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The Distinctive Nature of *Fachhochschulen*

The sector of* Fachhochschulen *in the German binary system of higher education is characterized by the practice orientation of its programs, a commitment to continuing education, and a strong emphasis on applied research and development and on technology transfer. In these ways, the* Fachhochschulen *make substantial contributions to the development of their region. Because of the strong demand for admission, as well as the growing need of business and industry for graduates from* Fachhochschulen, *the government has decided to enhance this sector both quantitatively and qualitatively.

In his article that appears in this issue of *Metropolitan Universities*, Michael Leszczensky provides an overview of the German *Fachhochschulen* (FH), which constitute one of the two segments of the binary system of higher education in former West Germany, the other segment comprising the universities. Leszczensky describes the historical background of the FH, their legal authorization in 1968, and their rapid development since then. They now enroll 27 percent of those entering higher education in the former West German federal states (*Länder*) but graduate fully 34 percent of those receiving a degree. This is because FH students graduate in eight semesters, on the average, whereas students in the universities graduate in twelve. The shorter study time also reduces the cost of a place of study at the FH to about one-third to one-fourth of that at a university.

This article will expand on Leszczensky's with a more detailed description of the distinctive nature of the FH in terms of the practice orientation of their programs of study and their substantial contribution to regional development through applied research and development, technology transfer, and continuing education. The central contribution of the FH to the effective functioning of the West German economy is very evident in the subjects in which they specialize. For example, the numbers of students being educated at *Fachhochschulen* include:

- more than 70 percent of all graduate engineers;
- 42 percent of all graduates in economic sciences; and
- over 90 percent of all graduates in social work.

It is no wonder, then, that Germany is undertaking substantial quantitative as well as qualitative

expansion of the FH throughout the country, including the former East Germany where FH did not exist prior to unification. In a recent declaration, the *Wissenschaftsrat*, the high-level federal body charged with formulating official policy in higher education, science, and research, recommends special measures for the expansion of the FH sector in order to meet the needs of a modern industrialized society. The proportion of FH students as compared to those in the universities is to be raised, and the *Fachhochschulen* are called upon to establish new degree programs that thus far were only offered by universities. These recommendations further reinforce the official view of the two sectors of the binary system as being equivalent in standing but different in function.

The Characteristics of Instruction

Teaching is at the center of a *Fachhochschule's* task, and is aimed at preparing competent practitioners rather than future researchers. It is oriented toward the application of rigorous scientific methods in order to seek concrete solutions for practical problems. In view of the fact that the problems in business, industry, and society grow increasingly more complex and expand beyond individual disciplines, instruction at FH is problem oriented and multidisciplinary. Gaining methodological and problem-solving competence is considered to be more important than the acquisition of factual knowledge.

The practice orientation is reflected in a number of salient characteristics of FH curricula:

1. an emphasis on practical studies by means of
   - a large proportion of practical exercises within the course work;
   - the integration of two practical semesters to be completed in industry as part of the regular eight-semester curriculum;
   - selection of topics for papers and theses that are professional in scope and closely related to actual practice. The work is often carried out within the framework of research and development or technology transfer projects of the *Fachhochschulen*;
2. theoretical as well as practical instruction in small groups so that seminar-style teaching can be ensured;
3. well-structured curricula and closely monitored student progress by means of individual advising, clearly arranged study plans and programs, and a well-organized exam system. Most importantly, frequent individual contact between teachers and learners help students achieve their study goals in acceptable time frames.

The professor is at the center of both theoretical and practical instruction at *Fachhochschulen*, whether in the classroom, the laboratory, or in the pursuit of practical projects. This places high demands on the faculty, including a strong orientation toward practice. The choice and appointment of professors must therefore meet corresponding standards. Professors are usually expected to have the Ph.D., but rarely the so-called *Habilitation*, a second thesis usually required for university chairs. Instead,

FH faculty must have held an appropriate position in industry for at least five years prior to their appointment.

Research and Development and Technology Transfer

In view of the fast pace of innovation, teaching that meets the high standards of being practice oriented, and therefore being pertinent to actual situations, can only be realized if the professors keep up their competence by means of continuous participation in practice-oriented research and development. Such activity, of course, overlaps to an extent with more basic research, which is usually carried out at universities. At *Fachhochschulen*, however, this activity is characterized by its focus on examining the applicability of results of basic research to current problems in practice and on transforming the results of basic or applied research in order to arrive at a concrete solution to an actual problem.

