Partner Final Report
Tallinn Technical University

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Partner Summary Report

1. Objectives of the project and planned actions

Objectives of the project and planned actions with participation of TTU were:

- Task 1. Microelectronics design environment maintenence,
- Task 2. TURBO-TESTER software tools and teaching materials
- Task 3. Education, training, dissemination
- Task 4. Organizing of local conferences

2. Contributions of the Tallinn Technical University

Task 1. Microelectronics design environment

The following actions were undertaken:

- A new Design Classroom was set up on 14 SUN workstations through cooperation and direct support from companies of Ericsson Telecom AB (Stockholm) and DIGSIM Data AB (Linkoeping)
- 9 new Cadence lisences were installed by support of SYTIC project (through direct cooperation with RAL
- EUROPRACTICE software maintenance kept running (SYTIC support)
- Visits to TTU by two consultants from RAL for consulting the design team of TTU.

Task 2. TURBO-TESTER software tools and teaching materials

The following original software packages were developed and updated:

- Test generation
- Fault simulation
- Built-in self-test emulation tools
- EDIF design interface

New manuals were developed:

- TT backgrounder
- TT user guide

New laboratory courses were developed:

- Test pattern generation for digital circuits
- Test quality and fault cover analysis

- Test quality analysis by dynamic simulation
- Design for testability
- Built-in self-test analysis

Task 3. Education, training, dissemination

Education, training:
An international course on Design for Testability was organized by TTU for 30 participants on March 20-23, 1999. 14 participants were from Estonia, 7 from Poland, 3 from Sweden, 2 from Bulgaria, 2 from Russia, 1 from Slovak Republic and 1 from Lithuania.

Dissemination:
Presentation TURBO-TESTER at workshops, conferences and user forums or exhibitions (11 publications in total during 1996-1999).
User forums and exhibitions:

- User forum for innovation in Estonia, Tartu, March 1998
- CeBIT'98, Hannover, April 1998
- Exhibition on the International Conference IST'98, Vienna, November 1998

Task 4. Organizing of local conferences

The following international events on microelectronics technology were organized by TTU with participation of local SME representatives and CAD technology users:

- The 15th NORCHIP Conference, Tallinn, November 10-11, 1997
- The 8th International Workshop on Field-Programmable Logic and Applications, Tallinn, August 31 - September 31, 1998
- The 6th Baltic Electronics Conference, Tallinn, October 7-9, 1998.

3. Description of the laboratory course developed based on Turbo-Tester

Test pattern generation for digital circuits

- Goal: develop an understanding of main approaches to test generation for digital circuits.
- Tasks: comparison of deterministic and random methods, creating tests by combining manual test with ATPG, and investigation of the model complexity impact to the ATPG tools productivity.

Test quality and fault cover analysis

- Goal: provide experience in using fault simulation tools.
- Tasks: comparison of different fault simulators, comparison of static and probabilistic test analysis tools, investigation of the model complexity impact to the productivity of tools.

Test quality analysis by dynamic simulation

- Goal: provide an understanding of the multi-valued simulation and to develop skills in using it to detect hazards and to generate tests for statically undetectable faults.

- Tasks: hazards detection by multivalued simulation, dynamic test generation and analysis, testing redundant faults, transition fault testing (delay and stuck-open faults), investigation of the model complexity impact to the productivity of tools.

Design for testability

- Goal: develop understanding of the need to join design and test activities, to provide hands-on experience in DFT.
- Tasks: estimation of the testability of the given design, improving the testability by using test generation tools and improving the testability by using the testability analysis tools.

Built-in self-test analysis

- Goal: provide hands-on experience of using test generation tools when designing BIST hardware and to familiarise the student with the general structure of the BIST as a composition of pseudo-random and prestored test approaches based on ROMs and LFSRs.
- Tasks: to find the optimum BILBO architecture for the given design, to optimize the self-test embedded tester based on the Circular-Self-Test-Path approach and to investigate the Store-and-Generate approach to self-testing.

4. New industrial and academic links created as the result of the SYTIC project

- Fraunhofer Institute of Integrated Circuits in Dresden (Germany)
- Ericsson Telecom AB in Stockholm (Sweden)
- Artek in Tallinn (Estonia)
- DIGSIM Data AB in Linkoeping (Sweden)
- Fincitec OY in Finland
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5. Conclusions

The main results achieved by the SYTIC project in synergism with other recent COPERNICUS projects (EEMCN, FUTEG) for TU Tallinn:

- **Design & Test Centre** at Computer Engineering Dept. was established in 1998 with the goal to concentrate professional design environment for the research and educational purposes.
- **Purchasing and maintenance professional CAD software** at low prices, which gave the possibility to start in Estonia VLSI design activity with the same tools and technology as in the western Europe, creating in such a way a real chance for cooperation with the West in form of subcontracts or joint projects.
- **Significant educational effect:**
  Students at different graduate levels have been involved in the EU project R&D activities. After leaving the university, young engineers and researchers will be able to handle modern CAD tools and to help SMEs to improve the quality of their products.
- **Increased motivation for research work:**

Participation in EU projects gave the possibility to keep young people motivated to stay at the university and do research.

- **Links to the Estonian industry:**
  The factory Elcoteq in Tallinn is producing electronics PCBs for communication, television etc. equipments - one of the best exporters in Estonia. Continuous expanding of the factory means a big need of qualified young engineers having experience in testing and diagnosis of complex electronics systems. The courses and training environment developed and the knowhow created through co-operation between project partners are the basic achievements which make possible to educate engineers needed in Elcoteq.
- **New competence for solving practical problems:**
  In the field of Test new methods and tools has been developed to increase the reliability of testing and fault diagnosis. In the field of Design, an original cryptographic module for digital communications - the first VLSI in Estonia - has been developed, manufactured and successfully tested.
- **Involvement in international teaching:**
  A PC-based low-cost system Turbo Tester, offering a diverse set of tools for teaching Design & Test has been successfully introduced into university program in Tallinn and used in other countries (Finland, Sweden)
- **Increased international reputation:**
  Participation in most representative international conference programme committees like ETW'97, ET&TC'97, NORCHIP'97, ETW'98, DATE'98, NORCHIP'98, EDCC'99, ETW'99, DATE'99 etc.