

From Initial Competence Building in International Education to Internationalization of most Master's Level Education in Engineering

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Abstract: *This paper discusses the experience of International Master's programs at TKK from 1999 until the present day. The main activity has been on programs in the area of ICT and these programs will be in the focus of this paper as well. We discuss the development of the curriculum, give some statistics on the activity and will pay particular attention on the motivation behind the programs from their inception till the present day considering also the alignment of the programs with wider goals of the University. We consider the issue of tuition language from the points of view of both the foreign and domestic students. Finally, we will discuss wider societal and job market aspects of the programs and try to formulate conditions under which the programs can be further developed and broadened to the extent that we could claim to be a truly international University.*

1. Introduction

In late 1990's the ICT hype was picking up and the industry was crying for more skilled engineers in particular to develop mobile communications products and services and to create software for re-engineering business processes across all kinds of industries. The Finnish government reacted and adopted a Program of Additional Measures in Education for the ICT Area in 1998. One of the actions in the Government program was the initiation of International Master's programs in several Finnish technical Universities. One of the Universities in the group was Helsinki University of Technology (TKK). We at TKK welcomed the move, in fact, we proposed to include this action into the Government Program in the first place. We saw this as an opportunity to take a very concrete step towards wider internationalization of the University. This is a sub-goal of becoming one of the best and internationally well-known technical Universities in the world, which has been written into the TKK strategy long ago.

For several years prior to the Government Program TKK had run so called Linkage Programs in Industrial Management and participated in international student exchange. The number of International students in all our programs was, however, very limited and our student exchange balance was negative. Even with the negative balance, the share of our domestic students that made use of the opportunity of spending a term or a year in a foreign country was a small portion of what we saw as a desirable target.

The Linkage programs were and still are classified as supplementary education programs since they do not give an officially recognized degree. Due to this feature, to an extent, it has also been possible to charge tuition fees in these programs. Recall, that by the Finnish law, any education program that targets a degree, must be free of charge. The positive experience of the Linkage programs in Industrial Management nevertheless, encouraged us to expand the intake of international students and take on new challenges.

From the very beginning the goal was to integrate the new Master's programs with our degree programs for domestic students and align their goals with the overall goals of the University. There were at least two reasons for this. First, it was a necessity because of the deficit of teachers and second, we saw that under the no tuition fees policy only programs that are well aligned with the main goals of the University, can survive. Recall, that Finnish Universities are managed by objectives by the Ministry of Education. This means that in the long run a University earns its money from the Ministry based on how it meets its targets. The heaviest targets are for the number of produced Master's and Doctoral degrees. Ideally, the International Master's programs should be as productive as the programs for domestic students measured in terms of the number of graduates and completed credit units while the cost of such programs should be close to the cost of the programs for domestic students.

So, as part of the Government Program to boost the education in the area of ICT, TKK created the Master's Programme in Telecommunications. The first intake to the program was in 1999. At present the program carries on under the name of the Master's School in Information and Communications Technologies having spun off two master's programs, one in Communications Engineering and the other in Mobile Computing – Services and Security.

The rest of the paper is organized as follows. In Section 2, we will summarize the experience gained in the Master's programs in ICT at TKK from the year 1999. In Section 3, we will discuss the wider motivation behind the program and newer programs. Section 4 considers the issues related to the tuition language. In Section 5, we evaluate the competence building and the achievements so far in a wider context. Section 6 discusses the impact of the Bologna process onto our International programs. In Section 7, we analyze the wider societal aspects of international study and, in particular, degree programs and try to formulate education policy and wider societal conditions under which it makes sense to expand international degree education in Finland. Finally, in Section 8, we conclude.

2. Experience of Master's programs in ICT at TKK

Recruitment of students is based on an open call to all that meet the selection criteria irrespective of the country of origin. The intake is based on paper evaluation and entrance examinations. The target is to recruit talented students who can achieve good results even under the somewhat harsher conditions of having to study in a non-native language, who can compete on the job market and who have potential and hopefully an interest to study

even until the degree of Doctor of Science in Technology. The entry level is set for applicants with a 4 year B.Sc degree in Engineering in a subject close to the area of the Master's program in order not to have to tailor a different study plan for everyone.