R&D projects are an integral part of FH curricula and serve to keep these curricula up to date. Students participate in such projects and use them as a basis for their papers and theses. This provides important motivation for the students by allowing them to solve concrete, practical problems. It confirms the subject and methodological competence they acquired in their studies. Involving students in these projects helps them to transfer their skills to practice, and to enter their profession in business and industry smoothly at the end of their studies.

Research and development are part of the regional responsibilities of *Fachhochschulen*. Small and middle-range enterprises are usually not able to maintain their own comprehensive research departments and therefore require assistance in the transfer of innovation and new knowledge. This need can be met especially well by *Fachhochschulen* because of their structure. Professors come from enterprises, know their respective problems, and speak the language of practice. FH also are able to address problems of limited scope in addition to dealing with larger-scale projects, and can offer timely solutions to firms that are under deadline pressure. Furthermore, Baden-Württemberg and some other *Länder* are covered by a whole network of *Fachhochschulen*, one of which is therefore always convenient to every enterprise.

The Organization of R&D and Technology Transfer

The effective implementation of R&D and transfer activities requires appropriate organizational structures in order to provide manifold support for the professional services of the faculty. Each *Fachhochschule* requires some kind of bridging mechanism to the outside so as to publicize the resources of the institution, establish contacts and ongoing relationships with potential clients, and cooperate with other institutions and organizations engaged in transfer. An appropriate organizational unit is needed as well for internal purposes, such as:

- adapting projects according to the development goals of the *Fachhochschule*;

- arranging a suitable project team composed of professors, co-workers, and students;
- providing administrative support in the execution of the project.

A variety of organizational models exist that broadly speaking fall into two categories:

- independent organizations affiliated with FH and designed to facilitate applied research and technology transfer as a part-time, supplementary activity of the faculty;
- organizational units within an FH designed to enhance research and transfer activities as part of the primary responsibility of every professor.

Organization of Technology Transfer as Part-time, Supplementary Tasks

Applied research and technology transfer carried out on a part-time, supplementary basis by FH faculty members constitute the dominant mode of such externally oriented activities at the *Fachhochschulen*. The pertinent organizational units are affiliated with, but are not an integral part of, a FH and are often clustered into networks within a given federal state (*Land*). The principal purpose of these organizations is to further economic development of the region by responding, on a contract basis, to the needs of enterprises, especially small and medium-sized ones.

In Baden-Württemberg this task is realized by the Steinbeis Foundation for Economic Development. This foundation was established by the state government as early as 1971 and received a full-time steering committee in 1983, which is also the governmental body in charge of technology transfer of the region. The Steinbeis Foundation has established technical advisory services at sixteen *Fachhochschulen* in Baden-Württemberg. These services have developed very well over the years and become an important component of the economic infrastructure of the region. Their success in turn led to the creation of new organizational units, so-called centers of technology transfer, in fields of particular interest to local industry. These centers received their initial equipment through a substantial subsidy from the Steinbeis Foundation. In Mannheim, for instance, two transfer centers for micro electronics and sensorics as well as process engineering bio- and environmental engineering were founded.

These organizational units of the Steinbeis Foundation are directed by FH professors on a part-time basis in addition to their basic responsibilities and for additional compensation. The centers can employ their own staff who are financed by the projects or assigned by the contracting enterprises. In Baden-Württemberg in 1989, 649 professors of *Fachhochschulen*, 709 technical employees (including 234 in permanent positions), 859 students, and 118 administrators engaged in transfer tasks through Steinbeis centers or services, carrying out over 8,000 assignments generating a total income of about DM 45.7 million (approximately U.S. $25 million). In addition, about 800 lectures and seminars were organized

at FH under the auspices of the Steinbeis Foundation.

Research and transfer projects carried out under Steinbeis auspices offer the following advantages for the professors at FH:

- being able to earn substantial extra remuneration in a manner consistent with governmental regulation of part-time off-load working agreements for full-time faculty;
- updating their expertise with regard to recent practical developments in their field;
- carrying out of projects outside of the framework of institutional and governmental regulations.

