Academic year 1994/95

INDIVIDUAL INSTITUTIONAL REPORT
For Eligible Country JEP Partners

1. Joint European Project Data

JEP NR.: 4722
Partner institutions:

1. **Technische Hochschule Darmstadt**
   Karlstrasse 15
   D-W-6100 Darmstadt, Germany
2. **Institut National Polytechnique de Grenoble**
   46, Avenue Felix Viallet
   38031 Grenoble CEDEX, France

Name: **Prof. Raimund Ubar,**
Head of the Electronics Competence Centre
Tallinn Technical University

Address: Ehitajate tee 5, Tallinn, EE0026, Estonia
Telephone: (+372) 2 532 119
Fax: (+372) 6 392 062
E-mail: raiub@pld.ttu.ee

Signature:

Date: October 04, 1995

2. Your Involvment in the Project

2.1. What did you expect to achieve from your involvment in this project during 1994/5.

2.2

2.3.

2.4.

3. Overall project outputs

2.1 Please describe the main achievements of Your project in 1993/94 and follow the points below, as applicable. Please indicate in each case Your institution's role in carrying out the activity.

a) Which courses and/or teaching materials have been developed? Have they been recognised officially yet? How many students are directly targeted by the new or adapted courses?

We have developed the curricula and prepared the teaching materials for the following two new courses:

- Course LIF 3970 "VLSI synthesis and computer aided design" (developed by K. Tammemäe, A. Sudnitsõn);
- Course LIF 3970 "Digital systems testing and diagnostics" (developed by R. Ubar, T. Evartson).

The course "Digital systems testing and diagnostics" will be supported also by a series of laboratory works based on the software package TURBO TESTER which has been developed at the Tallinn Technical University.

Both courses are accepted and officially registered in the list of courses teached at the Tallinn Technical University.

The methodology of the laboratory course developed in the framework of the project TEMPUS JEP 4772 was presented in two papers at the all-European methodological EUROCHIP Workshop on VLSI Design Training in 1993 in Toledo:

- Laboratory Course for Training "Digital Design and Test" (R.Ubar, V.Tulit, A.Buldas, M.Saarepera). Proc.of IV EUROCHIP Workshop on VLSI Design Training, Toledo, Sept.30-Oct.2, pp. 112-117, 1993.
- TURBO TESTER. A Set of Software Tools for CAD of Test for Digital Circuits (R.Ubar, V.Tulit, A.Buldas, M.Saarepera). Proc.of IV EUROCHIP Workshop on VLSI Design Training, Toledo, Sept.30-Oct.2, 1993.

In this year, another methodological paper about the teaching possibilities when using the mentioned software "A PC-Based CAD System for Training Digital Test" was prepared and will be presented at the next EUROCHIP Workshop on VLSI Design Training on 17.-19. October 1994 in Dresden.

We have developed curricula and gathered information for preparing and updating the following other lecture courses:

1) Computer hardware (chapters on digital design based on the PLD technology) - by T. Evartson;
2) Digital systems design and test (chapters on design for testability) - by R. Ubar and T. Evartson;
3) Parallel processing (chapters on the types of computer architectures and communication networks) - by T. Plaks and A. Sudnitsõn;
4) Computer theory and design (chapters on VLSI technology, regular structures and implementing on linear algebra algorithms on regular arrays) - by T. Plaks;

5) Practical course on high-speed algorithms on regular arrays for image and signal processing (using FPGAs and VLSI design systems like Cadence, SOLO, VHDL, XILINX) - by T. Plaks.

6) Digital systems (chapters on FSM implementations with PLA, microprogram automata transformations for PLD implementations, PLD implementations oriented to FSM decomposition methods) - by A. Keevallik.