In 1999 we started the Master's Programme in Telecommunications with just two majors, one in Radio communication systems and the other in Telecommunications software. The initial curriculum had one semester of common studies in the two majors, two semesters of specialization in the area of the major and the diploma thesis. A student with a strong B.Sc degree in a suitable area is required to complete 40 credit units (a cu nominally equals to one week of work) of studies and the diploma thesis that nominally takes six months to complete. All courses that form a Master's program are open to domestic students as well, although domestic students are enrolled in their own degree programs. The International curriculum is seen as a subset of what is available in the degree programs for domestic students.

In the year 2000, we added digital signal processing to our list of major subjects and in 2003, networking technology. In the year 2000 we also started the Master's Programme in Electrical Engineering with two majors.

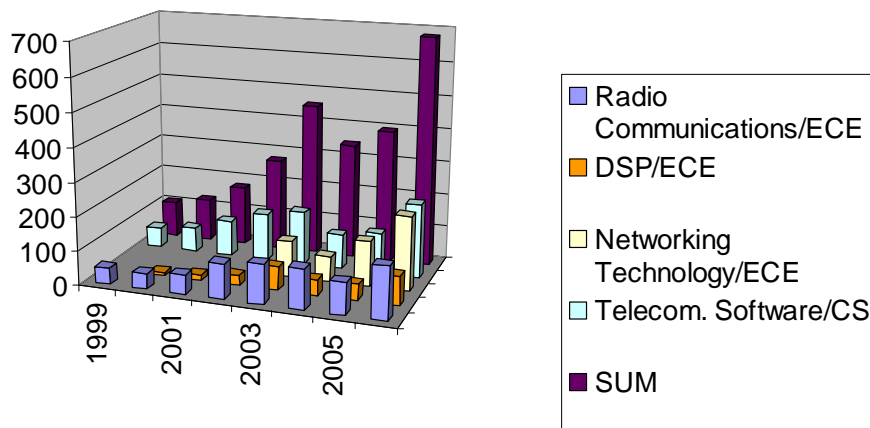


Figure 1: Paper Applications per Annum to the Master's School in ICT [4]

Figure 1 shows the growth of the number of paper application to the Master's Programme in Telecommunications and from 2005 to the Master's School in ICT. The last column shows the number of web applications this year. The Figure does not include the international applicants to the University entrance examinations. This channel attracts mainly foreign Bachelors of Science who either work or study in some other University in Finland.

The number of admitted students based on paper evaluation has been between 50 and 60 to the Program in total per annum. International applicants typically apply to many and

the best students are admitted to many Universities in different countries. In 1999 more than 70% of the students admitted actually enrolled and started their studies. The gain has tended to decrease in time probably due to two reasons. One is the overall downturn in the telecommunication industry and the other is the tightening of the entrance criteria over the years. The gain is currently around 30%.

Major countries of origin of the students are China, Pakistan, India and Bangladesh. The number of applications from Nigeria and Turkey is also significant. For example in 2005 these six countries comprise 83% of the paper applications. The total in 2005 is distributed among 44 countries.

3. Motivation for Master's programs

The Government motivation for launching its Program of Additional Measures in the ICT area was the deficit of skilled engineers in the Finnish Industry. In hindsight, we can see that this argument has not held its ground. Nevertheless, our International graduates have undoubtedly helped to improve the international operation competence of the companies in which they work. In the era of globalization international operation competence is a basic requirement for survival of many companies.

From the TKK perspective we saw the creation of the Master's programs as a part of our international strategy. Our goal is to become one of the top technical Universities in the world. An aspect of this is becoming a more attractive partner in research and education in Europe and globally. This clearly requires better operation capabilities in research projects and in the exchange of teachers. Such capability can be learned by doing.

It follows from the goal of becoming one of the top Universities that in our intake of international students, one of the selection criteria must be the assessed potential of the candidate for doctoral studies. We see the International Master's programs as an important channel into Graduate Schools¹ and research projects financed by external funds.

