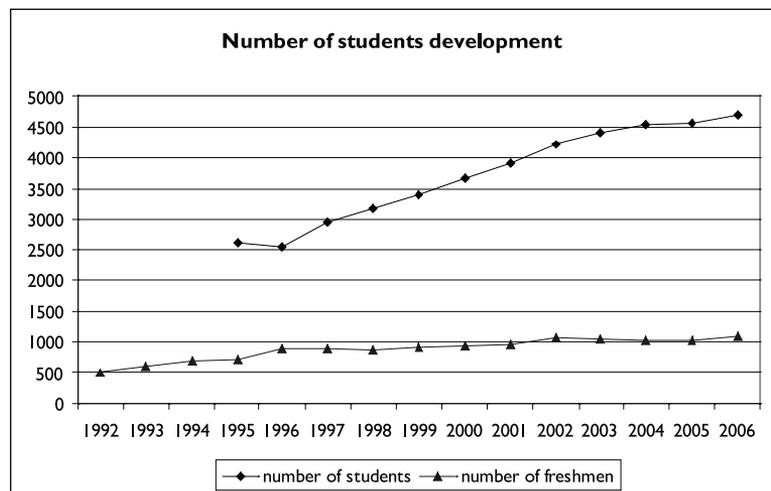
The University of Zwickau offers a modern academic education i.e. practice-oriented teaching, steadily integrating research and development, as well as technology transfer, all by an experienced teaching staff and sophisticated technological equipment. Newly arranged and well equipped lecture and seminar rooms, libraries, laboratories, studios and computer pools, with advanced information and communication technologies, provide the basis for both a modern, academic and practical university training. This is particularly reflected by co-operative training programs and postgraduate courses for full-time and distance learning, providing further training facilities for the University graduates.

As a modern practice-oriented institute of higher education, the University conducts applied research work with a high level of

commitment. Research projects are carried out at the University itself, at the Innovation Centre of Automotive Engineering, at the Research and Transfer Centre, or at newly founded institutes, associated to departments. As a result, indispensable scientific and technological services are offered for the region and beyond.

The strengths of the University offers in education and research are clearly appearing in regional business contacts. The students' catchment areas (or catchments) are also limited to the newly-formed German states, except for students in postgraduate distance learning courses. Anyway, the number of students has developed continuously (Figure 1).

Figure 1. Number of students development



It appears, in spite of the constant number of matriculated students, that the total number of students increases yearly, because of the longer duration of studies. Most students have no financial aid, and need to earn their living. In the near future, newly structured and modularized course contents will support the individual scheduling of studies. In the field of the Bologna process, relating to the demographical challenge of the decreasing number of applicants, the University needs to strengthen its position within the international competition. Mobility of students and professors as well as cooperation in European and international research projects need to increase. Fundamentals are flexible, modularized course contents, international exchange programs, and networking in

education and research, as well as an effective administration, including online matriculation and registration.

### ***Educational transfer***

The adjustment process in the department of Economic Sciences of the University exemplifies the challenge of modularization after accreditation, as well as the potentialities given. Analyzing the content in terms of needs of the market, associated with the competences of the professors and the legal requirements, a holistic range of courses and research focuses was developed. Coordinated first and second cycle programs (bachelor/master), postgraduate and distance studies, complementing with further trainings, supported by two research institutes, yield a balanced range of courses. Modern communication and learning systems aid the expectation of reducing the duration of studies.

## **The challenges of globalization in education**

### ***Globalization***

World-wide development is characterized by globalization. Globalization is a process of increasing integration and interaction between systems and organizations of different kind, and out of different nations: it is the growing independence of economic systems from national economic limitation through worldwide access to general resources and the free flow of agents of production. The process of globalization is associated to deterritorialization, interconnectedness, speed or velocity, and it must be understood as a long-term as well as multi-pronged process (Strunz, Dorsch, 2001).

