

Diversity in Engineering Education: Good or Evil for International Programmes?

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INTRODUCTION

International study programs have been offered for a very long time already. In recent years, they developed into a variety of products on the international market for education. And as any product on a competitive market does, they developed into very different forms under an ever fuzzier heading: *International Education*. As a result, the diversity of these products and also the diversity of educational approaches led to a vast, rather beclouded spectrum of offers and solutions.

Approaching the field from an overall perspective, one must keep the historically diverse constructors of higher education in mind: differentiating roughly into a Continental European tradition of essentially government-funded universities, and the approaches in the Anglo-Saxon world, which were only partially based on government funding, with contributions of alumni and to a larger part tuition fees for the funding.

BACKGROUND

In post-colonial times the historical differences in objectives and funding of universities affected the situation of the British universities positively, since the language of at least the elites in the former colonies was the same as in Great Britain. Plus, the structures of governments and industries were moulded by generations of British influence. Based on these facts, taken together with the hugeness of the Common-

wealth of Nations, it was merely logical for 'global international education' to be dominated by the traditions and influences from the former British Empire.

At least for the offspring of the elites in the Commonwealth, an English/British education was a 'must-have' to be eligible as future leaders of their own. Eventual elevated tuition fees and high cost of living was rarely seen as an obstacle by those who could extract the means from commodities as well as the workforce of their native countries. Additionally, Great Britain also contributed to the expenses of people whom she considered to be assets for the Commonwealth.

The continental European countries, with the exception of France, and maybe Spain, were in a very different situation during this post-colonial period. Their educational offers were mostly targeting a local or regional clientele. Aside from the funding by the tax-payer, one result of these different, defining parameters was the denomination of the degrees. They were defined and named in many diverse ways; from the German 'Diplom' (usually confounded in the global context with a similar named 'diploma' of a very different level), the French 'Lettres', the Spanish 'Licenciado', the Swiss 'Licentiate', and so forth. Overall, the universities of continental Europe were initially not focussed on international students.

Therefore, at least in the beginning of the international education as a marketable product, the Anglo-Saxon countries, like UK, USA, and later Australia, were in an advantageous position. Advantaged by the language of tuition (English), helped by the almost global recognition of a three-phased education along Bachelor-Master-PhD, 'international education' became almost a synonym of 'Anglo-Saxon education' [1].

And yet, the global name tag 'International Education' signified anything but a homogeneous market. Common terminology served more as an agreed-upon minimal construct to enable communication, than to actually represent a unified stage. The term 'International Education' thereby became more of a vessel, into which everyone could pour what (s)he perceived as such. And that was – and partially still is – based merely on an image formed by what the phrase 'Anglo-Saxon education' evokes in the individual.

Everyone began to talk about and ask for 'credits', for 'CPGA', and students in almost any lecture hall around the world inquired "How to obtain an A?" irrespective of origin or nationality.

This became even more prevalent with another group of students entering the market of international education: the children of a new social bracket in the emerging countries, like People's Republic of China, India, Brazil, etc. That is, the kids of an emerging middle class in the developing world. Like all newly rich, and contrary to the traditional elites, they were less bound by a traditional aspect of choice of universities for their education and would rather perceive education as a product to be chosen from a market place.

In a nutshell, when international education became a global market, the aspects on the objectives, targets, including returns, were seriously divers [2].

This diversity includes the sometimes hidden agendum behind the marketing efforts. Nobody in the current business of international education, more often than not centred on economic returns, believes in a fully altruistic motivation of their international education! Be it direct returns from fees, marketing of brands and products of the host country, subtleness in political formation of future leaders, up to replenishing a perceived ageing labour market with the need of incoming professionals, including students to stay, and settle, to join the workforce in the country of their studies. This latter objective is clearly, and even publicly, stated as one of the objectives of

the German government. With (at least high) tuition fees prohibited by the Federal Constitution, the objective can barely be seen in the numbers of international students shifting in and out. Rather, incoming students are perceived as potential future members of the German industrial and academic workforce. (This is similarly applicable for most continental European countries, btw.)