What comes to the area of Communications Engineering, we understood that Finnish telecommunications industry had become a significant global player, that the telecommunications markets are global, the same technology is used everywhere and that the new technologies are created and defined on international forums. The practical work on such forums is carried out by young bright engineers from the best companies in the industry, among them our graduates. It is also typical of the telecommunications industry that frequently there are battles of standards. The technical side of such battles is fought by engineers. Engineers also take part in the legal and commercial battles. The language on the main frontiers of these battles is English. The winners in defining the direction of new technology are those with the best technical and diplomatic skills. Clearly, this requires from TKK, that our graduates in Communications Engineering should be as

¹ Graduate Schools are financed by the Finnish Academy of Science. They typically enroll doctoral students for 4 years on a highly competitive basis.

efficient in formulating and selling their ideas in English as they are in their native tongue. If the Finnish industry can not find such engineers in Finland, it always has a choice of going elsewhere for the talent. In the long run, this obviously would draw the most advanced technical research and development out of Finland closer to the Universities that provide the critical talent.

To conclude the argument, we see the International Master's programs in the area of ICT as a way of creating possibilities for our domestic students to gain international exposure at their home campus and in the process improve their language skills and social competences in a multicultural environment.

A year after the Master's Programme in Telecommunications, we created a Master's Programme in Electrical Engineering. Gradually at TKK, new master's programs are starting to appear in other Engineering subjects such as the International Master's Programme in Forest Products Technology and the International Master's Programme in Nanotechnology. In all these areas, the industry in Finland is either owned by large international corporations or has become international while the ownership has stayed Finnish. For example, in the area of Forest Products Technology, TKK is the leading if not the only Technical University with a comprehensive program of higher engineering education in Europe. Clearly, for the needs of the forest products industry it is imperative to educate specialists willing and capable of working in many countries that can lead the industry and its technology to the future.

4. Language issues

In most large countries the formula for educating foreign students is to first teach them the local language and then take them into local Universities into the same programs that are offered to domestic students. In Finland we have not seriously considered this model, to my knowledge, no one has tried to implement it in Finland nor has the Ministry of Education or any other Government organization assigned funds for such an undertaking.

Those who look to the future, see an aging population and a deficit of work force in Finland in the coming decades. Therefore, it would seem to me that the Ministry of Education should find funding for a preparatory year program for international High School graduates with the view of enrolling most of the graduates after one year of Finnish language studies into different University programs. In my understanding none of the Finnish Universities is big enough to run such a preparatory program for itself alone.

Due to the motivation we discussed in Section 3, the traditional approach was not adopted at TKK. Instead we offer tuition in English in engineering subjects. Exceptionally, when competent teachers are not available, lectures may be given in Finnish but all the course material and practical exercises are in English.

For domestic students lectures in English offer an opportunity to taste what is to come in their working life. A recent development is the introduction of combined language and subject studies. If the lecturer is certified by the TKK language center to teach in English,

his or her course can be a means of earning credits from Subject studies in a foreign language that can contribute towards the language study requirements of the domestic students.

Researchers in culture and the Finnish language often see the use of English in higher education as a threat to the long term viability of Finnish and as a violation of student's rights to receive education on their own language [1]. The choice of language is seen as a matter of values. In section 3, we argued that the use of English is a matter of long term viability of our industry and retention of high paid R&D jobs in Finland. In short, it is a matter of survival. Therefore, bringing in the questions of values and rights just confuses the subject by raising emotions. Instead, I would like to challenge the researchers of culture and language to propose constructive solutions that help to keep our native language live and viable in the era of the Internet, global technology creation and global markets and globalization of work processes. This battle is won or lost on the work places more than in Universities. Since Universities are a part of that battle, we must carry our weight. A possibility is to create courses in new terminology creation in native languages. Engineers, who create new technology, are faced with this challenge all the time in their jobs. Instead of getting help, all we hear from people of Arts is criticism and emotional pleas.

Also, it should be noted that for example at TKK, the language center that is responsible for all language teaching at TKK is very resource limited. Students even have great difficulties to enroll on courses that are compulsory in their study programs. Adding any new teaching responsibilities to the language center always raises lots of complaints about the lack of resources. Under the current system of measuring the performance of the University and assigning budget funding to Universities based on the results achieved, this is an expected outcome. No separate funding is assigned for achieving some social or political goals such as preserving the viability of Finnish language. If the Ministry of Education cares about the argument of the viability of Finnish language in the long run, I am sure it will find ways to finance the language teaching accordingly.

