PROJECT N°: COOP-CT-2004-508436

DEVELOPMENT OF AN INNOVATIVE, MODULAR, RAPID PROTOTYPING SYSTEM FOR RIGID AND FLEXIBLE MODELS

(FLEXRAP)

SIXTH FRAMEWORK PROGRAMME
Horizontal Research Activities involving SMEs
Co-operative Research

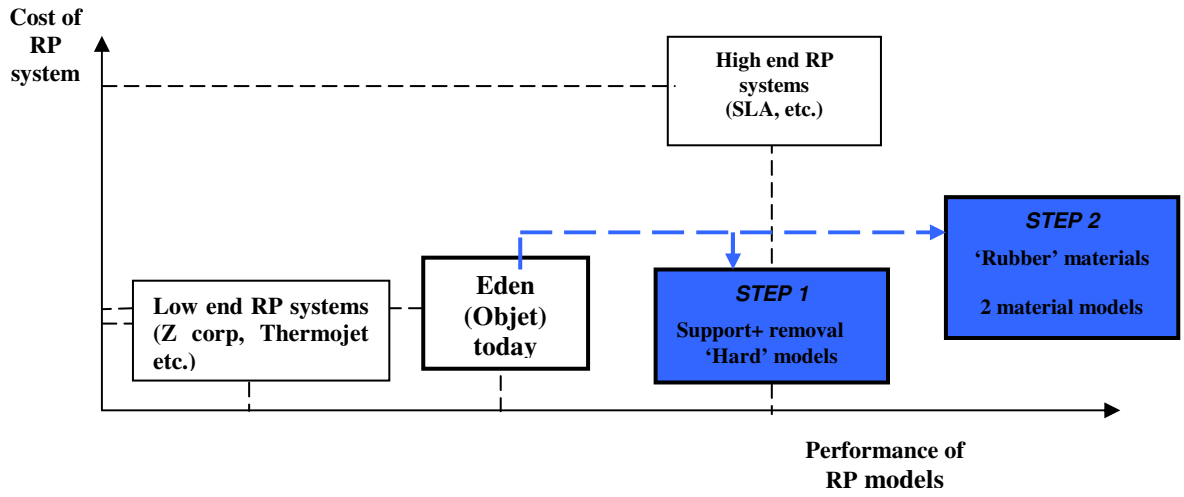
Final Publishable Activity Report

Start Date Project: AUGUST 1ST, 2004 **Duration:** 30 MONTHS

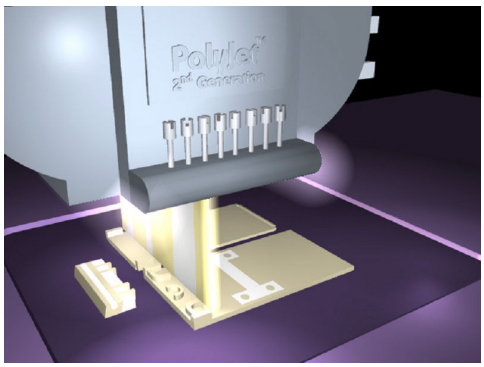
Final Publishable Activity report

Introduction

Rapid prototyping techniques are an important tool for a fast and efficient development of a product. It allows a short time-to-market and better design and quality of the product. In this way it enhances the competitiveness. Different RP-techniques are on the market but the threshold to use it especially to SMEs is still very high since there is no high quality technology available at a reasonable price. Also the mechanical properties of the RP-model is limited to rather hard materials. Also the technique is not widely accepted yet is that it cannot be used in an office environment and special skills are needed for the high end RP-techniques.
Availability of a flexible RP-technology that is possible to use in an **office environment** and gives **high quality models** for a **low price** and with the possibility to have **different types of (also soft) materials** would mean a breakthrough in the RP market.
Although many types of RP-machines are available the Objet technology as applied in the Eden machines is best suited as a starting point for the development of such a technology.
Therefore, two main improvements of the present technology are under development in the present project:



The aim is to have a high quality rapid prototyping system with more flexibility and functionality than the SLA-type of systems at the price of a concept modelling system or slightly higher.



Main objectives

1. Development of support material:

- Materials must have the same function as the present insoluble support material but can be removed easily in an office environment.

