

Approved
(Magnus Danestig)

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Patrik Eriksson

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Industrial Research School: Electronic Design (IRSED)

Associated with the KK-Foundation

Program Plan

Acreo (co-ordinator)
College in Jönköping
Royal Institute of Technology
Linköping Institute of Technology
Chalmers University of Technology
Lund University

In co-operation
with
Industrial Partners

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Industrial Research School: Electronic Design (IRSED)

1 Summary

The Industrial Research School in Electronic Design (IRSED) is a research school for multi-disciplinary graduate education in the area of electronic hardware design, involving close co-operation between several Swedish universities and colleges and participating industrial partners. The initiative to form the school was taken by Acreo and funding for up to 12 students for a duration of four (4) years has been made available by the KK-foundation. In the longer perspective, the intention is to find forms for financing of the research school without the direct funding of the KK-foundation. The long-term goal is hence to provide a stable base for education of industrial Ph.D. students targeting a career in the Swedish electronics industry.

The near-time target is to establish a research school producing Ph.D. students within technical areas considered important for the future of the electronics industry in Sweden. The Ph.D. students shall during their studies also acquire skills in non-technical areas, e.g. project management, making them suitable for a future career within the electronics industry. One key point in this program is the close connection between Ph.D. students and participating companies, enabling transfer of research result to industry and transfer of industrial needs to Ph.D. students during the progression of the studies.

Acreo is responsible for the administration of the program, and the following universities and colleges will be participating from the start of the research school;

- Linköping Institute of Technology,
Professors Christer Svensson, Dake Liu, Zebo Peng and Lars Wanhammar
- Royal Institute of Technology
Professors Axel Jantsch and Hannu Tenhunen
- Chalmers University of Technology
Professors Lena Petersson and Per Larsson-Edefors
- University College of Jönköping
Professors Bengt Magnhagen, Shashi Kumar and Peter Leisner
- Lund University
Professor Jiren Yuan

Currently, the industrial partners are;

- Kitron Development AB, Jönköping
- BlueLabs Microelectronics AB, Göteborg
- Acreo AB, Norrköping

2 Background and Primary Goal

The electronics industry is currently undergoing rapid changes because of increased requirements on performance, functionality and development time for electronic products. The trend is that electronic products are becoming increasingly more complex, comprising e.g. both RF/microwave electronics, high speed digital circuits and considerable software content while at the same time they need to meet requirements on small volume/size, short time-to-market (TTM) and, last but not least, reduced production cost.

To meet these challenges, Sweden needs a larger base of highly educated people who have both broad and deep knowledge in electronics, who are able to see the whole infrastructure of the electronics industry, and that can take lead roles in research and development activities in that industry. Motivated by this need a multi-disciplinary industrial research school, IRSED, is proposed by Acreo and the KK-foundation. In this school close co-operation between universities/colleges, Acreo and the electronics industry in Sweden will be emphasized. The focus of the school will be on education and training of graduate students in a broad applied electronics area that covers all steps from system architecture to detailed hardware design.

One key point in the proposed research program is that disciplines that normally are treated independently, but are dependent on one another in an industrial design process, consciously or unconsciously will be incorporated into the awareness of the Ph.D. students thereby preparing them to take lead responsibility for technical development in the Swedish electronics industry.

The primary goal with the research school is to support Ph.D. students to their degree while at the same time preparing them for a successful career in the electronics industry. The consequence of this will be to increase the number of engineers with a Ph.D. degree active in the electronics industry.

3 Official Starting Date

The official starting date for the program is set to **2002-07-01**. Projects in IRSED that were already running before that date will however get financing from the program for costs incurred from (and including) Q3 2001. No payments will however be made until financial means have been made available by the KK-foundation.

4 Projects in IRSED

4.1 Acceptance of Research Projects and Ph.D. students to IRSED

Each Ph.D. student and his/her related research and education is considered to be a project with the research school. To form a project within the framework of IRSED it is required that there exists an industrial partner willing to finance at least 50% of the project costs, a university or college with an interest and authority to take responsibility of the scientific training, supervision and examination of an industrial Ph.D. student, and last but not least, a person interested to pursue Ph.D. studies for a duration of four years.

The Ph.D. candidate can be employed by the university/college or by the company. Regardless of which, it is required that the candidate is formally accepted by the university/college as a research student. Further it is also required that the program board (described later) accepts the candidate and the project to IRSED.