However, certain dangers must be considered together with these advantages:

- Part-time activities tend to foster an orientation toward volume and may encourage routinization of services at the expense of innovative performance.
- Technology transfer has primarily economic goals. The purpose of the projects is not a priori compatible with the further development of the *Fachhochschule's* academic goals.

Organization of Research and Development as Primary Tasks of All Faculty

In addition to encouraging its faculty to engage in technology transfer on a supplementary basis for extra compensation, *Fachhochschulen* must also insist on the faculty's pursuit of research and development as an intrinsic element of their primary, statutory responsibilities. Both categories of scholarly activity are crucial to the continuing enhancement of the quality of the institutions. The two complement each other; indeed, they determine each other:

- Technology transfer presupposes preliminary research in new technological processes.
- Many external clients of technology transfer expect—and are willing to support—ongoing applied research and development in ways that strengthen the institutional infrastructure in terms of personnel and equipment. This makes faculty positions in the FH more attractive.
- The full-time R&D activities can be focused on a limited number of carefully targeted priority areas. This is facilitated by the creation of institutes for innovation and transfer, each concentrating on a specific topic. These institutes provide a supportive organizational framework to cluster related R&D activities as well as special innovative projects.

Continuing Education at *Fachhochschulen*

The need for continuing and further education is increasing for several reasons:

- The justified demand for shorter periods of study toward the first degree places a limit on what can be included in the initial curriculum. Some advanced knowledge and specialization cannot be taught within the degree programs and must be provided by means of periods of further education.
- Knowledge gained must be continuously renewed and supplemented because of the accelerating cycle of innovation.
- The increasing expectations of employers with regard to interdisciplinary knowledge and capabilities on the part of graduates call for additional qualifications that are best transmitted by further education.

Because they link theory and practical skills, and link knowledge and the economy, the *Fachhochschulen* are facing increasing opportunities in the field of further education. Their strong orientation toward practical application and their closeness to firms render these institutions particularly capable of transmitting appropriate technical and managerial knowledge in the introduction and application of new technologies. They are strongly engaged in continuing education also because they want to carry on an ongoing intensive dialogue with industry and other societal constituencies. The goal of the FH is to find additional ways of transferring the results of research to professional practice, and at the same time to enrich both their teaching at the first degree level and their applied research and development with practical problems of professional scope.

The *Fachhochschulen* offer a wide variety of continuing education programs leading to additional and advanced degrees or professional certification. Many of these are provided on a full-time basis and usually require prior completion of a first degree. A typical example is a four-semester program at the Fachhochschule für Technik Mannheim, in which individuals with a first degree in management acquire an additional interdisciplinary degree in industrial engineering with a curriculum combining business administration and applied technology.

FH also offer continuing education on a part-time basis for employees of regional enterprises. Most of these programs are developed in direct cooperation with these enterprises. They are generally successful because both sides show great interest in them and they correspond to actual needs. A typical project of this kind is a program in technical computer science that was developed in 1986 at the Fachhochschule für Technik Mannheim in collaboration with twenty regional enterprises. It is especially aimed at graduate engineers who finished their studies five to ten years ago and who have not been sufficiently exposed to computer-based techniques in fields such as construction and manufacturing. The necessary comprehensive knowledge and skills cannot be taught by means of short seminars. Instead, the *Fachhochschule* jointly with the participating companies designed a four-semester program for a maximum of twenty-six participants. These participants are released from work on Fridays and contribute their own time on Saturdays. This time frame allows engineers in small and middle-range companies to participate. The curriculum is divided into a basic course of three semesters and an advanced course of one semester that provides a choice of specialization among production engineering, manufacturing engineering, electrical engineering, and

construction. Theses can be written in the context of practical projects on the job in one's company. Hence, participants have the opportunity to apply the knowledge they gain to the solving of practical problems. The program ends with an external exam and yields a degree in computer science.