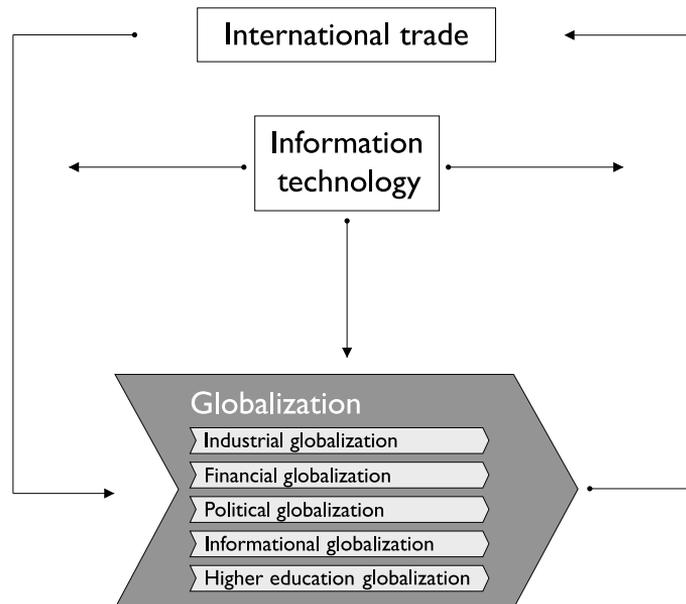
Globalization includes different dimensions:

- industrial globalization: development of multinational enterprises/global players;
- financial globalization: integration of international financial markets;
- political globalization: spread of political sphere of interest, in the regions and countries outside the neighbourhood of political (state and non-state) actors, and the potential formation of a global citizens movement;
- informational globalization: information flows between geographically remote locations;

- cultural globalization: growth of cross-cultural contacts.

Globalization is driven by international trade and investment, and aided by information technology (Figure 2). It is a complex connectivity (Tomlison, 1999).

Figure 2. Globalization process



It finds its expression in the increasing volume and variety of cross-border transactions in the commerce of goods and services, free international flows of capital and human resources, as well as the more rapid development and the increasing diversification of product design and technology. The causes for internationalization are classified as active and reactive reasons.

The process of globalization leads to a new quality in dialectics of global, world-societal and national relations.

New structures and tasks in all globalization dimensions evolve from these changes. Thus, the process of globalization generates new challenges for the educational practice too.

### ***Bologna process***

The world-wide system changes, forced by the process of globalization, require need for action, especially in the educational sector. Previously, there were different educational concepts in European universities. Therefore, it was difficult for students

doing their studies at different international universities to obtain acceptance for their examinations or degrees.

Against the background of this, in the end of the 1990s, an initiative for conforming the European higher educational systems has been started. Currently, more than 40 European departments and ministries of education co-operate in this context. Their ambition is the realization of the aims of the Bologna resolution until 2010 (European Association for International Education, 2007; European University Association, 2007; Federal Ministry of Education and Research, 2007).

The strategy of the Bologna process is concentrated on three dimensions: advancement of mobility, international competitive capabilities, and employment ability.

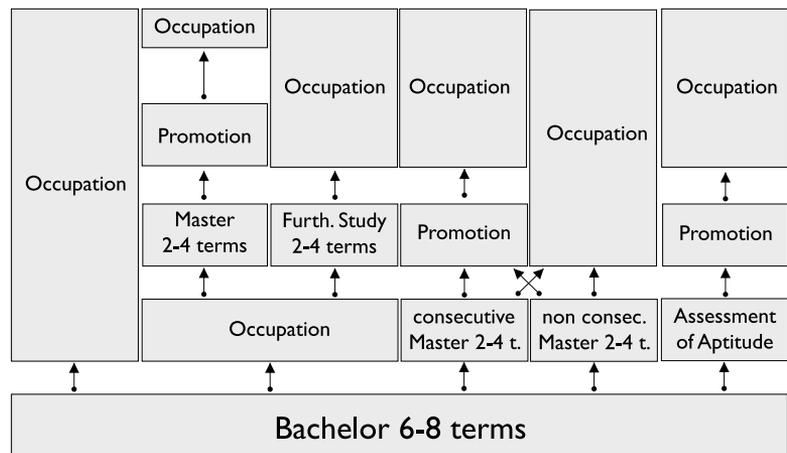
To achieve optimal results in the three mainstreams of development, fundamental core targets are defined (Federal Ministry of Education and Research, 2007):

- Comparable degrees: establishment of a system of easy-to-understand and comparable graduations.
- Staged system: implementation of staged graduation degrees in all countries; the first vocational qualification graduation after at least 3 years: three educational cycles - bachelor, master and doctorate degree.
- European Credit Transfer System: adoption of comparable achievement credits (ECTS) and modularization.
- Mobility: smooth out the barriers of mobility to achieve more mobility; in this context, it is not just regional mobility, but also cultural competences and mobility between universities and study programs.
- Quality Management: assurance of quality in higher education by development of faculties, accreditation of courses of studies, European co-operation in quality development.
- European dimension: advancement of the European dimension in the higher education.
- Lifelong Learning: inclusion of lifelong learning strategies.
- Involvement of students: involvement of higher education institutions and students as essential partners in the Bologna process.