Results:

Formulations were developed that can be printed with the inkjet print-head that is presently used in the Eden machines, that give sufficient mechanical strength after curing and that could be dissolved in water. The dissolution times at the moment are still quite long but new strategies were elaborated that bring a support material that fulfils all requirements within reach. Removal method is established that can be performed in an office environment.

2. The development of model materials:

- Hard Model materials with good mechanical properties
- Soft model materials with low modulus and for given applications with rubber-like properties

The technology demands very specific resin formulations:

- The resin formulations have to comply with the proprietary Ink-jet technology that jets the formulation at high temperature.
- The resin formulations have to show fast cure under UV-illumination
- The final mechanical properties must be good

Results:
Most of the emphasis in the development was on the development of flexible materials with a high elongation at break and good elasticity (short return times after deformation). This development was rated high risk at the beginning of the project. Very good progress was made and Objet developed a material with properties far beyond the state of the art for flexible materials in 3D printing. After further optimisation the formulation was introduced by Objet as a new resin on the market under the brand name TangoPlus with an elongation at break of 200%, a hardness of 27° Shore A and a very short return time.

3. An experimental printer that allows the use of 2 model materials and a support material.

Results:
To be able to print two model materials and one support material an experimental machine was build. To that end hardware and software were substantially altered. It was demonstrated that the two model materials can be combined in many different ways depending on the demands of a given application.

4. To determine the broad applicability of the developed RP technique by development of process and product applications

The potential applications of this technology are investigated. Case studies were made regarding applications in the foundry, toy and footwear industry. Training program was prepared to allow the easy introduction of the technology in the toy industry. It would e.g. be a big asset for the SMEs in the toy and footwear sector at the moment the import limitations for goods from south-east Asia is relieved (from 2005 on).

Results:
It was demonstrated that the technology is very interesting when flexible functional prototypes are needed. Different case studies in the toy industry showed the potential of the flexible, soft material or a combination of soft and hard material. In this way a prototype of a product that is to be produced by

over-moulding can be produced in one step. This is unique since there is no other prototyping technology available that is able to do that.

For the shoe industry a method was developed to produce a prototype shoe with a flexible sole in a short time. Starting with scanning the profile of an existing shoe, translating it into a file that can be read by the Eden Machine. The Flexible sole can be glued to an upper part of a shoe. The flexible sole has not the durability of a normal sole but these functional prototypes can be used for demonstration and for fitting tests.

For the foundry application a method was developed to produce directly from the cad design fo a product a mould material to produce wax models to be used in a lost wax investment casting process. It was demonstrated that is gives cheap wax models with a high precision in a short time. The method is limited to high melting applications.

Partners involved in the project:

Partner	Country	Activity	Role in project
SME proposers – Technology supplier			
OBJET	Israel	Manufacturer of EDEN machine and inks	Development of inks and adaptation to RP machinery
LAMBSON	United Kingdom	Photoinitiators manufacturer	Development of dedicated
A&CN	Spain	Manufacturer of machines for footwear industry	Development of specific machinery for footwear industry
SME proposers – End-user			
Joviar	Spain	High end producer of plastic and Zamak parts	Validation of process and materials for toy industry and guidance on development of RP-technology for foundry market
Matriceria Leon Y Martinez	Spain	Mould producer for shoe and heel and toy fabrication	Validation of materials and specific guidance on industry specific process and machine development
Creadisa	Spain	Producer of electric, outdoor and pre school toys	Validation of process and materials for toy industry and guidance on development RP-technology for the Toy market
Popular de Juguetes	Spain	Producer of popular toys	Validation of process and materials for toy industry for the Toy market
Activa	Spain	Design company	Validation of process and material for application in toy or other industry and guidance on development RP-technology
RTD performers			
TNO	The Netherlands	Polymer and RP expert	Formulation of Support materials and development of removal technique
ENSCMu	France	Specialist in photopolymers and UV-curing	Formulation of Model materials
Aiju	Spain	Specialist in technology for Toy industry	Formulation of materials and needs of Toy industry
Inescop	Spain	Specialist in technology for footwear industry	Formulation of materials and needs of Footwear industry

Coordination

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