Fachhochschulen are involved, as well, in many noncredit continuing education activities, such as conferences, symposia, workshops, and informational seminars. Many have also set up permanent working groups that bring together participants from higher education and business. Much of this kind of activity is carried out under the aegis of so-called "technical academies," which were founded at, or in cooperation with, FH and universities. These academies develop further education plans that correspond to the general need of an extended region rather than being focused on a specific company. The modules of further education usually consist of seminars lasting one or several days. Professors and company experts often work together to design further education offerings. In 1986, the Fachhochschule für Technik Mannheim, in cooperation with almost sixty companies, founded the Technical Academy Mannheim as a separate corporate entity. The academy offers further education in all fields of knowledge that are of interest to a company oriented toward up-to-date technical methods and modern management standards in its development and manufacture of new products. During the past year, a total of about 1,500 persons participated in 140 seminars, generating an annual income of DM 1.2 million (approximately U.S. $2 million).

Fachhochschulen and the Labor Market

The German labor market, like that in other industrialized countries, is characterized by steadily rising skill requirements at almost all occupational levels, resulting in correspondingly rising demand for academic credentials as a condition for employment. More and more jobs require a higher education degree, with graduates not only filling newly created positions but often also replacing employees with lower qualifications. In many technical areas, the traditional craftmanship based on manual skills suffices less and less for today's occupational challenges; it has to be supplemented or even entirely replaced by theoretical knowledge. A similar tendency can be seen in commercial and other occupations.

There are many signs that this trend will accelerate in the future, with higher qualifications needed to enter the job market in an ever-increasing range of employment, including many sectors in which they were not necessary at all in the past. Furthermore, because of the growing number of retiring persons and, for demographic reasons, the decrease in the number of young people entering the labor market, the employment situation for higher education graduates will continue to be relatively positive compared to that of less qualified persons. It may even improve in some sectors. However, with the expectation of higher education credentials becoming ever more widespread, these credentials lose their special status. It can no longer be taken for granted that graduation from a *Fachhochschule* or university can be counted on to lead automatically to

higher-level positions that were formerly connected with academic qualifications.

Both the challenges and the opportunities of these changes in the labor market are of particular importance for the *Fachhochschulen*:

- According to the prognoses available about the labor market, the need for higher education graduates will increase to about 5 million from the current level of about 2.8 million. This will increase the proportion of graduates in the work force from the present 11 percent to about 18 percent. Given limited resources, the necessary increase in enrollment can be achieved only by a decisively increased capacity of the *Fachhochschulen*.
- The growth of a work force with higher education degrees occurs at different rates in different economic sectors and leads to sectoral differences in the employment of graduates. Growth will be greatest in the private manufacturing and service sector, which are the sectors on which FH education concentrates.
- Within the companies themselves, the functions and management levels that are expanding are those in which primarily *Fachhochschule* graduates are employed, such as middle management dealing directly with production.
- There is a particularly strong demand for engineers and managers. These are the subject areas with the largest enrollment at *Fachhochschulen*. Even without further expansion, the enrollment capacity in these fields at *Fachhochschulen* today is comparable to that of the universities.
- The unemployment rate for graduates of *Fachhochschulen* is today still lower than the rate for university graduates. Employment and career opportunities for the former compare favorably with those for the latter, especially in the private sector.

Given these conditions, it is not surprising that, to date, industry has time and again expressed its support for a binary, differentiated higher education system with a strong and enlarged sector of *Fachhochschulen*. In their view, the need for FH graduates will increase in the future because the longstanding trend toward the demand for employees of higher qualification will persist. This is particularly true for engineers, computer scientists, and managers who have received a thorough FH education, characterized by a combination of practical experience, theoretical knowledge, and problem-oriented instruction.

Fachhochschulen in an International Context

Binary Systems in Other Countries

Developments similar to that of *Fachhochschulen* in Germany occurred in other western European countries as well, usually when technical schools and other advanced vocational institutions moved from the secondary to the higher education sector. In several countries this new component of the academic system has expanded faster than the traditional

university sector, for reasons that are remarkably similar to those that have spurred the rapid growth of *Fachhochschulen* in Germany.