- Promotion: promotion of the attractiveness of the European Higher Education Area.

There is a cross-sectional line for all these targets: integration of the social dimension. This target will be forced in the ministerial meeting in London this year.

Figure 3. Opportunities for the integration of studies and occupation



With the realization of the main targets of the Bologna process, the idea of international lifelong learning and the integration of vocational qualification can be achieved step by step (Figure 3). So the attractiveness of the European Higher Education can be optimized. This is a very important step towards the globalization of Higher Education.

### **Modularization**

In the context of globalization: how should the Bologna process work in detail? The execution of the Bologna process and the realization of its targets need to look at two perspectives: on the one hand, it needs a top-down perspective to standardize the network of European universities; on the other hand - the bottom-up perspective - it needs to look how to effectively use existing study potentials. Thus, there is a need to create a practical model, and regard the European Higher Education as a whole, as a system. A system is characterized as a determined formation. It consists of subsystems and respective elements. All elements of a system correlate and interact with the other elements of the system. Systems organize themselves by their structure.

There are special types of systems, for example in information sciences, engineering, social sciences, management research, and physics. In most cases, systems are models of the real life (Herrmann et al., 2005).

The segmentation of a whole system into logical units is called modularization. In many sciences, modularization is already applied, for example engineering, building industry, information sciences.

These small standardized functional elements of a system are modules. Modules realize a self-contained task, and are defined with rules for standardization, structures and interfaces. So modules can be integrated in the system.

Because of the framework for modules, they have attributes which enable to reuse, evaluate or combine them. Modules are not just subparts of a system. It is also possible to create bottom-up new systems from existing modules.

How can the idea of systems and modularization be used in the Bologna process?

The harmonization of study programs requires parameters and rules, applicable to all universities. Therefore, a system or framework should be created. In this system, each university is a subsystem with interactivities to other universities. Each of the universities has a pool of study programs.

So, in the next step, it is necessary to analyze the components of study.

Modularization of a study program means to integrate study contents in bigger content-consistent and examinable units, called modules.

Thus, a module is a study unit for the bachelor, master or doctorate programs at the universities. Modules consist of courses of different types from one subject area. In this context, a module communicates a consistent competence (Mandler, 2005).

A study program with a modularized structure consists of compulsory and optional modules. As a general rule, one module will take from 1 up to 3 terms. A module will be weighted with credit points, in relation to the workload of students. Furthermore, a certificate will be issued.

Important quantitative parameters of a module are ECTS-points. They represent the workload of the students. 1 ECTS-point corresponds to 30 hours. The target for students is 60 ECTS-points per year. For increasing transparency of modularized study program of each

university, standardized comprehensive module descriptions will be presented in a module catalogue.

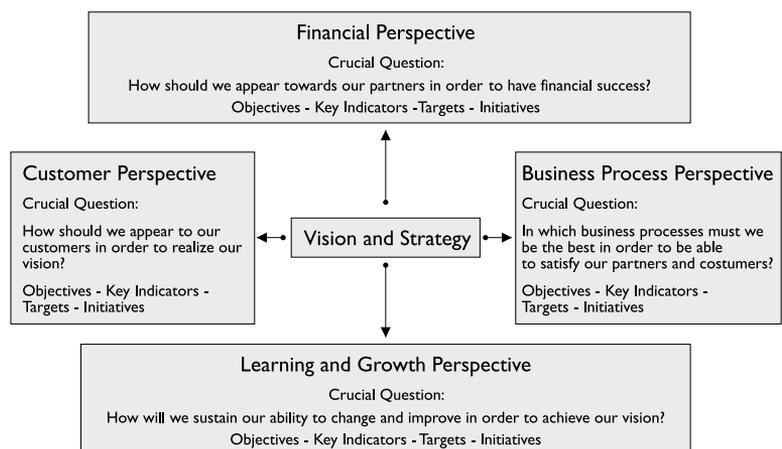
Because of the reusability of modules, there are at least two advantages of modularization. Therefore, it is possible to focus on teaching competences for the students. Furthermore, study programs can be flexibly designed on the fundament of study modules.

