

# **A NATIONAL GRADUATE RESEARCH SCHOOL WITH CLOSE INDUSTRIAL COLLABORATION**

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## **ABSTRACT**

This paper presents a national (Swedish) graduate research school which is a cooperation between a number of institutions with the primary purpose to produce doctors for work in the domestic industry. It organizes courses for doctoral students in product realization in all Swedish universities. The paper presents the rich CDIO inspired environment with industrial experiences that the school offers and also discusses the possibilities to internationalize the activities.

## **KEYWORDS**

National, graduate, doctoral, research, school, industry, links

## **INTRODUCTION**

Ph.D. programmes generally consist of some combination of course work and research work to be carried out by the doctoral students. It is common that the students take their courses, or at least the bulk of them, at their own university. This is a viable way of organizing the doctoral education in a larger academic institution, but for smaller universities the model is less suitable and also more difficult to apply. An alternative for the latter – which by no means excludes successful adoption of the same model also by larger institutions – is to team up and cooperate with other academic institutions, so that one in such a group gives a course to the doctoral students in the same subject from all the cooperating universities. There are several obvious advantages associated with an organization like this:

- Larger groups of students means more efficient utilization of the pooled available economic resources for doctoral education
- If the total teaching work is divided between partner institutions, each course can be given by the one that is in some sense best suited for it, which should produce courses with higher quality
- Higher course quality is also achieved through attendees coming from different universities, whose more varied backgrounds, experiences and views result in more questions and more qualified discussions

- Participating doctoral students get tremendous opportunities to build and maintain personal networks, which in the future are likely to benefit their own careers at the same time as they stimulate research cooperation and business not only domestically but also with foreign partners

This paper presents a national (Swedish) graduate research school which is a cooperation between nine domestic universities. It describes the activities in the school and how the many links to industry that it has are believed and perceived to benefit the partaking doctoral students as well as the companies involved. It also discusses the possibilities to further improve the school by internationalizing it.

## **THE PROVIKING NATIONAL GRADUATE RESEARCH SCHOOL**

The ProViking national (Swedish) graduate research school [1] is the successor to several other national graduate research schools and is part of the ProViking® research programme in Product Realization [2], which embraces a number of product realization projects, all with industrial as well as academic partners. The term Product Realization covers the two subjects Product Development and Production and spans the whole chain from perceived problem or customer need for a solution to recycling/destruction/deposition of the used product. The ProViking research programme is financed by the Swedish Foundation for Strategic Research (SSF) [3].

The ProViking national graduate research school was set up in 2003 and is a cooperation between nine Swedish universities. Among them they include

- the two universities in the country that are the geographically most distant – 1400 km – from each other: Lund University in the south and Luleå University of Technology in the north
- three of the four universities (i.e., all but Massachusetts Institute of Technology) that formed the initial Wallenberg CDIO project which later evolved into the CDIO Initiative, namely Chalmers University of Technology in Gothenburg, The Royal Institute of Technology (KTH) in Stockholm and Linköping University. Chalmers is also the host university for the ProViking programme and its graduate research school, which means that they are both administered from there

The original purpose of the ProViking national graduate research school was to offer courses to the doctoral students who are active in the ProViking research projects. All doctoral students who are funded by a ProViking project – partly or in full – are required to attend the ProViking graduate research school and to take a certain number of its courses. However, already from the outset the school began to admit also other doctoral students from Swedish universities who wanted to take part, and over the years this second group has gradually increased in size in relation to the first. Today, seven years into its existence, the ProViking graduate research school is still growing and now has well over 100 participants, of which more than 2/3 are not active in the ProViking projects.

Each doctoral student in the ProViking graduate research school has to take three compulsory courses and two more from the over twenty courses that are presently offered. Depending on the student's individual specific subject and home university, these courses amount to about 50% of the total course work for a Ph.D. Students who want to take even more courses in the school are welcome to do that, which is also for free for them.

There is a strong belief that it is beneficial to Sweden if leading actors in the domestic universities and companies know each other or at least know of each other. In the background of all activities in the graduate research school there is therefore a desire to stimulate contacts both between the doctoral students and between them and industry, which will give the students good opportunities to build their own personal networks. This is in line with the school's focus on producing doctors for careers in the industry rather than in academia, so various kinds of industrial elements in the education are of interest. For this reason the students are also required to attend the yearly ProViking doctoral student gatherings, which are described in more detail below.

The same motive underlies the way in which the ProViking courses are organized. With the ProViking doctoral students distributed all over Sweden, which is a large as well as elongated European country, it is of course not possible to run courses as if all attendants were in the same university. With regard to the above desire to create contacts between the students, the IT alternative of running televised lectures has not been regarded as ideal, so instead the courses are structured in a series of gatherings in which the participants meet at (most often) a university and attend lectures, seminars etc. for several days at a time, with intermediate work at home.