5. Achievements and Competence built so far

At TKK we have now been running International Master's programs for six years. What have we achieved during this time? In short, in the area of ICT and Electrical Engineering at TKK we have learned the basics of marketing higher education, recruiting and selecting international students from most areas of the world and providing tuition in English. Figure 2 shows that the availability of courses in English has evened out the international student exchange balance and today TKK attracts more foreign exchange students than we send to other countries. TKK is well placed in Europe as a University that offers courses that most exchange students can attend. The number of International applicants in communications engineering is of the same order of magnitude as the number of domestic applicants although the gain from the foreign applications is naturally significantly lower.

Overall, the number of international applications is however much lower than for example at KTH in Stockholm. At TKK, the share of foreigners among all enrolled students was 6.7% in 2004, the share of foreigners among doctoral students is 9.5% [4]. The share of foreigners among professors is only 3%. Figure 2 also shows the number of exchange and internship students going out from TKK annually. Considering that an average graduate has been enrolled for about 7 years and the total number of degree students is about 12 500, we can estimate that less than one fourth of domestic students gets some international exposure abroad through student exchange or summer internships. These are low numbers and can not be seen as a basis to claim that the campus has become truly international and that the University is an international or European institution of higher education rather than a Finnish University with some add-on activity in English.

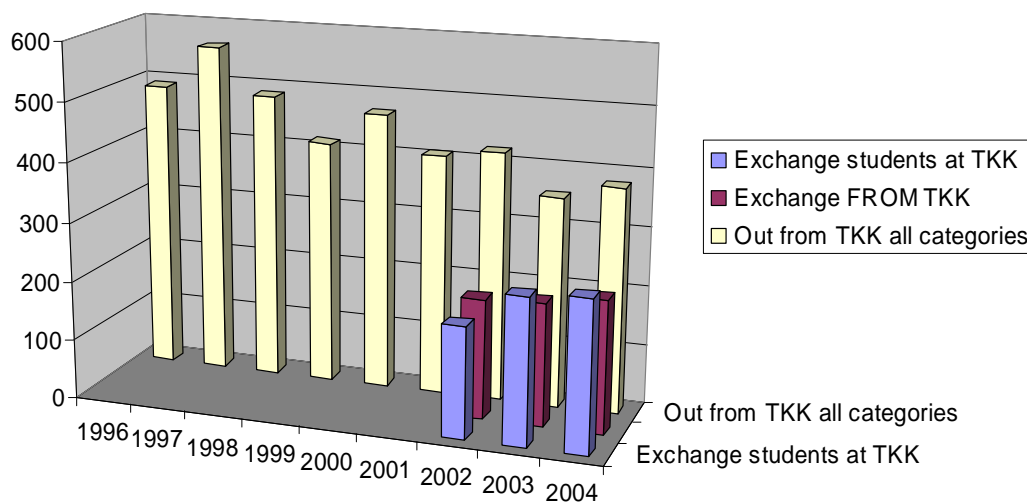


Figure 2: Student Exchange and Internships in and out of TKK [4]

Our competence building in international education has created a basis for further enlarging the offering of master's programs in other engineering subjects that produce specialists for their own global industries. We see that globalization is an expanding process and it will penetrate into new areas in the coming years and decades. Even in the areas of engineering that work for the domestic market, we see a deficit of talented students in the future due to demographics. Therefore, we envision that in the long run almost all engineering education from the Bachelor to the Master level will be given in English. Naturally, we assume that a Finnish teacher will not teach an all Finnish audience in English. We must also ask whether the society at large is ready for such a move. Or looking at it from another angle, what preconditions need to be met and what wider changes must take place before we can put such development into effect?

6. Impact of Bologna degree structure

The new degree structure of 3+2+3 envisioned in Bologna and later written in the Finnish law makes it possible for the European Universities to react quicker into the changing requirements of dynamic job markets and encourages them to enlarge student exchange after the first degree. The idea is to facilitate moving from country to country, from one University to another and from one study area to another after the first degree.

Today, on European forums we talk about the European Higher Education Area and the European Research Area. However, we see that in Europe, Universities, the key actors in EHEA and ERA are still national. What is missing are European Universities.

The Bologna structure will mean that gradually the International Master's programs at TKK will grow from 60 credit units to 120 ECTS and will become capable of taking students with a 3 year lower engineering degree from Bologna countries in parallel with taking 4 year B.Sc students from the rest of the world. The curriculum of the Master's programs will also be better aligned with the curriculum for domestic students so that domestic students can be admitted to the same programs as foreign students. These can be seen as steps towards the goal of moving to a system in which the B.Sc degree courses are taught in the native languages and most or all teaching from B.Sc to M.Sc is given in English. This development is, however, likely to take many years and it remains to be seen how far this change will really go.

7. Wider Societal Aspects

Particularly, the first intake of students in the Telecommunications program was very successful in finding traineeship positions and jobs in the industry. When the job market turned in 2001 and 2002, international students started to have difficulties in finding jobs while domestic student were doing better. Recently, the situation has leveled off somewhat.

Many things make finding jobs in Finland more difficult for our foreign graduates than for domestic graduates. It is only natural that the choice of jobs in which it is enough to know English and Finnish is not needed is narrower than the selection of jobs available to graduates that know both languages. Unreasonable visa regulations are another problem. The need to go back to the home country to apply for a work visa after graduation is clearly a conflicting policy to what Ministry of Education is doing: why provide higher education for foreign students free of charge and then immediately after graduation, force them to leave the country is beyond understanding.

In order to help the foreign students in Master's programs in Telecommunications and in Electrical Engineering to adapt to the local conditions, we added compulsory Finnish into the curriculum in 2003.

At the end of 2002 103 000 foreigners lived in Finland. In 2000 in the greater Helsinki area the number of people of foreign origin was 48 000 [3]. If we compare the share of

foreign students at TKK to the share of people of foreign origin in the greater Helsinki area, it appears that TKK is approximately as international (6.7%) as the general population in the area (5.1%)².

Let us now ask the question, are we as a society ready to target a significantly larger intake of foreign students in Finland in order to help in solving the demographic problem we are facing? What if say 25% to 30% of the master program graduates were foreigners? Would we see demonstrations of skin-heads on the campus? Would this country provide a home for a majority of those graduates? Would the tax-payers be happy to provide the education for free like now?

First of all, under even favorable job markets, there is a risk that a significant number of graduates would head for the US and other countries that have significant contingents of fellow nationals and a multicultural environment. Therefore, we must either do a lot more to help the graduates to feel at home in Finland and adapt to the Finnish society, or we must start charging tuition fees from Non-European students or we must do both. More international education is needed at schools. Well established national institutions must have programs to integrate foreigners into their work force. More discussion of the subject is needed in media to create a realistic perception of the problems of foreigners in the wider population based on facts rather than beliefs. National cultures of the immigrants need more room in the city life in places like Helsinki. We must be persistent and have patience in implementing such a policy. Social changes and changes in company recruitment practices take time to take effect.

8. Conclusions

At TKK we have created the basic competence of running higher education degree programs in English for foreign students. The recruitment of students takes place based on an open call after a suitable 4-year B.Sc degree. The recruitment targets are high in terms of the level of students. The intakes are, however, still rather low and the share of foreign students among all students is low but is gradually increasing. The University is adopting and implementing the goal of increasing the share of foreign students to 10% of all students as agreed with the Ministry of Education. We see the need of additional efforts in language tuition for both foreign and domestic students. Courses and more teachers are needed in all languages of tuition i.e. Finnish, Swedish and English and also in cultural studies. This should be seen as a social responsibility of a University rather than an activity that is measured and the results summarized among all performance results of the University.

Due to the aging of the population, during the next decade the Universities in Finland are facing the issue of a significant increase in the intake of foreign students up to a third of all master level students in many subjects. Technical preconditions for such a move either exist or can be created in a few years at least in some areas of engineering science.

² We ignore the fact that the statistics are from two different years assuming that changes in the general population are slow.

However, clearly, we must ask whether as a society, we are really ready for such a development. Based on our experience with our graduates, we could be doing a much better job in this respect. A major part of the job market is either closed or disfavors foreigners, visa regulations are not aligned with the idea of purposeful immigration, the local culture can still be characterized as almost homogenously Finnish, a part of the population still harbors hidden or open xenophobic feelings etc. Over the past 10 to 15 years, progress in all these respects has however been rapid. Continuation of this internationalization of the society at large is both a necessary precondition and a result of the internationalization of Higher education. Due to the aging of our population we are forced to a rapid development on both fronts in the coming years.

Acknowledgements

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