## Multi-level modelling for syllabus design

### *Multidimensional scorecard model*

The Balanced ScoreCard (BSC), based on former key indicator systems, is an advanced management system, including different indicators from all corporate divisions of the organization, in order to enable the management to efficiently realize appropriate strategies. Key indicators are quantitative, concentrated data informing about the complex reality by using countable business facts and circumstances. They are applied for the definition of tangible objectives and their compliance. If they are not achieved, adequate activities will be initiated, and their success will be evaluated. But the only unidimensional use of financial key indicators does not meet the extended requirements in the organization practice. The concept of BSC includes, in addition to the Financial Perspective, a Customer Perspective, an internal Business Process Perspective, and a Learning and Growth Perspective (Strunz, Dorsch, 2004).

Figure 4. Balanced ScoreCard due to Kaplan and Norton (Kaplan, Norton, 1996)



The BSC is one of the useful means for the sustainable reduction of complexity, for the evaluation of the correlations of several effects, and the translation of an individual organization strategy into operational key indicators. It is suitable as a tool for the communication between the management and the employees, as well as for the holistic organization control, because of reducing the risks of a one-directional view and forcing the evidence of causes and effects chains (Mertens, 2001).

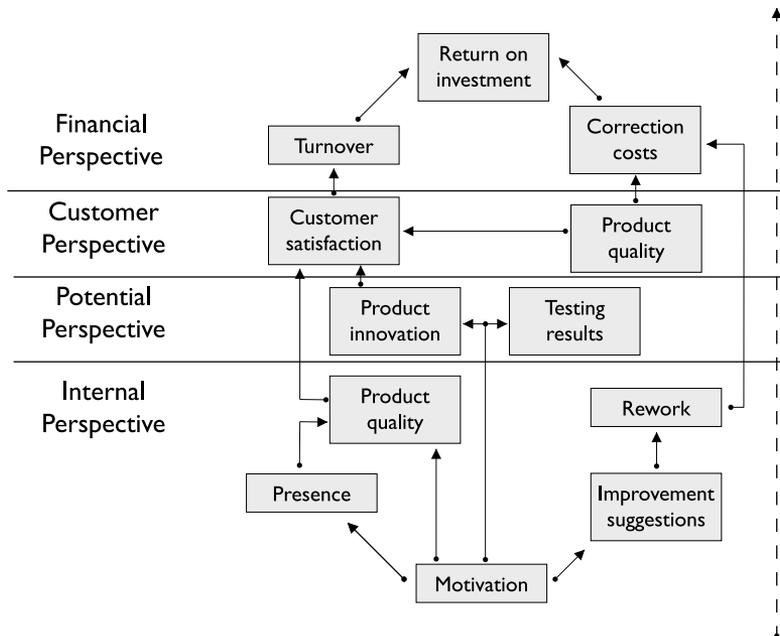
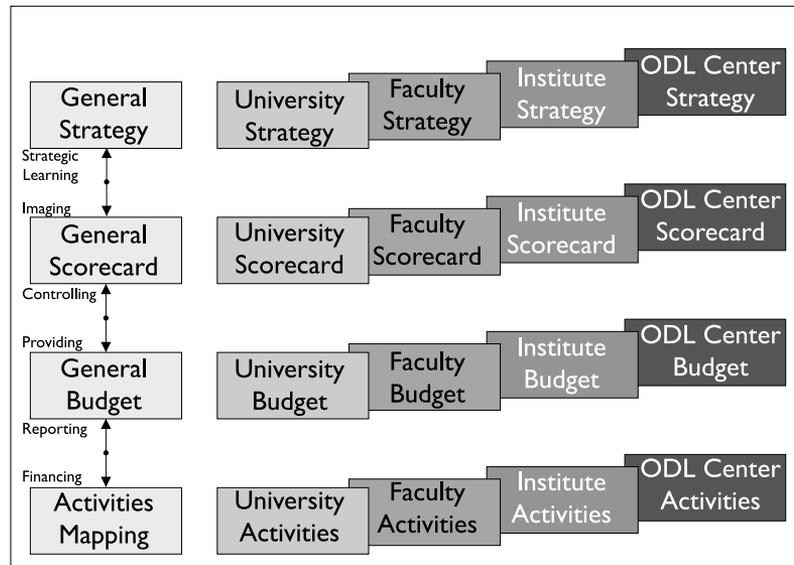


Figure 5. BSC causes and effects chain (Ebert, 2000)

The BSC perspectives are valid for different kinds of organizations and different levels in the organization. The BSC is top-down transferred to the upper organizational units forming a BSC cascade. The advantage is that the general use makes possible to scale the strategic orientation of the organization to the subsidiary levels, and to compare different organizations and levels. Besides the hierarchical alignment, other functional domains, such as Human Resource Management and IT, are embedded by adequate kinds of BSC in the management system (Kemper et al., 2004; Jaspersen, 2005).