For each project accepted to IRSED by the program board there shall exist a trilateral contract regulating the terms and conditions of the agreement made by the industrial partner (company), the university/college and Acreo for the specific project. The contract also details the financing of each specific project.

4.2 Number of Projects and Project Duration

The KK-foundation provides co-financing for a maximum of 12 four-year (4-year) projects. Initially (Q1/Q2 2002) the number of projects will however be only five (5), but every effort will be taken to quickly expand this closer to the target number. However, since there is a need to keep the various projects in the program reasonably well in phase, this effort will be concentrated to year 2002.

Thereafter, acceptance of new projects to the program will be more restricted.

The expected project ramp up/down plan is given in figure 1 below.

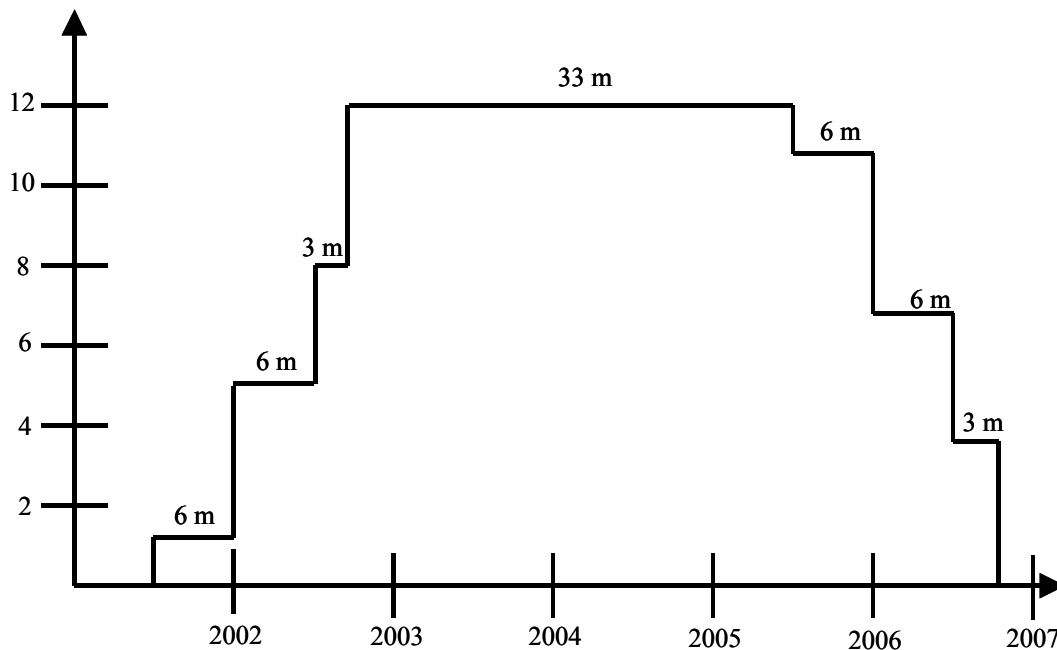


Figure 1: Expected program ramp/up down plan in number of equivalent project-months as a function of time.

The total project volume is 576 project-months corresponding to a total program budget of 38.4 MSEK assuming a yearly cost of 800 kSEK for each project.

The target is hence to produce 12 Ph.D.s, but for flexibility some projects may instead only target a Licentiate degree. The number of projects can therefore be more than 12 since one Ph.D. project financially corresponds to two (2) Licentiate projects.

5 Financing

5.1 Financial Model

For this program the cost for one Ph.D. student is given to 800 kSEK per year by the KK-foundation. However, it is up to the partners, industry and corresponding university, to agree on the actual cost for a student (salary, overhead, supervision, travel, etc.). The used cost model only means that the KK-foundation will finance each Ph.D. project with up to 400 kSEK/year. The financial contribution from the KK-foundation can however never exceed that of the industrial partner.

The financial model is given in figure 2 below. In essence, Acreo requests means for the different projects in the program from the KK-foundation. For each project in the program, Acreo invoices the industrial partner the amount agreed upon in the trilateral contract and the university and industrial partners thereafter invoices Acreo for the amounts also agreed upon. Acreo charges 80 kSEK per year from each project to cover the cost of administrating the program.

