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THE IMPACT OF GLOBALIZATION ON STUDENT PREPARATION IN GERMANY AND THE UNITED STATES

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ABSTRACT

A Student Exchange Program began with four students from Germany visiting Siemens-Westinghouse and the University of Central Florida in Summer, 1999, as an initiative from Siemens training officials in Muelheim, Germany. In Summer 2000, a program with four German apprentices coming to the U.S. and four U.S. interns working and studying in Germany was very successful. The initial UCF students continued part-time work at Siemens during their senior year and were offered full-time employment upon graduation. Not only did the German students complete their work, but some of them returned for employment in the U.S.

Siemens, as a multinational enterprise, is preparing technologists and engineers to understand product design and manufacturing for integrated systems in international markets. Students will benefit from an understanding of the systems, standards, and cultures involved. The internship model being developed uses the best from the German and U.S. systems and merits further study and implementation.

INTRODUCTION

The dual system of vocational training in Germany. The occupations for which training is provided within the dual system are determined in accordance with the requirements of the job market and in close cooperation between the Federation, the states, and both sides of industry. Depending on the occupation, training takes from two to three and a half years. The content is geared to the demands trainees will face later in professional life. Trainees are paid a training allowance. Considerable funds are spent by the state and the companies involved to finance the dual system.

The dual system of vocational training differs from the purely academic vocational education customary in many other nations in two respects:

Most learning does not take place in schools, but rather in the production facilities or service operations of private business and industry, in a workshop, in a practice of one of the independent professions or in the public service. Trainees are released for specific periods of time to attend a part-time vocational school (Berufsschule), so they are simultaneously vocational school (Berufsschule) students. Young people receive training three or four days per week at their company, and one to two days per week at the vocational school.

Training is split between two providers: companies and part-time vocational schools. Competence for vocational training is split as well: On-the-job training is subject to federal law, whereas classroom schooling is the responsibility of the states.

Vocational training in firms takes place under conditions and at machines and facilities corresponding to the standard of technology currently in use. Larger firms provide training in their own training workshops and at the workplace. Trainees in smaller enterprises are trained on the job. Where firms are too highly specialized to be able to impart all the necessary knowledge, they are supported by inter-company training centers. Certain aspects of training may also be taken over by other firms.

The task of instruction at part-time vocational schools is to support and supplement on-the-job training with specialized theoretical training and to broaden young people's general knowledge. Two thirds of classroom instruction is focused on specialized training and one third on general education. The obligation of the trainees to attend part-time vocational school arises out of the education acts of the German states.

Vocational training is provided by more than 500,000 firms in all branches of business and industry as well as by the independent professions and the public service. About 1.6 million young people are currently receiving training in one of the roughly 360 recognized occupations for which accredited vocational training is required.[1]

Fachhochschulen in Germany (Universities of Applied Sciences) The German system of higher education includes a total of 305 institutes subdivided into 159 universities and 146 Fachhochschulen.

Fachhochschulen are a recent form of higher education in Germany, being first established between 1969 and 1971. They emphasize high quality, practice-oriented education. During their studies students, will get competence in using scientific methods and research results to solve concrete professional tasks. They will be equipped with the suitable methods and problem-solving

strategies to quickly find solutions to professional problems. Lecturers at Fachhochschulen must have professional experience along with their scientific abilities.

The practical orientation in teaching and application in research and development are elements of the profile of Fachhochschulen. Approximately 40% of graduates from all institutes of higher education in Germany come from Fachhochschulen. In some courses the amount is even higher especially in courses important for industry and commerce. It is as high as 50% for computer science, and even 70% of engineering graduates come from Fachhochschulen.[2]

Most Fachhochschulen have included a practical placement program in their courses, which means one semester of [practical training in a company. Mostly during the main study program, students are expected to practice what they have learned with tasks and problems they will face during their future, everyday professional experience. A degree thesis or final project covering a concrete professional problem to be completed in the last semester is often being developed in cooperation with a company through this type of practical training. Small and medium-sized businesses are often involved in these contacts with students, who frequently get their first career opportunity through their practical placement and degree thesis.

The normal duration of studies of eight semesters - including the practical placement as well as the degree thesis and final examination - is quite characteristic for Fachhochschulen as well. Besides the clear emphasis on teaching, Fachhochschulen increasingly develop activities in application-oriented research and development projects - often in cooperation with small and medium-sized businesses of the region.

Since 1960, the percentage of a given age group commencing studies at higher education institutions has risen from eight percent to more than 30 percent. In the 1997 academic year, the number of new students exceeded 266,700; total enrollment in the 1997/98 winter semester was roughly 1,833,000. In addition to teaching, higher education institutions must meet continually growing demand in the area of basic research. To accommodate this growth, the education system has been expanded since the 1960s by extending existing institutions and building new ones, as well as by increasing funding and the number of teaching staff. New courses of study have been introduced, and studies have been more strongly oriented towards the requirements of professional practice. Expansion has not kept pace with the rise in the number of students, however. This has had a negative impact on both the general conditions and duration of study.

The problem of student numbers. Reforms have been under discussion for some time, principally with a view to reducing the length of the period of study. Today students in Germany spend on average 13 semesters at a university. They are also commencing studies at an ever older age. Many of them, for example, have completed an apprenticeship or compulsory military or civilian service before pursuing a course of study. The fact that they are earning their living

comparatively late in life appears to put them at a disadvantage vis-à-vis job applicants from other nations -- particularly in view of constantly increasing international mobility (within the European internal market, for instance).

Opportunity for a New Partnership (Siemens and Siemens-Westinghouse). Siemens is one of the leading companies in the field of electrical engineering and electronics in the international marketplace., The Power Generation Group (PG) is one of the world's leading vendors of power plant technology, offering a complete range of services and products for cost-effective power generation in power plants of all types and sizes.

The Muelheim Steam Turbine and Generator Center is part of the Siemens Power Generation Group, which is responsible for Siemens' business in the power plant sector throughout the world. The Muelheim Development and Manufacturing Center develops and manufactures complete turbine generator units used in power generation. These are deployed in:

- fossil steam power plants
- combined-cycle power plants
- nuclear power plants equipped with light water reactors.

The acquisition by Siemens of Westinghouse's fossil plant business in August 1998 was a milestone for both companies. It has brought together engineering design and manufacturing groups from Germany and the U.S.. In the U.S., most of the design group is located in the University Research Park in Orlando, FL , with major manufacturing facilities situated in Charlotte, NC.

According to the Siemens officials, the acquisition of Westinghouse (particularly the fossil fuel plant operations) has generated decisive synergies in design, procurement, sales and services in a demand driven world market.[1] One of the outcomes has been the integration of design engineers who are attempting to interpret design drawings from the U.S. and Europe and take the best from both systems, resulting in improved products It was found that major efforts were required to prepare both groups to understand and integrate the technologies. Other outcomes have been an increase in the design staff in Orlando, FL, a projected increase for the workforce in Charlotte, NC, a stabilization of manufacturing workers in Germany, the development of improved products that are now being produced for new markets, increased demands for service or rebuild of older products, and overall improvements in sales and profitability.

This integration effort is continuing, and is requiring considerable effort by U.S. and German counterparts, who have apparently developed an excellent spirit of cooperation.

Language Skills Learning and Cultural Relationships. Changes in the way work is organized not only require new and higher qualification requirements, but must also correspond with

changes in available learning opportunities in the training or work process. Workplace learning will inevitably become more complex and demanding. Teamworkalso becomes a necessity. Coordination of processes, on job rotations at various workplaces, will all require new, high-skill qualifications and qualification processes.

With the increasingly international scope of society, science and economics, foreign language skills are becoming ever more important. Through the introduction of modern communication technologies and a willingness to engage in mobility in the workplace, good language skills and experiences in dealing with foreign partners greatly improve job prospects.

In order to exploit these advantages, trainees must seriously endeavor to improve their foreign language potential and their knowledge of the customs and living conditions of other countries in order to guarantee the company's competitiveness.