All theses lecture courses will be supported by the corresponding laboratory works based on using the following professional software: SOLO 1400, XILINX, SYNOPSYS, HILO, CADENCE. The mobility possibilities of the current project year and the courses held by partner institutions at our university were mainly used for getting the corresponding knowledge and experience concerning the mentioned software with the goal to introduce it into the teaching process at Tallinn Technical University. The teaching materials for working with the above mentioned software will be prepared during the current year by B. Gordon and A. Udal.

The following new and updated courses have been offered in 1993/94 at the Tallinn Technical University:

- Course LIF 4190 Computer Architectures (T. Plaks) 11 students 32 hours;
- Course LIF 3970 “Digital test and diagnostics”(R.Ubar) 28 students 48 hours.
- Course LIF 3970 “VLSI synthesis and CAD” (K. Tammemäe) 20 stud. 32 hours
- Course LIY 2141 “Digital systems” (A. Keevallik) 20 stud. 48 hours
- Course LIF 3010 “Computer hardware” (T. Evartson) 120 stud. 48 hours

A course of continuing education for Estonian electronics engineers is under development. It will cover the following topics: introduction to PLDs and FPGAs, using PLDs and FPGAs in electronic design, VLSI and ASIC design, contemporary professional design tools, design for testability, testing and fault diagnosis. Also a laboratory course based on using XILINX design software, Cadence, Synopsis and HILO is beeing developed to provide hands-on experience to enable participants of the course become proficient in the use of modern CAD tools.

b) The aim of and the strategy adopted for the (re)training and updating the staff: To what extent has the mobility scheme contributed to it ?

The aim and strategy of (re)training was to update and prepare new courses, new laboratory works and support building up new computer and CAD technology environment at home university.

The plan of retraining and updating includes different activities: preparing of courses, learning about the CAD systems and about the functioning of the infrastructure of CAD tools. The plan also includes learning about IC technologies and competence centres activities in supporting teaching and offering services to SME.

The active people from their fields were chosen to cover these various training activities to develop curricula and form active teaching and research atmosphere at home university.

We are shure the mobility scheme is very important support of the renewal of teaching and research. Through the people working and studying in advanced and different environment than home, it is the fastest way to change teaching programmes and create new curricula.

The direct contacts between people is the best way of transfer of knowledge, this forces innovative work and create new ideas.

The retraining and updating activities for the university staff on teaching VLSI and PLD design have been carried out on following fields:

1. **Teet Evartson** (Darmstadt, 4 weeks) - preparing the course on PLDs and using SOLO 1400;
2. **Helena Krupnova-Bogushevitsh** (Grenoble, 8 weeks) - CAD-tools (Synopsys), logic synthesis, diagnostics
3. **Aleksander Sudnitsyn** (Grenoble, 4 weeks) - preparing lecture ”Digital Systems” and “VLSI Design and CAD”
4. **Kaido Vainomaa** (Grenoble, 4 weeks) - organization and services of CMP, engineering management, technology transfer and cooperation with SME in high-tech.
5. **Raimund Ubar** (Darmstadt, 2 weeks; Grenoble 8 weeks) - preparing course “Testing and Design for Testability of Digital Systems”
6. **Andres Keevallik** (Grenoble, 2 weeks) - FSM-s synthesis, preparing lecture “FSM synthesis on FPGA”.
7. **Jyri Poldre** (Grenoble, 2 weeks) - technologies of silicon fabrication of designed ASICs
8. **Boris Gordon** (Darmstadt, 6 weeks) - ASIC design using CADENCE
9. **Andres Udal** (Darmstadt, 6 weeks) - ASIC design using CADENCE
10. **Kalle Tammemäe** (Darmstadt, 3 weeks) - preparing course “VLSI Synthesis and CAD” participating in EUROCHIP course “High Level System Design”.

c) How many students have been trained? How were they trained?