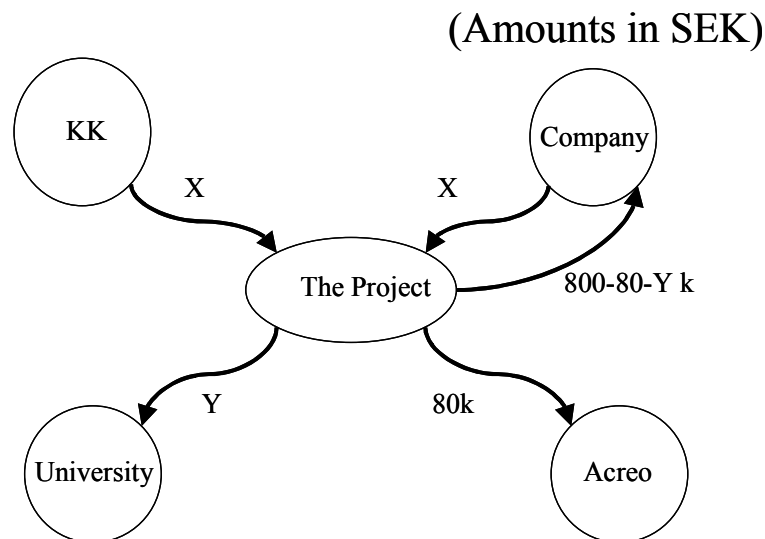


Figure 2: The project financing model. The amount available from the KK-foundation is limited to 400 kSEK per year. The variables X and Y are dependent on the specific agreement between the company and the university.

5.2 Financial reporting

The university and industrial partners annually report, at latest on the 15th of January, the project related costs for the previous year to Acreo. The details are regulated by the trilateral contract.

Acreo in turn summarizes the financial status of the whole program and reports this back to the KK-foundation at latest on the 1st of February.

One purpose with the financial reporting is to assure that the payment plans correspond to the actual costs of the projects and program. If this is not the case, the payment plans will be adjusted to better reflect reality.

6 General Conditions for Studies within IRSED

The students will have their scientific training and supervision at a department of a university or college and have their specific industrial development by participating in projects in the industry with support from a corresponding project leader or mentor and also by taking courses in e.g. project management, business management and entrepreneurship.

The general requirements on the Ph.D. studies will be according to the study plan of each university or college, which may differ in the number of course and research credit unit required for a Ph.D. degree. It is however required that each Ph.D. student takes the compulsory courses common to all students of the research school. The exact number of credit units for common courses is to be decided during the progression of the school, but will be in the range of 8-10 (one credit unit corresponding to one week of full time studies). It is also recommended that the Ph.D. students take a *Licentiate Degree* as an intermediate step towards the final doctor degree.

As mentioned, a Ph.D. student may either be employed by a university/college or by a company. The students can also, to a smaller extent, participate in teaching at the university/college. The students shall spend part of their study time at the company (minimum 20%) to ensure that the industrial connection is strong.

7 IRSED Workshops

Workshops will be arranged twice annually where the Ph.D. students are required to present the progress of their work in an informal environment. These workshops will be open to attendants from both industry and academia and not only to the companies and universities participating in IRSED. Acreo is responsible for the arrangement of these workshops. The workshops can be arranged in co-operation with other projects or programs organizing events of similar character.

8 IRSED Seminar Series

Acreo will organize an annual seminar series with invited speakers who will present material relevant and of interest to the Ph.D. students in IRSED.

9 IRSED Common Courses

The courses that will be common to all Ph.D. students within IRSED will either be of a very broad technical or a non-technical character. The total package of common courses is planned to be 8-10 credit units to be distributed over four (4) years. Acreo is responsible for arranging the courses. Considerations will be taken to the fact that the students are geographically distributed when deciding on the exact time and place for the courses. Subject areas that will be considered are (but not limited to)

- Electronics Production
- Project Management
- Philosophy of Science
- Business Management

The tentative time plan for these courses are as follows;

VT 2003, 2p
HT2003, 2p

VT2004, 2p
HT2004, 2p

10 Reporting

10.1 Reporting to the KK-foundation

Acreo annually reports to the KK-foundation on the activities, the financial status, and the achieved results for the previous year. Further, the Program Board shall, together with the Program Manager, also provide the KK-foundation with an annual report summarizing the activities and achievements for the previous year.