Trainees should accordingly:

- Receive solid vocational training that enables them to respond to the changing requirements and take responsibility for new tasks. This also expands their scope for action and decision-taking, and broadens their job selection opportunities.
- Learn about the interrelationships of their job taking into account job experience, knowledge and insights so that they are well prepared to enter the world of work.
- Acquire skills and attitudes that will enhance their ability to make judgements and their capacity and willingness to act in professional and non-professional capacities.
- Be capable of recognizing company, legal, economic, and social responsibilities.
- Be aware of any conflicts between their own requirements and those of their contemporaries and their environment, and be willing to work toward a compromise and manage stress.
- Learn about a different cultural environment.
- Learn about work and training methods used in the United States and Germany, benchmarked with the best in class throughout the world.

The exchange of globally-oriented specialists with language skills and factual knowledge about the world's different political and economic systems, information about the legal and social provisions in force in the various states, and an understanding of the living conditions of people in other countries (between Siemens employees and "colleagues" of subsidiary companies), is absolutely essential. It is above all achieved through the international orientation of the dual system of German education and by integrating trainee exchange programs and periods of occupational development abroad (Germany, England, and the U.S.).

Due to the globalization of the workplace, it has become increasingly important to accept new and highly differentiated forms of worker mobility between the individual company locations. Siemens is planning work placements as well as training and further education opportunities for employees and trainees at all levels.

A New Internship Model for German Students. In March, 1999, as the consolidation of Siemens-Westinghouse was taking place, Mr. Ferdinand Walbaum, Training Manager of Siemens (PG division) in Muelheim, contacted the author at UCF concerning a proposed exchange of students, wishing to meet with a UCF representative and a Westinghouse representative in early April. The meeting was hosted by Mr. Phil Ratliff, Siemens-Westinghouse, at his office in the Central Florida Research Park, near the University of Central Florida. Mr. Walbaum arrived with a program in mind based on the German experience, but wished to encourage the U.S. managers to develop a program locally. Once he clarified the Siemens goals and those of the German Economic Development and Training certification groups, Mr. Ratliff and the author prepared a plan to receive the first of German apprentice students in July, 1999. The training period was to be seven weeks , with five weeks in the Westinghouse divisions and the equivalent of two weeks with the University of Central Florida. Many details had to be worked out, but Mr. Walbaum simplified it by saying that "the Germans would take care of everything there for U.S. students," (the next year) and he hoped that "we would take care of everything in the U.S. for his students." With the strong personal leadership (and funding support) from Mr. Ratliff, the program was arranged as a test vehicle. It was determined that the certificate method of delivery of course material to the German students would be used at the university.

A checklist for student arrival and orientation was prepared and the first four students arrived in Orlando for the July-August training period. The checklist follows and continues to be refined.

For the students being received:

- Arrange housing for the four PG apprentices close to the Siemens/Westinghouse facility with some means to get to work each day. (Student apartments and bus tickets were provided,)
- Meet the students at the airport and transport them to their housing.(Some household items should also be provided for the student prior to arrival.)
- On the first day, take the students to a grocery store to buy food, or make other arrangements as appropriate.
- Pick up the students the first morning and take them to work and to security for badges. Arrange for personal protective equipment.
- Arrange for a seat in the office or location on the shop floor with a networked computer and passwords. (Appropriate tools are made available).
- Write a training plan for the students and assign them to a supervisor and mentor prior to arrival.

- Schedule the university lecture and laboratory experiences for certificate training.
- Provide bus passes and possible tickets for swimming, theme parks and week-end excursions. Invite others to escort the group and take them to places of interest, (A social mentor or sponsor should be assigned with a plan of activities for week-ends.) Give them instructions on job safety and advice on personal safety.
- Arrange a certification ceremony and luncheon prior to departure.

Once the students had begun work at Siemens-Westinghouse, they were taken on an orientation tour of UCF and they began a series of lectures and lab sessions specific to U.S. methods of design, prototyping, manufacturing, CAD/CAM, drawings and specifications and were assigned projects in UCF laboratories. They toured several industries and power plants where U.S. concepts and other methods were demonstrated. The UCF experience was scheduled on half-days in the latter part of their apprenticeship. The offices assigned at Siemens-Westinghouse were considered their home base where they saw a supervisor or mentor daily..