## **PROVIKING DOCTORAL STUDENTS**

The nominal study time to get a Swedish Ph.D. is four years. The majority of the domestic doctoral students have paid university positions which are tailored to make it possible for them to get the degree in five calendar years. The extra year comes from the duty, associated with the position, to perform one year's work for the academic institution. While that admittedly delays graduation, it does on the other hand give the students enough pedagogical merits for them to be employable as academic teachers afterwards.

Fairly common are also industrial doctoral students, i.e. students who are employed by a company and do graduate work as the main part of their ordinary job. In connection with the admission, their employer and the university agrees on their teaching duties, which can range from nothing at all to the 20% common for doctoral students with university positions. The higher number is unusual though, since most of these students also need to devote time to company work. Some industrial doctoral students have an office at the university and work there for most of their time, much the same way as the doctoral students with university positions, while others just come in now and then to meet with their supervisors.

A third but small group of doctoral students consists of people with positions as e.g. lecturers or research engineers at a university and who want to pursue doctoral work in order to advance in their profession. For them it usually takes much longer to get a Ph.D. since in contrast to the first two groups they do not have any (or very little) work time allocated to their studies.

## **PROVIKING DOCTORAL STUDENTS INDUSTRIAL CONTACTS**

This section describes the various kinds of contacts that a ProViking doctoral student might have with industry. No one student is likely to encounter *all* of them during his/her studies, but the majority will have experienced most when they graduate.

### ***Doctoral students in ProViking research projects***

Doctoral students who work in ProViking research projects do that together with people from the industry, since all projects have academic as well as industrial partners. This does not necessarily mean that the students work alongside their colleagues from industry on a daily basis, but during the course of the project the two parties have enough to do with each other in different ways for the students to get good insight into how industrial product realization is carried out at the same time as the companies benefit from the work done by the students.

### ***Industrial doctoral students***

The industrial doctoral students are of course much more exposed themselves to industry demands on and aspects of their work than their colleagues with university positions are. However, through interaction they also provide a lot of industry views that benefit the latter group.

### ***Result Days***

The ProViking research programme organizes yearly Result Days at convenient domestic locations where the status of and results from the ongoing projects are presented. These events are open not only to academic institutions and companies participating in the ProViking programme; anyone interested can take part. Many ProViking doctoral students who work in the projects attend, and some of them are active presenters there. They thereby meet people from industry who are interested in what they do, and discuss their research with them.

### ***Result Center™***

The Result Center™ [4] is a virtual meeting place for Swedish researchers in product realization. Among many others all doctoral students in the ProViking projects present themselves and their research here, and this exposure leads to new contacts with industrial people.

### ***Joint ProViking courses***

All ProViking doctoral courses are also open to industrial people, who, unlike the doctoral students, usually have to pay a course fee. The courses are expected to benefit from also having attendees who can contribute industrial experience and views on the subjects that are discussed.

For different reasons the number of participating industrial people in the ProViking courses has so far been low. An exception is however a product development course which one of the authors of this paper is responsible for and which was originally developed for industrial engineers and offered by the Chalmers school of continuing and professional studies. When it ran last time it included a half-day session with a foreign expert, to which was also invited those who attended a ProViking doctoral course which ran at the same time. After the presentation there was a poster session in which the industrial people in the Chalmers course showed applications from their companies to the doctoral students. This was perceived as very useful and interesting by both the students and the engineers.

In the absence of other domestic courses in the same subject aimed at his category, a doctoral student asked if he could attend the Chalmers product development course mentioned above. Since the results from the joint session in the previous run were positive, the ongoing third run

was consequently announced as a joint arrangement by the Chalmers school of continuing and professional studies and the ProViking graduate research school. About one third of the attendees are doctoral students. Among this latter group there are younger students who have entered the graduate research school directly after obtaining their masters' degrees, as well as some older industrial doctoral students who have as much industrial experience as the participating engineers from companies have.

If there even is one, the ideal ratio of doctoral students to practicing engineers in a course is probably dependent on the subject. The more theoretical it is, the less interesting it is to discuss practical experience and the less important the ratio is too. The product development course mentioned above is a relatively practical and applied one. At the time of writing half of it has been completed, and although there is of course no conclusive evidence yet, the impression from talking to engineers as well as doctoral students is clearly that both groups appreciate the other and think that this blend of people with different backgrounds makes the course better. The doctoral students learn a lot from the practical perspective that the engineers have through activities such as literature seminars, group exercises and home assignments in which some students team up with engineers. The flow of knowledge goes both ways though. The students are generally better updated on the recent theoretical advances in the area and to some extent act as supplementary teachers in general and guest teachers on specific subjects.

#### ***Industrial people as teachers in ProViking courses***

All course organizers are encouraged to invite engineers from the industry to teach selected parts of their courses.

#### ***Doctoral students as teachers in courses at the Chalmers school of continuing and professional studies***

Doctoral students with supervisors who give courses in the Chalmers school of continuing and professional studies can get opportunities to teach a part of a course which is closely related to their own research and which they can therefore be considered to master. Teaching engineers from industry does however give them a lot of practical feedback which adds to their own knowledge.

#### ***Study visits at doctoral student gatherings***

The yearly student gatherings run over three days, and besides many school-internal activities in them, each contains at least two study visits to industrial companies and other commercial enterprises. The nature of them varies – during some, really prominent development managers have given presentations – but simply by attending the doctoral students get good insights into the Swedish industry. One gathering was even conducted on the premises of a large company.

#### ***Study visits within ProViking courses***

Some ProViking courses contain study visits. One particular visit that deserves mentioning was to a company which had decided to try to get help from the visitors, so they basically used them as consultants (for free of course) for half a day to improve their own product development process. Their hosts were extremely satisfied themselves with the results, and all but a few of the visiting doctoral students also ranked this study visit well above average,

### ***ProViking ProViking graduate research school's scholarships***

ProViking graduate research school has scholarships that its' students can apply for to finance a trip to and stay in a research institution in a foreign country for up to about five months. It is recommended that such a stay takes place after the student has obtained his/her licentiate of engineering (exam halfway to the Ph.D.)

Several of the doctoral students who have received this kind of support have visited industrial R&D places instead of universities.

### ***Supervision of students' project and thesis work in the industry***

A doctoral students' research and thesis work is in most cases carried out in the industry, so the students get industrial input in that way too, by interacting with engineers in companies.

### ***Industrial representatives in the graduate research schools executive body***

The doctoral students have two representatives (one regular and one substitute) in the ProViking graduate research schools executive body, where there are also three industrial representatives.

### ***ProViking courses run at companies***

In particular one ProViking course has had several meetings not at a university but at a company, which, besides perhaps reducing costs also puts the students in an industrial environment for several days at a time.

### ***Industrial representatives in grading committees at disputations***

Although this ceremony does not belong to the ProViking graduate research school, it is proper in this context to mention that at doctoral disputations there is often an industrial representative in the grading committee.

## **INTERNATIONALIZATION**

There are plans to extend the activities across borders by inviting a number of universities in other EU countries to give courses and of course also to send students to the existing courses. Some of the existing ProViking courses are already offered in English, in some cases because the responsible teacher prefers that language. Regardless of the reason for teaching in English, it is decidedly an advantage that the participating doctoral students are used to attending courses in that language. There is already one course on the programme which is given by foreign institutions.

An internationalization of the activities is believed to increase the course quality in the graduate research school and to further stimulate the interest among students to take part. It would also develop the organization into an entity which could attract funding from international actors such as for example the European Union.

## CONCLUSIONS

The ProViking national graduate research school is an efficient and successful organization for doctoral education, which is proven by the fact that the original ProViking research programme was extended for another five years following the results from the first period. Of particular interest to its' doctoral students is the CDIO inspired study environment that it offers which is rich in possibilities for various industrial contacts and experiences. The schools attractiveness is proven by the fact that the vast majority of the present ProViking doctoral students are not required to belong to the graduate research school, but have in fact taken an initiative of their own to become admitted to it. This is an indication that among product realization doctoral students themselves it is considered very positive to be part of this large network.

The graduate research school is a nationally well-established platform for doctoral education which is ready and well suited for expansion into the international (European) arena.

## Acknowledgements

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## REFERENCES

- [1] ProVking national graduate research school, ProViking Forskarskola homepage, [www.chalmers.se/ppd/provikingforskarskola-sv](http://www.chalmers.se/ppd/provikingforskarskola-sv), accessed on April 20, 2010
- [2] ProViking research programme, ProViking homepage, [www.chalmers.se/hosted/proviking-en/](http://www.chalmers.se/hosted/proviking-en/), accessed on April 20, 2010.
- [3] Swedish Foundation for Strategic Research, SSF Home Page, [www.stratresearch.se/en/](http://www.stratresearch.se/en/), accessed on April 20, 2010.
- [4] Result Center™, Result Center Home Page, [www.resultcenter.com/about/?lang=en](http://www.resultcenter.com/about/?lang=en), accessed on April 20, 2010.

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