Figure 6. Multidimensional BSC approach



The vision of an educational organization like a university is characterized by general targets, particularly with regard to the organization's strategy. Main objectives could be:

- Global and regional improvement of the living standard by higher education.
- Knowledge transfer and development of professionals, specialists, and skilled employees.
- Open and networked educational and related systems.
- Problem solution competence for general as well as for special challenges of human beings.
- Safeguarding of existence and advancement of the organization itself in the competition.

Based on these vision targets, individual BSC for the educational organizations can be derived (Figure 7).

The number of objectives and key indicators is eligible, but it should be limited, for the controllability and the manageability of the system.

Perspective	Objectives	Key indicators	Targets	Initiatives
Financial	Increase in turnover	Turnover	Quantity of increase	Extended educational export
	Cost coverage	Cost centres	Cost amount	Reduction of costs
Customer	Customer satisfaction	Ranking results	Ranking number	Intensification of coaching
	Information access	Portal and LMS access	Average access time	Service improvement
	Efficient learning	Content quality	Growth of fact knowledge	Quality control loops
Business process	Process optimization	Development time	Saved time	Process chains
	Emergency maintenance	Absence time	Reduction of absence time	Defining the responsibilities
Learning and growth	Human capital enrichment	Available specialists	Number of specialists	Human resources development plan
	Increase of academic standards	Educational level of the employees	Number of employees in educational levels	Further education activities
	Improvement of co-operation	Network level	Number of co-operation contracts	Co-operation initiation map

Figure 7. Example of BSC in educational organizations

### **Modular-design course model**

Architecture is defined by the recommended practice as the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution (ANSI/IEEE, 2000). Applying the definition to the problem, the architecture of a course and its modules, or a system of courses, is the structure of the system comprising objects as modules, the externally visible properties of those objects, and the relationships among them. The consequences are (Bass et al., 2003):

- The architecture defines content objects.

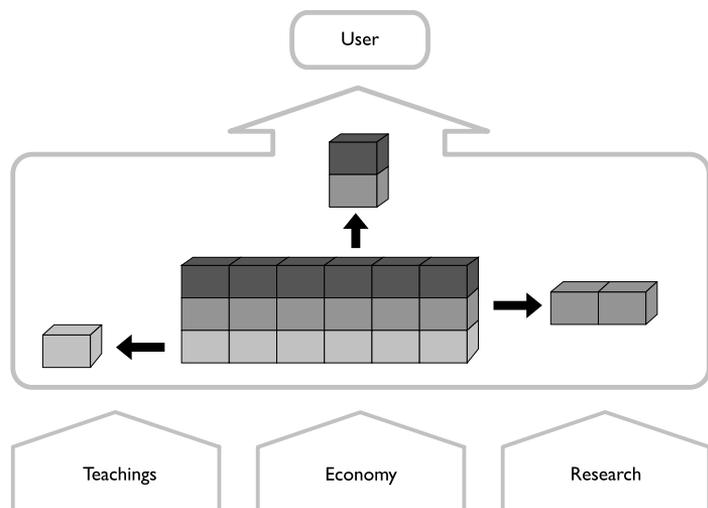
- The systems can and do comprise more than one structure.
- Every content system has an architecture.
- The behaviour of each element is part of the architecture.
- The architecture for a system is a good one or a bad one.

In the past, relatively large-scale and complex course offers were generated. They were characterized by a monolithic structure. The disadvantages of monolithic structures are:

- Inflexibility concerning changes of the system requirements.
- Enormous complexity.
- Abandonment of modular-design concepts and reusability of submodules.
- Partial redundancy of functions and contents.
- Inflexibility concerning evaluation and control requirements.
- Difficult maintainability, extensibility and adaptability.

Therefore, the recent and future system development is oriented towards intensified modularization: that means that courses are structured into relatively small-sized, as far as possible independent, and logical partitions as modules and submodules.

Figure 8. Meta modular-design model for educational offers



The advantages of the object-oriented module design development are:

- Increase of flexibility.
- Improvement of quality.
- Reduction of costs and developmental periods.
- Increase of efficiency in implementation and application, etc.