Preparation for U.S. Interns to visit Germany. In March 2000, two University of Central Florida personnel traveled to Germany to assess and prepare for the experience of the U.S. students going to Germany in the Summer, 2000. The Student Exchange Program began with four students from Germany visiting Siemens-Westinghouse and UCF in Summer, 1999, as an initiative from Siemens training officials. A program with four German students coming to the U.S., and four U.S. students working and studying in Germany during Summer 2000 was being prepared.

The UCF professors, Dr. Richard E. Denning and Dr. Hugh K. Rogers, visited (1) the Siemens Training Center and Power Generation Plant in Muelheim, (2) the Siemens Transport System (ICE Train) in Krefeld, (3) a Technical School in Muelheim, (4) the University of Applied Sciences in Gelsenkirchen, (5) German Education and Economic Development Officials that plan and operate Germany's educational and training systems, and (6) a Rotary Club cultural event. (This event involved an exchange of flags between the Rotary International Clubs of Lake Mary, FL, and Muelheim, Germany with declarations of support to assist the student exchange program.) They were met and hosted in Germany by Mr. Ferdinand Walbaum of Muelheim and Mr. Werner Franz (formerly of Lake Mary Siemens Telecommunications) of Krefeld.

Selection criteria was developed and prioritized for U. S. student participation in the program. It was determined that the prime criteria should be engineering technology majors (3.0 GPA or higher) in design or manufacturing operations with Metrology, CAD/CAM, Machining, and Logistics courses completed. The interval of training should be in the Summer of the Junior year, with provisions for additional coursework and part-time internship with Siemens-Westinghouse during the Senior year. Students could look forward to a potential offer of full-time employment upon graduation.

U.S. students were selected in April, 2000 for the exchange, with two coming from existing Siemens-Westinghouse employees and two UCF students. Michelle Kiaaina and John Jensen, met the criteria on a best qualified basis at UCF.

For the Summer of 2000 in Germany, the U.S. students followed a detailed schedule, that included fours hours per week of German language and terminology useful in engineering drawing interpretation. The following is a description of experiences for the U.S. students in Germany:

Student Experience in Muelheim and Gelsenkirchen. During the seven weeks in Muelheim, Germany with the Siemens Training Center, students gained experience in the following areas:

- reading drawings and understanding tolerance and welding symbols used in Germany
- creation of technical information (drawings, models) using both 2D and 3D software (Pro-Engineer, Siegraph)
- learning how to construct parts, layout drawings, and create assemblies.
- learning manufacturing methods and finishing techniques used by Siemens.
- preparation of technical drawings with applications, standards, and sets of rules.
- mechanical engineering-referred components, modules with cuts, manufacturing and functional dimensioning of components and modules.
- tolerances, fits, upper flat and additional specifications
- tutoring in the fundamentals of German language (vocabulary, sentence structure, descriptive sentences)
- understanding the German words and phrases that conform to Siemens-Westinghouse standards for calling out material specifications and archiving.
  touring facilities that covered all major aspects of factory work, including:
  a. The main Muelheim factory and the assembly harbor plant (Turbines and Generators)
  b. Thyssen, the iron and steel foundry
  c. Doncaster Buchum, the blade casting company, with an extensive quality control department.

At the University of Applied Sciences in Gelsenkirchen, students received classes in:

- controller software
- finite element analysis
- continued applications in Pro-Engineer
- introduction to Pro/Mechanica
- microscopy
- fluid mechanics, and pressures relevant to turbines
- design standards and tolerancing

Completion of the first training cycle for U.S. students. Students entered temporary full-time employment for the Summer, 2000, beginning May 7. Their Germany internship began in early July and ended in late August, when they were offered 20 hours per week employment in their Senior year. These students were also offered full-time employment by Siemens-Westinghouse in May 2001 (upon graduation), completing the training cycle.

German students for Summer 2000. For the German students coming to Florida in Summer 2000 the checklist for preparation was again followed. The university certification courses and labs were similar, with the addition of working on-site three days with a U.S. industry in a planned design prototyping, and production experience. The students were also more involved with the university experience using the student center, library, and athletic facilities. They were sponsored for social and cultural activities by company personnel and the Lake Mary Rotary Club.

