
AC 2011-2853: DETECT - DESIGN ENTREPRENEURSHIP TECHNOLOGY ENGINEERING COLLABORATION TRANSATLANTIC PROJECT

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Heinz Schmidt-Walter is from Germany, the town of Bremen. He studied Electrical Engineering at the University of Hannover where he also got his PhD in the area of power electronics. Consequently his first industrial engagement was in power electronics, specially high speed brushless frequency drives for high speed centrifuges. 1988 he went back to the University, first to the privat University of Deutsche Telekom, where he worked and lectured in power electronics, specially Switch mode power supplies. 2000 he changed to the University of applied sciences, Darmstadt. There he started his work in the fuell cell and hydrogen technics area beside power electronics.

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Michael Dyrenfurth is professor in the Department of Industrial Technology at Purdue University. He is co-PI of the DETECT and Atlantis Concurrent MS degree projects. Active in international aspects of the profession, he teaches and researches in the areas of technological innovation, technological literacy, and international dimensions of technological education.

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Dr. Barnes is a professor of Integrated Science and Technology at James Madison University. He has worked in the science and technology field for over 39 years, having served in leadership positions in education, business/industry, and government. Dr. Barnes is also a co-principal of Barnes Technologies International LLC. Prior to joining the faculty at James Madison University, Dr. Barnes was the Director of NASA RISE, a NASA research institute at Eastern Michigan University. Dr. Barnes has also directed a technology research center at The University of Texas at Austin and has served as President and CEO of two technology research companies. Dr. Barnes earned his baccalaureate and doctorate degrees at Virginia Tech and his masters at Virginia State University. Dr. Barnes has conducted many research projects and third party evaluations, published numerous articles, and has authored several books in his research areas of Innovation, Problem Solving and Sustainability.

DETECT - Design Entrepreneurship Technology Engineering Collaboration Transatlantic Project from the German point

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Project Summary: This mobility project is a collaboration of four engineering, design and technology education institutions addressing a 21st century global imperative--namely that innovative Engineering & Technology will be done by multidisciplinary knowledge integration in a collaborative, cross-cultural, global, and digital environment. The project's primary vehicle is the exchange of students for a full semester across the Atlantic. The project started in 2007 and is funded by the EU for €180.000 and by the US Fund for the Improvement of Postsecondary Education for \$ 180.000. The partners involved are:

EU lead institution:

Dublin Institute of Technology, IE
School of Engineering and the Built
Environment
School of Control Systems and Electrical
Engineering

EU partner institution:

Hochschule Darmstadt, University of
Applied Science, DE
Department of Electrical Engineering and
Information

US lead institution:

Purdue University
College of Technology
Industrial Technology Department
Electrical and Computer Engineering
Technology Department

US partner institution:

Electrical and Computer Engineering
Technology
The Pennsylvania State University

Since 2007 the US Universities Purdue and Penn State and the German Hochschule Darmstadt, University of Applied Science had an intensive student and faculty exchange. The facts of this exchange since 2007 are as shown below:

One-semester student exchange US -> Hochschule Darmstadt:	9 Students
One-semester student exchange Hochschule Darmstadt -> US:	9 Students
One-semester faculty exchange US -> Hochschule Darmstadt:	1 Professor (Spring 2011)
One-semester faculty exchange Hochschule Darmstadt -> US:	1 Professor
Short-time student exchange US -> Hochschule Darmstadt:	16 Students
Short-time faculty exchange US -> Hochschule Darmstadt ->US for lecturing and administration:	approx. 15 Professors

Several special events and meetings for exchange organization and research collaboration

A couple of joint research projects : So a RFID-Project (radio-frequency identification) about contactless object tracking and a Smart Grid project about renewable energy systems.

Numerous site visits at the participating institutions by academic, administrations and head of universities involved in the program.