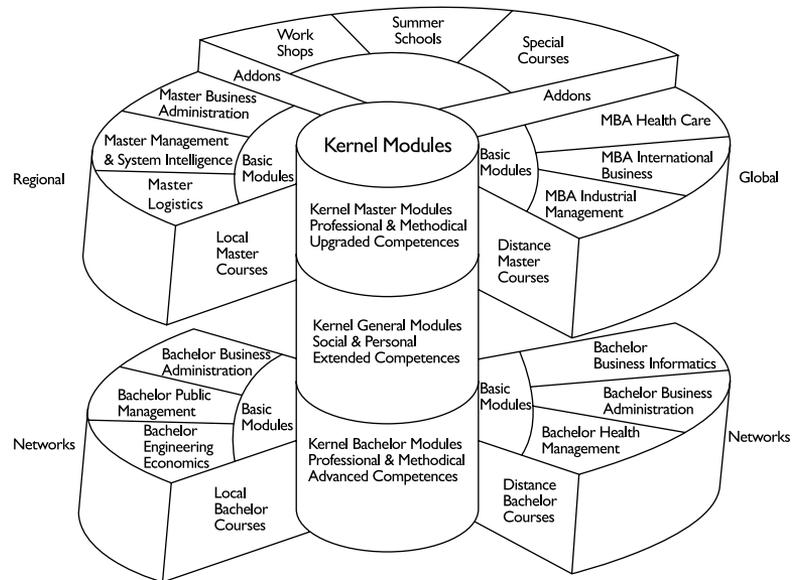
The challenges and changes of modularization were recognized and used in course development, in recent years. Particularly, the flexibility of external offers for further education by universities was increased by the application of modularization. The modular-design concept was supplemented with the layer concept, permitting the course planner to pool together congeneric modules in layers as course terms. It is important, for instance, in courses for further training and education in knowledge transfer for high technology (Figure 9; Schumann et al., 2004).

Planning Systems				
GP-Analysis (e.g. ARIS)	GP-Modelling (e.g. ARIS)	KLM / DCS	ERP-Systems- Practical Introduction	
Factory Systems				
Innovative Factory Concepts and Realization	Simulation Systems and Practical Use	PPS/ E-Commerce in electronical Industry	TQM / CAQ	
Production Systems				
Assembly Technologies and Systems	Alternatives in Assembly Planning	IT-Basics Microelectro- mechanical Systems	IT-Basic Laser Technology	
Information Systems				
Basic Networks	Basic Databases	Applications Windows- Networks	Computer and Data Communication	Introduction Databases and Data Modelling

Figure 9. Modular-design/Multilayer concept for knowledge transfer course (example)

The knowledge, experiences and skills of the systemic approach to the problem of complex reorganization of the course system, due to the conditions of the Bologna process, globalization,

Figure 10. Rough concept of a multilayered modular-design course model



But in the majority of application cases, the complexity and, for that reason, the inflexibility of the more and more individualized learning is still too high. That is why the next generation of systems will be characterized by granulation. That implies the decomposition of the modules and submodules into the smallest logical units which are achievable. By this means, the highest flexibility and efficiency of learning, knowledge and competence transfer by extremely flexible course planning will be attainable (Schumann et al., 2006).

### ***Multichannel output model for educational markets***

The recent development of commerce is characterized by the relation of global activities for regional markets. The increase of individual demands will be satisfied by using the enormous opportunities of services and offers which are available worldwide. An increasing diversification of the market is the result of the dialectics of globalization and individualization. This is valid for the educational market, too.

The result is, besides the mentioned diversification of the market, a growing number of players in the market, coming from the public as well as private sector, and offering a growing number of educational services. Therefore, authorities and market players have to work towards a large extent of market transparency. It will be able to be generated by market information transparency, supporting free competition. The same objectives are pursued by developing educational e-market, as part of the global educational market, using the advantages of Web services and communication by the market community (Ehlers et al., 2003). On the one hand, the interested persons, learners as consumers, are looking for the right individual offer of learning and training; on the other hand, educational providers try to find interested persons using their offers. Such kinds of traditional markets already existed in the past, but there are new chances for improving the relations between learners and providers, by using the new forms of electronic communication, especially Web-based communication.