U.S. students for Summer 2001. Currently, four UCF students are continuing the 2001 experience in part-time work status as graduating seniors. (The 2001 program was also opened to both Engineering Technology and Mechanical Engineering students.) They were permitted to carry up to two college program courses to maintain academic continuity for the summer. They were selected and began temporary full-time employment May 21, 2001 followed by the German exchange experience on July 8, 2001. In sequence with the current training model, they continued with part-time employment in Fall 2001 and look forward potential full-time employment upon graduation in June 2001. Each step in the program of training and work experience involved review and approval by managers.

Conclusions:

- Industries in Germany have invested in apprentice type training that is complementary to public or state schools, vocational schools, and Universities of Applied Science. Students can complete compulsory education with "certificate" level education and training, or with the proper prerequisites and school placement, complete college level work with a "diplom" at Universities of Applied Sciences. A broader and more comprehensive education is available at "Gymnasium" levels with principal universities.

- Larger industries have established in-plant training capabilities, not only for their existing employees, but for students in state supported schools who qualify for their level of work, and be assigned to in-plant work experience and training.

- Multi-national corporations, such as Siemens, are taking a "world view" approach to training and education to insure return on investments and the highest possible workforce skill levels. The high skill levels enable design and production of high quality products, while meeting demands of world markets.

- As acquisitions are made (for example, the Westinghouse Power Group purchased by Siemens), assessments and integration of technologies via design can add value and market share if the workforce skills and tools are there to integrate and apply the best technologies available to meet market demands.

- As acquisition and mergers occur, workforce training must follow. This training may involve new machinery, software, methods, materials, and appreciation for the language and cultures in new markets.

- Engineering drawings of multinational companies represent real property that must be assessed and interpreted for value and potential use. Differences in measurement systems, processes, standards, and applications must be understood in a multi-lingual, multicultural world of business.

- Few public schools, colleges, and universities in the U.S. are preparing the workforce to work in the multi-national enterprise environment. Some inroads are being made with languages and international standards, but the German example of teaching the equivalent of fluency in English during several years in state schools sets an example for other nations to follow.

- The German workforce receives more equivalent years of training and education than its U.S. counterpart at all levels, and generally enters the full-time workforce with more maturity, enabled with work experience through apprenticeships or in-plant training.

- The U.S. college and university environment generally attempts to accomplish more learning (less the work experience) in a shorter period and many will agree that the students are well prepared theoretically and logically but are less "work ready" due to limited exposure to tools and software used to design and manufacture.

- The Siemens-Westinghouse, and UCF Student Exchange Program is still in a formative stage. It is now in its third year with participants rating it highly. The "bottom line" is that the first U.S. students completing the summer experience and two semesters in part-time work in the senior year are now entering full-time employment, with good reviews.

- The occupational skills required in this program have been studied and defined by U.S. professors and some curricula changes have already been implemented, with new courses proposed. A structured internship for credit is also being proposed for all students in the regular program in the summer of the Junior year.

- The certificate modules being presented by the U.S. university have been well received by the German interns whom have profited from the fast-moving design, prototyping, and production exercise being offered on-site with industry.

- The German training and education counterparts are congratulated for their enthusiasm, follow-through, and commitment on even the smallest details of the project.

- The U.S. managers at Siemens Westinghouse, Mr. Phil Ratliff and Mr. Al Pallotta, continue to be very supportive and innovative with training methods for both the U.S. and German interns. The benefits for their company are that they are preparing their future workforce, and can more directly influence the curricula of institutions involved with student preparation in a supportive, partnership role.

Recommendations:

- The internship training program should be continued, and continuously improved by annual assessment and updating.

- Skills profiles for the jobs to be mastered and the employer expectations should be considered in updating relevant curricula at the University of Applied Sciences in Germany and the University of Central Florida in the U.S.

- U.S. schools, colleges, and universities should devote more study to promote and develop experiences that will better prepare the multi-national workforce of the future.

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