Hochschule Darmstadt:

Hochschule Darmstadt, University of Applied Sciences, is situated in Germany, near the city of Frankfurt. Darmstadt itself has about 150.000 inhabitants including about 30 000 students. Darmstadt has two large Universities, Hochschule Darmstadt, University of Applied Sciences and the Technical University of Darmstadt. Both institutions are mainly engaged in sciences and engineering.

Hochschule Darmstadt is mainly an undergraduate School with some additional Master Programs. The following list gives an overview over the departments of Hochschule Darmstadt. Electrical and Mechanical engineering as well as Computer Sciences are among the strongest.

- Architecture
- Civil Engineering
- Chemistry and Biology
- Computer Science
- Economics
- Electrical Engineering and Information Technology
- Industrial Design
- Mechanical Engineering and Plastic Technology
- Mathematics and Sciences
- and others

In Germany, the DETECT program was started by the Faculty of Electrical Engineering and Information Technology. The Faculty of Electrical Engineering and Information Technology is the biggest department (Institut) within Hochschule Darmstadt. It employs about 40 Professors giving lectures and running labs, 20 Engineers assisting the labs and 6 secretaries for administrative assistance. The faculty is working in three main technical areas:

- Telecommunication,
- Energy and Environment,
- Automation.

Academic hosting of international guest students

The Hochschule Darmstadt is very experienced concerning international student and faculty exchange. An international office provides the administrative structure and service for incoming and outgoing students. The incoming students are guided the first days for getting a bank account, using the public transport or finding their accommodation in a student hostel for example. Also they are introduced to the area around Darmstadt by Darmstadt students for example to the city of Frankfurt or to the Rhine river valley, a world heritage site.

The guest students start their stay on March 1st or September 1st. The academic semester starts near the end of March or in the beginning of October. This means the guest students have about three weeks to get familiar with the country before classes begin. These three weeks are used for a full day intensive German course. Every guest student has to participate in an

appropriate level German class. The German lessons are continued over their full stay twice a week.

We do not expect, given their fresh German knowledge, that the guest students could fully follow the faculty's lectures. Therefore we offer several academic possibilities:

- Lectures in English language: Our Masters program offered by the Faculty of Electrical Engineering and Information Technology is specifically designed to serve international students and purposes. In it, international and German students get their academic lectures presented in English. That helps all of them to get together and to work in international groups. Even good undergraduate students could join these classes, by getting an extra supervision and additional help.
- Final thesis projects as well as small additional research projects are offered: All professors are able to supervise technical projects in English. Nearly every Professor offers projects that students can apply to. The projects ranges from 2.5 up to 15 US-Credits, which can be accepted from the sending institution (2 EU-Credits count approx. 1 US-Credit).
- Practical training semesters and projects in industry. German industry is strongly embedded in the technical education of the Universities. Nearly all students of engineering go for one or two semesters into industrial companies. They are supervised by a professor of the sending institute, but working fulltime on an industrial project in industry. This system could be joined by American guest students.

Social life of the guest students

The international students of the Hochschule Darmstadt are accommodated in student hostels. These are very different from American student dormitories. Student groups of 4 or 6 students are self-organized in living groups. Each has his/her own room, but kitchen and bathrooms are communal. The groups are international and often friendships for life are created.

Europe offers a huge number of sights, i.e., heritage sights, modern town or places of natural beauty. Many students take the opportunity to travel, not only before or after their academic stay, but also during their study, for example given the relatively small distances involved the weekends offer numerous and affordable travel possibilities. To the latter point, note that every student has free public transport with her/his enrollment and paid fees. This means roughly an area of about 100 kilometers (60 miles) radius around Darmstadt is freely available. In the Rhine-Main-Area (where the Rhine-river and the Main-river merges, Frankfurt, Wiesbaden, Mainz, Darmstadt) nearly every village is connected by railway, and over all every point is reachable by public transportation.