The following 8 students have been trained for using CAD systems, for PLD design and related topics in Grenoble and Darmstadt:

1. **Maarja Kruusma** (Darmstadt, 3 months) - VHDL programming, VLSI design and simulation, neural network implementation on dedicated parallel VLSI hardware;
2. **Andres Kaasik** (Darmstadt, 3 months) - CAD laboratory work of design of a microprocessor;
3. **Priidu Paomets** (Darmstadt, 3 months; Grenoble, 2 months) - CAD laboratory work of design of a microprocessor, work on CAD tools for testability analysis;
4. **Jaan Raik** (Darmstadt, 3 months; Grenoble, 2 months) - CAD laboratory work of design of a microprocessor, neural networks and fuzzy logic, developing interface for SOLO 1400
5. **Mart Pais** (Grenoble, 3 months) - diploma thesis’s “Design tools for convolution-like calculations based on VLSI”;
6. **Julia Dushina** (Grenoble, 3 months) - simulation and synthesis on CAD, testability;

7. **Marina Brik** (Grenoble, 3 months) - testing of FSM, CAD tools Cadence, Synopsys, Hilo
8. **Pjotr Mjakoshin** (Grenoble, 3 months) - VHDL language and CAD on Synopsys

d) Which Intensive Programmes have taken place and what was their role with respect to other project activities (development of courses, retraining of staff etc.)?

Two intensive courses with the laboratory work have been held in Tallinn:

1. Course of PLD design (one week in Tallinn),
   by Thomas Hollstein, Darmstadt;

2. Course of CAD on CADENCE (one week in Tallinn),
   by Prof. M. Glesner, Eng. T. Hollstein, P. Windirsh, M-D Doan (Darmstadt),
   Prof. B. Courtois, Prof. P. Amblard (Grenoble).

3. Lecture "Trends in CAD, Test and Manufacturing in Electronic" (in Tallinn)
   by Prof. B. Courtois, (Grenoble);

4. EUROCHIP advanced course "High Level Digital System Design"
   attended by ass prof. Kalle Tammemäe;
5. Course "Microelectronics CAD Laboratory" (two weeks, in Darmstadt),
   attended by students Kruusma, Raik, Paomets;

The courses in Tallinn held by professional teachers were successful passing the knowledge and experience supported with laboratory training. These courses were opened, the students and teachers from different institutes were involved. The people from industry were invited and they participated in these courses. The computer and software infrastructure developed inside the TEMPUS-project supported the courses.

e) purchase of equipment:

SUN 20/502, 64 MB RAM, 2GB HD, 2 CPU;
SUN 64 MB RAM SIMM;
SUN 4 GB HDD;
SCSI card + QIC02 tape;
SUN NFS cashe memory;
Printer Postscript SIMM and LAN card;
Ethernet Tranciever; Solaris 2.x media;
UPS 2KW + Control software;
PC workstation upgrade - motherbrd 66dx2-> 66dx2VESA +VRAM - 5 pc;
Graphic adapter: S3MIRO - 5 pc; Monitor 17" - 4 pc;
PC 486 66dx2 - 2 pc; TV VGA converter;
Magnet cards and reader.

We have achieved much more compared to that of what we expected in planning the project even in making the renewal application for the second year. Instead of the

initially foreseen computer class based on 4-5 IBM PC-s and 1-2 SUN workstations, we have now established a **universal computer classroom** based on powerful SUN 20/502 server, 8 PC-workstations with 17" monitors, and a SUN IPX workstation, which has through the original strategy of using simultaneously even **two basically different** functionality's:

a) **PC classroom** with 8 working places for teaching professional software developed for PC-s under MS/ DOS operating system (XILINX software for PLD design);

b) **workstation classroom** with 8 working places for teaching professional software developed under UNIX operating system (SYNOPSYS and CADENCE for ASIC design).

These two functionality's were achieved through upgrading PCs and monitors of PCs to the ones typically used for workstations and through installing beside the PC operating systems (MS DOS, WINDOWS) the LINUX operating system which replaces efficiently the workstations UNIX operating system. The laboratory was developed by the people of our university using consultations from the partners.