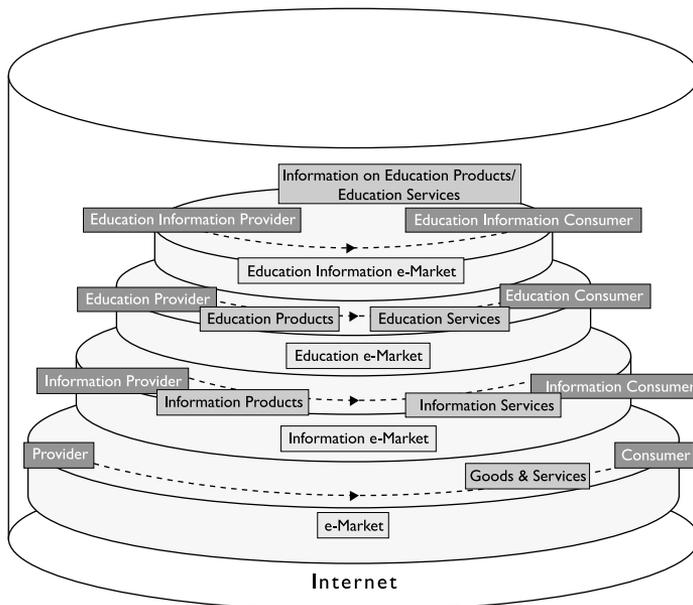


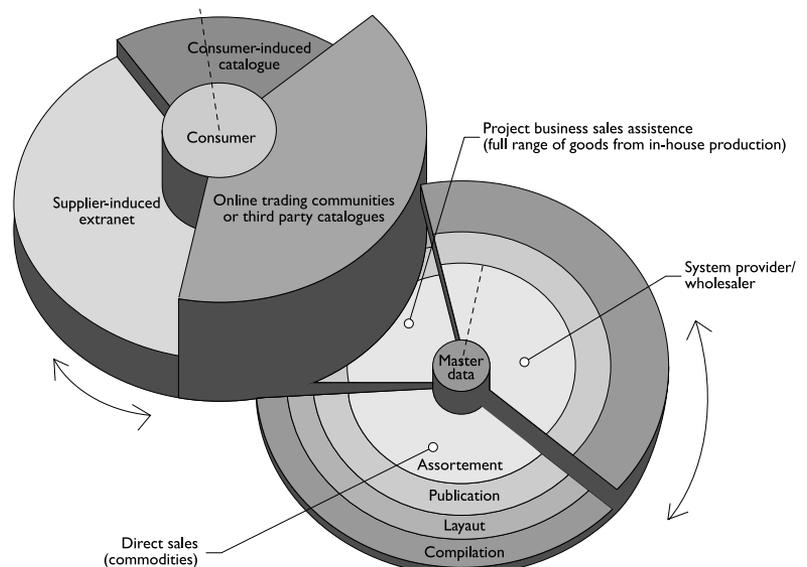
Figure 11. Electronic educational markets as subsystems of electronic markets

The modern educational e-market should dispose of information, communication, and transfer platform for learners and providers as access layer for initiating and managing the partners' relationship. Therefore, it has to have a database system as data storage layer, in which providers are able to input the relevant information concerning

the provider itself, the products and services, as well as additional hints and remarks of the branch. Access to the database will be realized by a functional layer. This layer offers the main functions for linking the access and the database layer, by using the Web services of the preferred access by Internet, extranet or intranet (Schumann et al., 2005).

The distribution of course offers will be connected with the use of the opportunities of electronic markets and, for this reason, with electronic commerce, defined as a subset, or some time declared as a substitute of electronic business, initiating, negotiating and concluding commercial transactions between business subjects over electronic systems, such as the Internet and other computer networks. The opportunities of information and communication technology are used in order to buy and sell products and services under avoidance of the costs of a physical presence. Andy Grove, the co-founder and former CEO of the Intel Corporation, said in 1999: "In five years' time, there won't be any Internet companies. All companies will be Internet companies or they will be dead" (Schumann, 2006). That is why educational organizations such as universities should apply the new methodical and technological means for the extension of course offers in their traditional markets. It is possible to use the existing commercial concepts of multichannel distribution and provision systems as a pattern for the university activities. The pattern systems have channels for online communities, extranet supply, and catalogue access to services (Figure 12).

Figure 12. Multichannel e-commerce solution



According to the commercial multichannel approach, the different kinds of channels for the distribution can be adapted to the course offer situation in the educational systems. By using the means and services of Learning Portals (LP), Learning Management Systems (LMS), Content Management System (CMS), Web-Based Training (WBT), Authoring Systems (AS), etc., the multichannel co-operation and distribution model for the faculty educational program in international networks will be derived from the existing services of traditional educational offering, as well as blended kinds of learning and training.