Student exchange evaluation

The international exchange model used the Hochschule Darmstadt, University of Applied Science for the DETECT project, from Barnes Technologies International, LLC's (the independent evaluator) viewpoint, provides an excellent example for educating students in an international context. Their model is based on a strong working relationship between the

Hochschule Darmstadt's International Program's Office and the University of Applied Science. They work together to provide an excellent pre-departure and hosting orientation. These orientations include an extensive series of inclusive activities that engage students with other international and Darmstadt students. DETECT students studying at the Hochschule Darmstadt arrive three weeks before their exchange semester to take an intensive German course, based on their incoming level of German and study German through their exchange experience.

Over the life of the DETECT project, the data show that Darmstadt students, both exchanged and hosted, received an excellent and well-rounded educational experience. Students showed positive gains in language, cultural sensitivity and learning.

Language gain

Rudimentary language competency is imperative when studying in a non-native language country, a key goal of the FIPSE Atlantis EU-US Program. To determine how well this goal was achieved by the English-speaking students studying at the Hochschule Darmstadt, Barnes Technologies International, LLC (BTILLC), the independent evaluator, collected data about language gain from three sources, 1) pre-departure student survey, 2) post student survey, and 3) language courses taken at H-DA as part of their exchange experience. Both survey instruments were conducted electronically. A four-point Likert-scale was used on both surveys (very comfortable, comfortable, somewhat comfortable, not comfortable or very capable, capable, somewhat capable, not capable). The European Qualifications Framework for Language Learning is used to certify language gain from the H-DA language coursework. Besides the students being able to use German for day-to-day living, i.e., interacting with students, faculty, travel, shopping, etc., BTILLC examined language gain relative to 1) their comfort reading technical and scientific literature required for course work, 2) capability to orally explain technical and scientific concepts required for their coursework, and 3) their capability writing technical and scientific concepts required for their coursework.

Only a small number of students exchanging to Darmstadt indicated that they were was fluent in another language. Most students had studied another language, but indicated that they did not speak it well. A few students either were not confident in speaking a foreign language or did not speak a foreign language at all. However, the Darmstadt students indicated that they felt fluent in English. The data indicated that the Darmstadt students' command of English was more than sufficient for them to succeed academically, culturally, and socially during their exchange.

To succeed academically during a foreign exchange experience, students must be able to read and converse the language of the country in which they are studying. In the case of Darmstadt, DETECT students must be able to read, write, discuss, and present technical and scientific material in English. The Darmstadt students indicated that they were comfortable reading technical and scientific literature required for my course work. While a little more difficult, the Darmstadt students indicated that they were capable of orally explaining technical and scientific concepts required for my course work. The Darmstadt students also indicated that they did not experience language barriers in their day-to-day living or traveling in the United States.

However, while the Darmstadt students did not experience academic, cultural, or social language barriers, the Purdue and Penn State students indicated in the pre-departure interviews some initial concern about being able to function as well academically or day-to-day due to their lack of sufficient use of the German language. However, the student post-interviews show that this concern was not a problem – probably due to the extra efforts made by Darmstadt faculty. The students indicated that their language course and day-to-day interactions with the Darmstadt and other students and faculty helped them to be academically successful. The students indicated that after a few weeks they felt at ease living and studying at Darmstadt. They also indicated that their language gain during their exchange experience gave them more confidence in traveling to other countries.