The new courses and laboratory works are fully based on the new infrastructure.

f) other activities

Initiated from the need of overall renewal of technology environment in university teaching and from the development opportunities generated by TEMPUS project as well as other international cooperation activities, a new institution - **Electronics Competence Centre** (ECC) was founded in TTU within this year. The task of ECC is to make the best use of the CAD tools, workstation resources and network infrastructure, provide courses for students, to carry out continued education, run the international cooperation projects and provide technology transfer to small and medium size enterprises.

Since its foundation Electronics Competence Centre has plaid leading role in carrying out the project objectives, using created CAD environment and developing directions for further proper use of established resources and knowledge developed.

CADENCE course at the TTU in the end of this summer was announced open for interested participants from industry. Special invitations were mailed out to the companies. Around ten people from industry participated in the course, two of them participated full laboratory course.

2.2. Will the changes that have been introduced through the project have an impact at the following levels and, if so, how?

a) individual

Open contacts and cooperation projects inspire and give new ideas. Many courses, papers and projects have been initiated from the project. The created infrastructure allows effective teaching of the developed courses, and cooperation in research.

b) departmental
The infrastructure of the design laboratory created inside the project, updated and developed during the last year, and mobility has been important support for the department.

c) faculty
The mobility grant has been divided between five institutions of our faculty:

- Electronics Competence Centre (the grantholder) - 32%;
- Department of Computer Engineering and Diagnostics - 39%;
- Department of Digital Systems - 17%;
- Institute of Electronics - 6%;
- Institute of Control Engineering - 6%.

All these institutions are working in very tight cooperation. Other institutes and chairs within the faculty have joined with the building up of the Electronics Competence Centre technology and information environment. People from different units have participated in mobility, widening the knowledge of technologies and teaching possibilities along to their work.
The Centre of Languages of our university was supported by giving them to use lecture books, audio and video tapes purchased by us for teaching the French language and also to teach special topics on electronics in the English language.

d) institutional
Active participation in development of the institution has been generated from project.

e) the Higher Education System in Your country
Development projects like TEMPUS influence the education system as development centre with new ideas. Electronics Competence Centre is involved in development of programme for electronics design (including microelectronics) in Estonia.

f) other (please specify)

One of the main results of the project is the creation of the new institution at our university - the Electronics Competence Centre at the end of the year 1993. This centre, based on the Electronics Design Laboratory created by financial means of this TEMPUS project, will provide the teaching and training possibilities for all the Control Engineering Faculty, for other departments of our university which are involved in mechatronics or in design of intelligent systems based on electronics.

Electronics Competence Centre is also working on transfer of technology to the SME influencing the technology development of the industry.

3. Project management

3.1 How was the decision-making process organised within the project ? How did you contribute towards this management/decision-making process (from an academic, organisational and financial point of view) ?

The decisions were made in tight contact with the partners.
My input into the management of the project was the following:
a) analysis of the

- current situation in teaching electronics and computer engineering at our university,
- the current situation in the Estonian electronics industry, and

b) specifying on that basis the activities of using the competence of partner institutes for developing new curricula and infrastructure for university and continuing teaching at our department;

From the academic point of view,

- I planned, carried out and supported the activities of developing the conceptions of new lecture and laboratory courses at our department;
- also, I carried out the negotiations with partners concerning the content and forms of the guest courses they held at our department;
- I supervised personally and took part in the development of the laboratory course "Digital systems testing and diagnostics" and in the development of the strategy and methodology of introducing the CAD software TURBO TESTER into the teaching process.

From the organisational point of view, I planned and carried out procedures of choosing the proper candidates for student mobility, organised the stay of mobility guests from the partner universities and organised the activities of choosing, ordering and purchasing the new equipment and software.