10.2 Reporting to Acreo

For each project, the company provides a financial report detailing the cost that the company has had due to the project and the university reports the study results, publications and the project-related cost.

11 Dissemination

By cooperation between several universities, participating companies and Acreo, it will be possible to spread results from the program to the electronics industry outside of the program. This will be achieved by

- Natural spreading through the existing industrial network already in contact with the university partners.
- Acreos's participation in the Socware program and Acreo's program on Industrial Service (Acreo-Företag Teknik Utveckling) will facilitate spreading of research results through a large national industrial network.
- Future Ph.D.s from IRSED will carry their knowledge and competence to the society.
- Publication of results from the projects in scientific journals and at conferences.
- Presentation of research results at special open workshops arranged by IRSED.

12 Secrecy, Intellectual Property and Publication

There is no predefined model in the program for handling of ownership of results and non-disclosure. This is instead handled by an individual agreement, as given by the trilateral contract, between the university and industrial partner for each project. It is Acreo's responsibility to assure that the conditions are reasonable with consideration to the financing of each project.

Whatever agreement is made regarding non-disclosure and rights of ownership to results this shall not affect the possibility to publish the results according to internationally acceptable standards and requirements. Nor shall any arrangement cause an unduly long delay of publication or degradation of the scientific quality.

13 Program Organization

An overview of the organization of the program is given in figure 3 below.

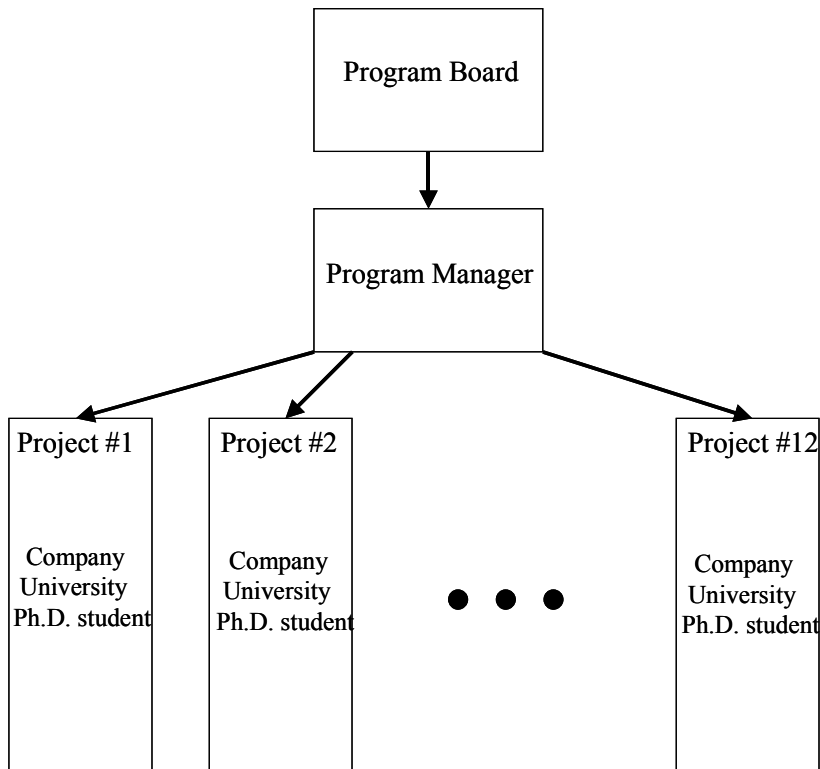


Figure 3: Overview of the program organisation

13.1 The Program Manager

Acreeo is responsible for appointing a Program Manager for IRSED who shall be accepted by the Program Board. The Program Manger is responsible for the daily administration of the program. The Program Manager reports to Acreeo and the Program Board.

13.2 The Program Board

IRSED will have a Program Board, consisting of three (3) representatives from the participating companies, two (2) representatives from the participating universities/colleges, and one (1) from Acreeo. The Program Board will meet at least twice annually and constitutes the steering board for the program with a responsibility for

- Co-ordination of the activities in the program including interactions with the industrial and university partners and supervision of their work within the framework of the program.
- Recruitment of Ph.D. candidates and industrial partners to the program.

- Decisions regarding acceptance of new Ph.D. students, industrial and university partners to the program.