These objectives must not be underestimated, since this motivational strain will – under consideration that the fees are essentially paid by the German tax payer – lead to a differentiation with the dominating parameter: *who to select*, and *when to select*. More than specific amounts of incoming tuition fees, the aim is to ‘attract the best’ for the future sake of one’s country.

And even this target sees diverse approaches: One conviction is to attract fresh graduates from elsewhere, who shine in their thesis, be it on the level of Bachelor or Master. The hope is, to attract these graduates by attractive further educational offers. Another, almost contrarian, view is the desire to select, and attract, talent from the very first steps of their tertiary education and make them stay; because it is feared for those who already have made themselves standing out of the crowd, to no longer be swayed to change places. This second educational view is also known as the ‘chimney model’, because students start very much at the bottom of the host university before ascending to a PhD or PostDoc.

This raises the question: Which method is best to fulfil the obligation to maximize the monetary underpinnings paid for by the general public; the tax payer?

If Germany wanted to enter the market on a large scale, it had to undergo serious changes to become comparable in that newly established market place dominated by the Anglo-Saxon universities earlier. To be precise, all of Europe had to change, and therefore adopted the system of Bachelor-Master-PhD in the so-called Bologna-Reform [3]. Also, Germany as well as the other European countries had to review the choice of language of instruction.

Interestingly, some questions remain to be answered in Germany. Here included are some that were thought to have been answered already. Firstly, the question of language: English or not English? While the DAAD (German Foreign Academic Exchange Service) used to bet on “100 percent of English, in English and with English” close to a generation ago, more recent views are much more differentiated. In November 2014, the leading technical universities of Germany had a meeting in Darmstadt to discuss the question “Do engineers need German?” [4]. The answer at the end of the day was unambiguously ‘yes’, and not only to communicate with their landlords, or the cashier in the supermarkets! Rather, it was perceived that language is not only a basic communication means, but also a framework to develop thoughts, formulate academic questions, and express engineering contents.

In the United States we can also find comparable developments: the University of Rhode Island has introduced engineering degree courses as combination of a technical course as major and German language as minor. This strategy was started many years ago and found a good number of US American universities to follow this scheme. The University of Rhode Island does offer such international degree courses also with other integrated foreign languages, including a version with Chinese language.

Another question, still contested in some places, is the change of methodology at studying introduced by the Bologna-Reform: the Anglo-Saxon model of studying is more streamlined, sometimes with compulsory accommodation on campus, continuous evaluation, includes sports, fitness and guided interaction (‘cheer leaders’), while

the traditional German system was one of full liberties with respect to scheduling, length of studies, etc. Some parties are adamant that future leaders also need these liberties to develop optimally.

Everything taken together in this brief analysis of the historic background and the pressing questions for the Europeans trying to cut larger portions off the globally available cake 'International Education', this paper envisages to present a concept and implementation of an engineering education that tries to answer the questions from the angle of a tax-funded German university, including that of language of tuition, and considers the objectives of the German government to attract students to stay in the country.

1 STRATEGIC GOALS

Under consideration of all these diverse determinants for setting up international education in their universities, executive, e.g. rectors, chancellors and deans, must answer the question, which student population they are targeting and which kind of graduates they are willing to produce. In addition, resulting diversity and costs must be considered and be balanced with financial income and academic gains.

The diversity of those questions will, and must be answered differently by different universities. Which strategy is useful to recruit "the best" students (only)? Also this term, "the best", needs to be specified, if not defined: This could be the best students to contribute to the power of research and development of the institution. "The best" could also be understood as students who will become lecturers to contribute to the academic development of a(nother) nation; a definition often encountered in developing or threshold countries. Last not least, "the best" could entail suitability for the industrial workforce in the country.

For the underlying purpose, we will try to answer these questions from a (naturally) subjective point of view, based on more than 15 years of experience with a large scale international educational program in engineering.

This programme was not set up to 'mirror' an existing programme that is conducted completely in German. Neither was it set up to complement an existing program. It rather serves as a stand-alone program ('Chimney', see above) from Bachelor to PhD. Contrary to some other programs, our program is not intended solely for foreign students, but encourages native German students to enrol, too. This sets it apart from most other programmes that try either of the above. We intended to create a truly 'international' offer in engineering. To be noted: from the beginning we intended a program that is conducted 50% in English and 50% in German; thereby being attractive for foreign students (to immerse into German language and culture), as well as for German students (to immerse into English, and cultures of the other participants).

Before we try to tackle the questions above and summarize answers from our own perspective, we prefer to introduce the underpinnings, targets, successes and shortcomings that we have seen with our program in engineering throughout its almost 20 years of existence. Then we will revert to the original question: Diversity in engineering education; and which obstacles and which chances are potentially coming with this diversity.

2 INTERNATIONAL STUDIES IN ENGINEERING (ISE)

In 1998, the German Federal Government recognised that overseas students were no longer choosing Germany as their preferred industrialised country for studying, and rather gave preference to the Anglo-Saxon countries. Therefore, their numbers

in Germany were on a decline. This was the time when long established traditions in the global higher education market were challenged, as lined out in our chapter 'Background' above.

For Germany as export-oriented nation and being poor in natural resources, "brain" was and is highly important – so government tackled the challenge and funded – via DAAD – a good number of projects to develop attractive international projects to compete with newly emerged key players on the global market, also under the consideration of the recently emerged clientele of the newly rich middle class parents in the developing world.

Long before the Bologna pathway, UDE was one of the first IHE to be granted such a project, offering just a first degree Master/Dipl.-Ing., that is bridging between the German tradition and the Anglo-Saxon system – and without asking for tuition fees! For Germany, this program was a novelty: Before, all overseas students had to spend about one year to study for the elevated German language requirement, the so-called DSH ("Deutsche Sprachprüfung für den Hochschulzugang"). This level allows pursuing the studies of any subject, including social sciences, philosophy, linguistics, to name a few. It was our belief that engineering students could do with less. The requirement of DSH added a full year to the length of the study, and scared a good number of otherwise interested and potentially good engineering students off. Due to a lower entry level requirement in languages and the language of tuition being English and German 50/50, it was possible to attract an ever increasing number of overseas students. This resulted in many critical discussions in Germany, whether this is the path to take, especially under the consideration of the funding by tax money. However, many also understood that this is not primarily a business management or microeconomic game – that is for the coffers of the university - , it rather became a factor for macroeconomic accounting.

After a first funding phase of 4 years and many positive experiences, by students as well as lecturers, UDE did win a follow-up project in 2001, expanding from the simple first degree Master into a broad spectrum of Bachelor and Master degree course. In the meantime, UDE had created a comprehensive Faculty of Engineering, combining all engineering disciplines under one roof (as a copy of what Anglo-Saxon engineering faculties tend to be). Thereby, the new study program, called ISE (International Studies in Engineering), with actually 6 Bachelor and 8 Master degree courses could become a full-fledged program in research-oriented higher education in engineering. The program fell into the following shape, from Bachelor to PhD (Fig. 1):

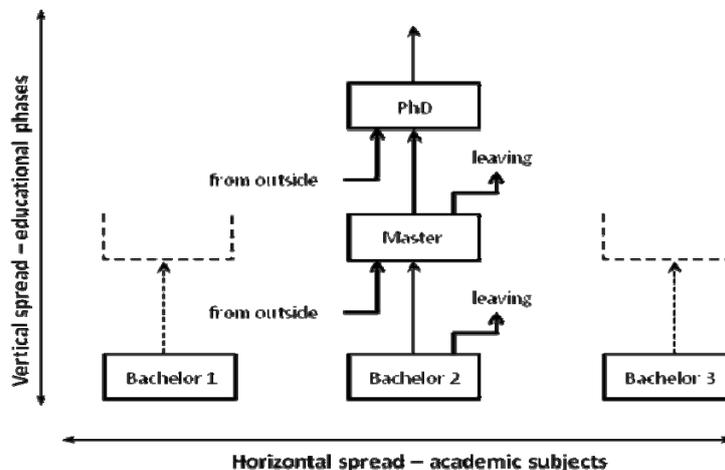


Fig. 1: Breadth and height of ISE

The horizontal dimension describes the broad spectrum of disciplines offered. This dimension contributes mainly to the attractiveness for (many) new undergraduate students: they have a large choice of degree course to enter and also to change later from the originally chosen one to another, matching better with personal interests. It ought to be mentioned that all engineering disciplines start with a common first year to teach basic engineering concepts. Through this common year, a change of subject towards the end of the first year is simplified considerably.