From the financial point of view, I followed continuously a strategy to use the project money in the most optimal way. I used the possibilities to purchase the professional design software with special discount provided by the EC Association of EUROCHIP for universities. As a member of this organisation we got the rights to purchase very expensive professional top-level design software with membership discount up to 95% (!). To benefit from these possibilities, I carried out the corresponding negotiations with representatives of the EUROCHIP organisation. **In fact, this action amplified (multiplied) the amount of money received in the framework of the TEMPUS JEP 4722 project (during the second project year) for purchasing equipment by the factor of three (!).**

The management was carried out by the coordinating partner with high competence. From the academic point of view, we got continuously high-level consultation for creating new courses, for purchasing teaching materials and for establishing the laboratory with new hardware and software. Very useful lecture courses were chosen for us and carried out by both partners. Both partners had to do a lot of work in organising the mobility and planning the activity of our students and staff in Darmstadt and Grenoble.]

3.2 Did you receive a copy of the contract ? Did you have the breakdown of the project costs at your disposal ?
If possible, indicate the amount your institution received for the separate expenditure items:

a) equipment including books (please give a full list)

b) student mobility grants (Mobility Grant)
c) staff mobility grants (Mobility Grant)
d) staff costs (administrative and academic staff)
e) overheads (excluding staff costs)
f) other costs (please specify, e.g. travel, intensive/language courses etc.)

Yes, we have a copy of the contract. We have also the breakdown of the project costs in our disposal.

a) equipment including books (please give a full list)

Equipment: 50000 ECU

SUN 20/502, 64 MB RAM, 2GB HD, 2 CPU
SUN 20/502 64 MB RAM SIMM
SUN 4 GB HDD
AUI adapter cable
Solaris 2.x media
UPS 2KW + Control software
PC workstation upgrade - Motherbrd 66dx2-> 66dx2VESA +VRAM - 5 pc
Graphic adapter: S3MIRO - 5 pc
Cooling Fan for CPU - 5 pc
Monitor 17" - 8 pc
PC 486 66dx2 - 4 pc
Printer Postscript SIMM and LAN card
SCSI card + QIC02 tape
SUN NFS cashe memory
Ethernet Tranciever
TV VGA converter
Electric Heater
Magnet cards and reader
Software: XILINX for SUN, Cadence, software maintenance

Books:

1. S.D. Brown, R.J. Francis, J. Rose, Z.G. Vranesic. “Field-Programmable Gate Arrays”. Kluwer Academic Publishers. 1992.
2. S. Mazor, P. Langstraat. “A Guide to VHDL”. Kluwer Academic Publishers. 1993.
3. P.Michel, G.Saucier. “Logic and Architecture Synthesis”. North-Holland. 1990.
4. M.Raynal. “Algorithms for Mutual Exclusion”. North Oxford Academic. 1989.
5. J. Handy. “The Cache Memory Book”. Academic Press, INC. 1993.
6. The New IEEE Standard Dictionary of Electrical and Electronics Terms. IEEE 1993.

Periodicals:

1. IEEE Spectrum (1994).
2. The Institute of Electrical and Electronics Engineers (1994).
3. IEEE Design & Test (1994).
4. IEEE Micro (1994).
5. Computer (1994).

Video lectures:

1. David Patterson. Terabytes Megaflops (Or Why Work on Processors When I/O is Where the Action is.) V12
2. Eduard A. Feigenbalum. Tiger is a Cage. Applications of Knowledge Based Systems. V13
3. John Sanguinetti. Simulation Speed and Logic Design. V14
4. James Armstrong. Academic Leaders in Computer Science and Electrical Engineering. V15
5. C. Gordon Bell. Tracking the Teraflop. V16
6. Graford Alpert. An Overview of Intels Pentium Micropocessor.V17
7. Richard Karp. NP- Complete Problems.V18

b) Student mobility grants	6900 ECU
c) Staff mobility grants	8600 ECU
d) Staff costs (administrative and academic staff)	4661 ECU
e) Overheads (excluding staff costs)	759 ECU
f) Other costs (please specify)	599 ECU
Management meeting in Darmstadt	354 ECU
Management meetings in Tallinn	245 ECU

3.3 How was the distribution of funds decided between the partners? Does the distribution of funds ensure that the project objective will be reached ?