Level 3 - Multichannel output								
Multichannel offers								
Internal			External			On	Personal contact	Electronical communication
01	02		03					
PS CL	SS EL	PT CL	PS CL	SS EL	DE EL			
Level 2 - Method & technology blending								
Patterns of blended offers								
Presence Studies (PS)	Practical Training (PT)	Self Studies (SS)	Distance Education (DE)	Electronical Learning (EL)				
				Classic forms of Learning (CL)				
Level 1 - Modul & content basis								
Patterns of syllabuses								
Computer & Web-based modules						Method	Technology	
Classic kinds of modules								

Figure 13. Multichannel output model for course offers

The modularization of the module basis, as classic and electronic modules and submodules, in combination with the high flexibility of blending the different kinds of educational method and technology, allow providing a wide range of multichannel outputs, according to the consumer needs, and available resources of the university. The multilayer and multichannel concept demonstrates the decisive superiority of the systemic approach.

## Conclusion

Successful globalization of Higher Education in Europe is based on intelligent modularization of study programs and multichannel

offerings of courses.

For this purpose, suitable educational methods and e-commerce concepts will be adapted and enhanced.

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## Sintesi

L'Università di Ingegneria ed Economia di Zwickau, fondata nel 1992, è nota a livello internazionale come University of Applied Sciences of Zwickau. Situata nella Sassonia Occidentale, è cresciuta fino a comprendere sedi a Reichenbach, Schneeberg e Markneukirchen. Nonostante l'orientamento fortemente regionale e la limitazione dei bacini di utenza a studenti tedeschi (ad eccezione degli iscritti ai corsi post-lauream a distanza), nei 15 anni di vita ha registrato un aumento annuale costante di studenti: da 500, nel 1992, a quasi 5000 unità, nel 2006, mentre il numero di matricole è rimasto pressoché invariato, oscillando tra 500 e 1000 unità circa. In prospettiva, a causa della globalizzazione, che ha generato nuove sfide anche per la pratica educativa, l'Università di Zwickau dovrà necessariamente entrare a far parte dei network educativi, nazionali e internazionali, cercando di raggiungere, entro il 2010, gli obiettivi posti dal processo di Bologna: diplomi e lauree comparabili; sistema a stadi con i tre cicli educativi di laurea, master e dottorato; Sistema Europeo di Trasferimento dei Crediti (o ECTS, da European Credit Transfer System); mobilità; gestione della qualità; Lifelong Learning; coinvolgimento degli studenti; promozione dell'Area Europea di Alta Formazione (o EAHE, da European Area of Higher Education).

A tal fine, e per adattare i corsi ai requisiti del mercato educativo, all'interno del quale grande importanza riveste ormai il cosiddetto e-market, per l'Università di Zwickau è fondamentale avviare programmi internazionali di scambio, creare reti articolate di formazione e ricerca, mantenere un'amministrazione efficiente, anche per quanto riguarda immatricolazioni e iscrizioni, realizzare contenuti di studio modularizzati. La modularizzazione, affiancata alle modalità di strato e di granularizzazione, permetterà di combinare moduli dello stesso genere in strati distribuiti lungo semestri e la loro decomposizione in unità logiche fortemente concentrate. La granularizzazione caratterizzerà inoltre la successiva generazione di sistemi, e ciò renderà la massima flessibilità ed efficacia nel trasferimento di competenze, conoscenze e apprendimento.

La globalizzazione ha provocato una crescente diversificazione del mercato, con l'offerta di un numero sempre maggiore di servizi improntati alla trasparenza e alla libera competizione. Gli stessi obiettivi sono perseguiti dall'e-market educativo, in quanto parte del mercato educativo globale, utilizzando i vantaggi della comunicazione e dei servizi Web; possono oggi migliorare le relazioni tra discenti e providers, utilizzando le nuove forme di comunicazione elettronica, in special modo la comunicazione di tipo Web-based.

Il BSC-Balanced ScoreCard, per esempio, è un sistema avanzato di management, con diversi indicatori che rendono possibile l'identificazione di obiettivi concreti e la realizzazione di strategie appropriate per raggiungerli. Il BSC comprende una prospettiva economica, una prospettiva relativa al cliente, una prospettiva relativa al processo di business interno e una relativa alla crescita dell'apprendimento. Il BSC è di fatto uno strumento di approccio sistemico.

*Le conoscenze, esperienze e competenze dell'approccio sistemico al problema della complessa riorganizzazione del sistema dei corsi, imposta in genere dalla globalizzazione e dalle sfide metodologiche e tecnologiche, sono state utilizzate per progettare corsi in modular-design, secondo un'architettura a strati multi-livello che permettono alla University of Applied Sciences of Zwickau di realizzare una vasta gamma di prodotti/corsi multi-canale. Tale strategia consente di venire incontro alle necessità del discente/consumatore e di applicare criteri di economicità alle risorse universitarie disponibili. Il che dimostra la netta superiorità dell'approccio sistemico.*