The vertical dimension comes with problems, but also with clear benefits: The interfaces between two neighbouring educational, vertical, phases do not only act as a hurdle for students to progress to the next higher level at their institution, they also act as additional possible entry points for students from outside. With a higher vertical range of the scenario we obtain more levels of educational phases, and thereby we gain more entry points for students with different levels of qualification.

Own experiences show that the combination of horizontally and vertically wide spreading programs results in a very diverse and versatile student population, enriching the international flavour. A high vertical dimension causes the “chimney” effect mentioned above: students who enter at a lower level are encouraged by good results to enter the next level; some others will decide to leave for a career elsewhere, and can be replaced by new entrants on the next higher level. This leads to a higher satisfaction with graduates on all levels, and also avoids high dry-out of student populations on higher levels.

Strategic goal in this concept is to combine a diverse student population with many chances to develop personal and academic standing. At the end, this is a combination that caters for mass education and brilliance in personal developments.

This challenging concept pays out for all stakeholders in their respect: for the students as well as for the tax payer. With the 50% of German as language of tuition and the intensive experiences with German culture and job market, there is a clear preparation of the graduates to fulfil the demand for well prepared experts for the global labour market; including the German labour market. These graduates also became ambassadors of German society and industry. Under U-Multirank, the results for our institution show good rewards for all the work done. [5]

Let us close this chapter with some figures of merit:

- **Horizontal width:** Civil, Computer, Electrical, Mechanical & Metal Engineering
- **Vertical width:** Bachelor, Master, PhD, with exchange and double degrees
- **Student population:** 2015 more than 2,000 with more than 100 nationalities
- **Applicants:** 2014 around 4,400,
- **Freshmen:** 2014 around 720
- **Acceptance rate:** ~ 2 out of 10 applicants

Further details of our international programs can be taken from the paper “International Studies in Engineering - Results from more than 12 years of experience in offering the most comprehensive international engineering programme at German universities” by S. Werner, A. Hunger, and R. Kärchner-Ober, which is presented also at SEFI 2015 and published in the same proceedings.

3 INTERNATIONAL EDUCATION IN ENGINEERING: GOOD AND EVIL ASPECTS

In this paper, we could present another piece of the multi-faceted ‘animal’ called *international education*. We have shown that diversity in international education is not limited to nations from where students hail, not limited to students’ destinations, and neither limited to study programs.

Instead, it became necessary to consider the diversity of subjects with respect to entry language requirements, societal and national objectives. Hereby it can be taken into consideration that engineering education is an education with similar demands and a similar labour market globally. Therefore, engineering is truly a subject that lends itself to globalisation.

By the way, Germany has done pretty good in this respect and risen to number three in the hit parade of countries considered attractive for studying by students globally.

And yet, the conditions under which students pursue studies in engineering are as diverse as the objectives and targets under which global engineering study programmes are being developed and offered. There are those where the objective focuses mostly on the throughput of the student population for income to sustain the expenditure of personnel and infrastructure (“the market domain”). There are others that rather focus on a macroeconomic perspective, and intend to maximize public investment for the greater good of a sustainable local labour market. Other aspects in this area are graduates becoming ‘ambassadors’ for the industrial culture of the host country.

In this paper we have chosen the – sometimes overlooked - perspective of returns beyond the individual institution as major focus, including some arguments for an education paid for by taxes, therein included the education of students from overseas. We have shown advantages for the university involved (in our case UDE).

Last not least, by setting up this programme, and similar ones, knowledge could be gained and experience developed on and in the market of global (engineering) education in the early 21st century. From here, we - that is UDE as well as Germany as a country – can systematically better and better understand the current undercurrents of international education, follow with adequate programmes, including double degree and mobility programmes, and achieve all this under consideration of the demands of the tax payer as well as the society as a whole.

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