Cultural sensitivities

Student life experiences are crucial to the success of exchange programs. Overwhelmingly, both the Darmstadt students and Purdue and Penn State students exchanging to Darmstadt indicated that the best component of their exchange experience was their interaction with students from so many countries. The students indicated that these interactions began with their host orientation and continued throughout their exchange through the Office of International Program activities, housing arrangements and coursework. The students also indicated that the hosting faculty was extremely helpful in sharing cultural and global perspectives with them. All the students explored their host city and traveled extensively to other cities, states and countries during and/or before or after their exchange. For the most part the students traveled on weekends or university holidays with other students from their home institution, or in the case of Purdue and Penn State students, they sometimes traveled together. Some students traveled with exchange students from other countries they had met during their exchange. Interestingly, the students from Darmstadt felt more comfortable using public transportation than the Purdue and Penn State students, a fact directly contributed to their previous experiences with city living in their home communities or their previous travel experiences. The Purdue and Penn State students also indicated that they were initially shocked with the nature of co-educational housing (including coed bathrooms) and the freedom it allows. For example, at Darmstadt, the students living in residence housing control the housing, while the university controls the housing at Purdue and Penn State. Students being exchanged also experience a different campus environment. At Purdue and Penn State, the Darmstadt students experience a campus environment as oppose to the urban environment to which they are accustomed. The converse is true for the Purdue and Penn State students. However, these factors did not take away from their overall experience and appreciation of their exchange – instead it probably augmented the impact.

Learning gain

All students, regardless of their institution, experienced a different type of learning environment during their exchange. The Purdue and Penn State students experienced a system at Darmstadt where the weight of the grade is determined by the final examination in a course. There are fewer labs, no required textbooks and a lack of continuous feedback though routine homework and periodic tests, a highly independent learning culture. The Darmstadt students experienced just the opposite experience - routine homework, required textbooks and labs, periodic tests, and a final exam that was averaged in with other course requirements.

The Purdue and Penn State students experienced not being required attend class, while the Darmstadt students experienced required class attendance.

Interestingly, the students indicated that the courses were either about the right level or more difficult than at their home institution. The Purdue and Penn State students indicated that not having routine homework and tests, with only a final exam at the end of the course, made them a little uncomfortable. Conversely, the Darmstadt students were not used to having homework and periodic tests. All the students indicated that the laboratory experiences were different than at their home institution. Interestingly, the Darmstadt students indicated that instruction was more structured than the more independent structure of their home institution. Some students pointed out that the technology and terminology being taught at Darmstadt was at a much higher level than at their home institution, but not at such a level that they could not manage the content. However, they indicated that the professors were very available and helpful to them with their studies. The students also stated that as the semester evolved they felt more at ease with the way courses were conducted at their host institution. The students indicated that it helped having other exchange students from their home country in their courses. Some of the Purdue and Penn State students indicated that it was somewhat hard fitting in with the hosting institutions students since those students for the most part were studying as a cohort and furthermore many lived off campus. Regardless of instructional differences or the nature of the courses, the students overall specified that they were satisfied with their academic experience during the exchange and that it did not jeopardize their completion pace at their home institution.

Summary

Universities have to prepare the students for their career. This is more than learning expert knowledge. Communication skills, respect for other people, understanding of different ways of social life, just knowing not being the center of the world is also a part of learning. This is not countable in examinations but nevertheless a big learning effort.

International exchange lives from the involved individuals. Close contacts up to friendships are essential to run international connections. The faculties must live what they expect from the students.

Also the support from the institutions is essential. The institutions need systems as our international office which deals with and helps in all administrative requirements as visas, bank accounts, housing, transport. The academic systems need to provide expert learning in lectures and projects regarding the language requirements. We are all glad, having the English language as the main international communication tool. And international exchange needs the support from the leading people of a University.

All this is given at Hochschule Darmstadt and supported by many faculties members. A certain feature of German technical education is the very strong link to industry. Industry is directly involved. American students could participate in it.

Additional, international exchange programs need a financial frame, but a sustainable frame. As internal education costs money, so does external. We are glad having the DETECT project under the EU/US Atlantis program. But this program is time limited. We hope that we can extend our DETECT program.

At the moment we try to expand the program to more departments of the Hochschule Darmstadt. All Departments of the Hochschule Darmstadt have very good experience in international exchange, but the Atlantis program supports specially the EU-US exchange. Appropriate MOUs exist for all attended Universities. We just have to encourage more people in all institutions to take part of it. I may invite you to Darmstadt.