The nonuniversity sector in Great Britain consists primarily of the polytechnics, which are described elsewhere in this issue by Michael Lewis. *Fachhochschulen* and polytechnics show several parallels with regard to their origin, their development, and their function. In Britain as in Germany, the government expects to expand the capacities of the nonuniversity sector in the 1990s. The British polytechnics offer a broader range of programs than German *Fachhochschulen*, including teacher training as well as social studies, business administration, law, and the engineering sciences. At polytechnics, where courses of study normally take three years, about one-third of the students is enrolled in so-called "sandwich-courses," which combine studies and professional activities. The German FH sector offers only few possibilities for individuals to integrate professional activities and the pursuit of programs leading to a degree. The high number of part-time students is another characteristic of polytechnics, which offer instruction on weekends, evenings, or individual days of the week, mostly as part of continuing education activities.

In the Netherlands, the nonuniversity sector was reorganized in the mid-1980s. The 350 mostly small colleges of higher education belonging to the HBO sector (*hoger beroepsonderwijs*), each of which offered only a small number of subjects, were clustered into about eighty *hogescholen*. These are institutions ranging from three hundred to sixteen thousand students. The smaller ones continue to offer only one or two subjects, but the larger ones have a broad spectrum of programs, principally in teacher training, social services, business administration, and engineering. Programs in languages, journalism, health-related and human service professions, and the arts can also be found in the HBO sector. Practical training is included in most of the subjects. In 1986, about 65,600 students started their studies at HBOs (26 percent of them as part-time students) compared to only 31,600 at universities. The role of research and development at HBOs is slowly becoming more important. Research and development are mainly financed by third parties, mostly by industry, but in recent years also by the government for selected research fields. The structural reforms in the Netherlands are intended to develop the HBO institutions into an independent part of higher education, deliberately different from universities, but in which qualified HBO graduates are able to enroll in postgraduate courses of the university sector and can therefore obtain a Ph.D.

In France two university-level institutions exist: the universities and the *Grandes Écoles*. Originally, the latter were established to prepare the necessary professionals for the higher levels of the civil service. They continue their tradition of a strong career orientation, which they share with the German *Fachhochschulen* and with which, therefore, they have often developed intensive cooperation. From the end of the 1960s on, the universities have also made efforts to create their own career-oriented programs. Such programs, lasting two years, are offered at the newly established *Instituts Universitaires de Technologie* (IUT). The IUT are part of the universities, but offer their own set of programs in which the enrollment, in contrast to that in the traditional university curricula, is limited by a

rigorous quota system. IUT programs are oriented toward the professional life, but a considerable part of the graduates continues with further studies at a university or an *École*.

International Cooperation by Fachhochschulen

Diplomas of *Fachhochschulen* can be ranked, by international consensus, between a bachelor's degree and a master's degree, whereas a university diploma corresponds to a master's degree. The similarity of the degree structures in Anglo-Saxon countries to that of the *Fachhochschulen* means that FH graduates do not face problems when intending to earn their master's degree there within one year.

The *Fachhochschulen* have entered into many international cooperation and exchange arrangements. A recent study showed a total of 467 such ventures with foreign higher education institutions in 1988; about 40 percent of them are governed by contracts. The majority of these arrangements connect German with British or French universities; contacts with other European countries, with the U.S., and with the People's Republic of China are much more limited. Almost all subject areas participate in contacts abroad, although, in spite of their large enrollment in FH, the engineering sciences have developed relatively few foreign relations. Economic sciences, on the contrary, are overrepresented. On the whole, FH have been very successful in establishing bi- or multinationally integrated programs of study. The number of German FH students abroad and the number of international cooperation agreements have increased enormously during the last years, though still modestly when compared internationally.

Prospects for Future Development

The evolution of the *Fachhochschulen* within the past twenty years was appropriately described by the *Wissenschaftsrat* as the greatest success of educational reforms in Germany of the recent past. The distinctive nature of the *Fachhochschulen* is at the moment especially attractive both for prospective applicants as well as for industry. This has forced many FH to impose tough entry restrictions, channeling student flow massively toward universities, and in turn causing industry to complain about too small a number of FH graduates. The *Wissenschaftsrat* has recommended that the *Fachhochschulen* be substantially strengthened both quantitatively and qualitatively. This will include the five new federal states of former East Germany where an effective net of *Fachhochschulen* will be established by transforming some existing universities as well as by newly established institutions. The FH in the new states are expected to play a decisive role in the buildup of the region out of its current economic disaster.