The distribution of funds was decided to do the way the best supporting the project objectives. In the contract, it was planned for us minimum amount of ECU 50,000 from the total sum of 120,000 ECU to be spent on equipment. The sum for equipment was fully spent for the development of the infrastructure in Tallinn. We received additionally 6019 ECU for other categories of costs (personnel, meetings, other costs, overheads etc.).

Also, we are very thankful that we were allowed to do some minor changes in the distribution of the amount of money in Mobility grant between the staff and student categories.

Please also indicate whether the distribution of funds mainly:
a) favoured your institution?
b) was fair to all partner institutions?
c) favoured an/the EC institution(s)?
d)favoured another eligible country institution?
e) other (please specify)?

The distribution of funds favoured our institution compared to that what was planned and we appreciate our partners very much for that.

3.4 Have you received any complementary financial support from external sources? If so, please indicate the source(s) and amount(s) concerned.

For the purpose of creating a new institution at our university - the Electronics Competence Centre based on the laboratory equipped by the means of the current TEMPUS project, we have got the following grants from different Estonian foundations:

- The grant G-1434 from the **Estonian Science Foundation** for the project "Creating the infrastructure of the Electronics Competence Centre" in the amount of 145000 EEK;
- The grant from the **Estonian Informatics Foundation** for the project "Creating the environment for the design and development of data securing hardware" in the amount of 245000 EEK;
- The grant from the **Estonian Innovation Foundation** for the project "Launching the computer aided design activities in the field of electronics in Estonia" in the amount of 324000 EEK.

The total amount of these grants is 714000 EEK (about 50 000 ECU)

Taking into account the difficult economical and financial situation in Estonia this represents a considerable effort from Estonian Government. Through this kind of support, it can be concluded that the current TEMPUS JEP 4772 project is regarded from the side of Estonian society as very important for the development of our country. It also has to be mentioned that the success in competition for these grants was reached not only because of the importance of this field of science and education for Estonia, but also because of the good scientific and teaching potentials at our faculty.

4. Appreciation

4.1 In what way did Your institution (department, faculty, university) support Your project? Please explain how this attitude was expressed, and give the reasons for it, if possible.

Our institution's attitude towards the project has been very supportive. Since one of the goals of this project was to establish a new Electronics Competence Centre for concentrating very expensive hard- and software resources for electronics design, the university appointed special rooms for that purpose. Our activity has been appreciated by the university administration continuously at different events and emphasised as a very important project the Estonia.

4.2 Do You find Your cooperation with the EU partners:

Our cooperation with the Western partners we find excellent. We have established very quickly good contacts with both partner-universities (in Grenoble and in Darmstadt). Our students have been involved in project works at partners and they are continuing this cooperative activity at home via e-mail. The results of the training period of two students (Tammemäe and Udre) in Darmstadt were presented as a paper

at a conference of international level. The methodical work made by Prof. R.Ubar with partners in Grenoble to develop a new teaching course on VLSI Testing was also published as a methodical paper and presented on Sept. 30, 1993. at the IV EUROCHIP Workshop on VLSI Design Training in Toledo (Spain). A paper will be presented by Prof. R. Ubar and his students also at the next V EUROCHIP Workshop on VLSI Design Training in Dresden (Germany).

4.3 Given your present experience of cooperation within a TEMPUS Joint European Project, are there any points you wish to give feedback on, e.g. problems you experienced, suggestions you could make for the administration of the TEMPUS Scheme etc.?

No, we don't have any essential suggestions. We appreciate all the broad possibilities we have got thank to this TEMPUS project to build up a new level of teaching electronics in Estonia. It is especially important because the electronics is nowadays the key technology for every developed country, and Estonia is oriented to get a developed country and to be a real cooperation partner also in technological fields to EC countries