The Program Board members are;

- Håkan Dahlbom, BlueLabs Microelectronics AB (Chairman)
- Peter Haglund, Kitron Development AB
- Axel Jantsch, Royal Institute of Technology
- NN1, Chalmers University of Technology
- NN2, Acreo AB
- NN3, Company x

The Program Board can be summoned by any member of the board, by an industrial or university partner or by the Program Manager. The chairman is responsible for distributing the call for the meeting and the agenda.

14 Evaluation

The program will be evaluated annually by the KK-foundation. The evaluation will be based on the reports provided by the Program Board and the Program Manager. The program Board will make an internal evaluation of the project each year to supervise the progression of the program. Some of the evaluation criteria that will be used are;

- Number of projects in the program and their industrial relevance.
- Number of publications and patents (national, international).
- Success of IRSED workshops and seminar series.
- National and international recognition of the program.
- Level of co-operation between industry and academia.
- Establishment of common courses and outcome of those.

15 Description of Projects

The specific research projects within the program (school) can cover any aspect of electronics from hardware/software co-design to device modeling as long as the project is industrially relevant. At the start of the program the following projects are defined.

15.1 Methods for realization of electronics in harsh environments

Partners: College in Jönköping and Kitron Development

Ph.D student: Mats Lindgren (Kitron Development)

Supervisor: Docent Peter Leisner

Industrial mentor: Anders Jonliden

Description:

Industridoktorandstudiets syfte är att utveckla metoder för realisering av tillförlitliga elektronikprodukter för användning i svåra miljöer. Svåra miljöer omfattar:

- Hög temperatur (> 125 °C)
- Hög temperaturvariation
- Kemisk svår miljö
- Mekanisk svår miljö (vibration, acceleration)

Huvudfokus i studiet blir metoder för elektronikbyggsätt för högtemperaturtillämpningar.

Metoden som skall utvecklas är av typ *virtual prototyping* där ett byggsätts tillförlitlighet kan simuleras i ett tidigt skede. Efterföljande skall simuleringen verifieras i accelererade miljötest. Viktiga element blir återkoppling från resultat av miljötest till simuleringen, samt återkoppling från verklighetens värld till den accelererade miljötesten, för att ständigt förbättra metodiken.

15.2 Reconfigurable and Adaptive Receiver Architectures and Circuits for Wireless Communications

Partners: Linköping University of Technology and Acreo

Ph.D. student: Joacim Olsson (Acreo)

Supervisor: Professor Christer Svensson

Industrial Mentor: Patrik Eriksson

Description:

This project is concerned with the development of **reconfigurable and adaptive receiver architectures and circuits** There are two key objectives with the project

- To develop the analog part (up to and including the A/D) of a multi –standard, multi-band receiver architecture for HiperLan type 2/IEEE802.11a (5 GHz), IEEE802.11b (2.4 GHz), IEEE802.11g (2.4 GHz), and W-CDMA (2 GHz). The outcome is expected to be possible to generalize to the design of any flexible receiver and can therefore be said to constitute a framework for a structured design approach for multi-standard, multi-band receivers based on the software radio concept.
- To propose and design reconfigurable and adaptive analog circuits for use in the above receiver.

15.3 Transceiver Linearization

Partners: Chalmers University of Technology and BlueLabs Microelectronics

Ph.D. student: Peter Engelbretsson (BlueLabs)

Supervisor: Professor Lena Petersson

Industrial Mentor:

Description:

The project concerns linearization of power amplifiers by digital predistortion. The key objectives are

1. To develop a digital predistorter for a 802.11a terminal transceiver with focus on transceiver power consumption.
2. To optimise power efficiency at each power level of a 802.11a terminal transceiver.
3. To find the output power level where the introduction of the above predistorter leads to decreased overall power consumption.
4. To develop calibration algorithms for the measurement receiver.
5. To investigate if the standard receiver (with a bandwidth of 20 MHz) could be used as measurement receiver. If possible, develop an algorithm to extract predistorter parameter updating information from 20 MHz baseband data.
6. To decide which of a DSP or ASIC solution is the most suitable.

15.4 Thermal management of electronics for avionic applications

Partners: College in Jönköping and Saab Avionics

Ph.D. student: Jonas Johansson (Saab Avionics)

Supervisor: Docent Peter Leisner

Industrial Mentor:

Description: