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## **Editorial**

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**Guest Editors:**

**Paulo Bártolo and Bopaya Bidanda**

The Polytechnic Institute of Leiria (Portugal) hosted the 1st International Conference on Advanced Research in Virtual and Rapid Prototyping in October 2003. Over 100 peer-reviewed papers were presented by authors from around the world. The breadth and depth of research papers at this conference provided an insightful and succinct view of state-of-the-art research in virtual and rapid prototyping. It is both a privilege and pleasure to present a few of the best papers in the four days of the conference. These papers fit well with our theme of Product Development and Realization.

In today's highly competitive marketplace with short life cycles of products, developing new products to meet consumers' needs in a shorter lead-time is very important. Thus, to improve competitiveness, a product should not only satisfy consumers' physical requirements but also their needs, increasing the product complexity and reducing its lifetime. More and more, companies must meet increasingly customer expectations in terms of quality and cost of products, adopting new strategies leading to a tremendous change in their internal flexibility. As a consequence many changes in technology, particularly in the areas of computers and information management, have been introduced into the manufacturing sector.

However, as shown throughout this special issue the success of rapid product development and realisation lies not only on the use of advanced technologies but also on managerial and organisational strategies. Besides, other domains rather than the manufacturing area are increasingly demanding the use of the same strategies and technologies opening new and exciting challenges for research.

The first paper from Bidanda and Desai presents an in-depth analysis on organisational, strategic planning and educational aspects for developing prototyping and product development centres, a need within the current context of rapid product development. In this context, the significance of virtual and rapid prototyping in industry and its academic implications are also described. The strategic location of these centres, their business drivers and a possible framework for a successful centre within an academic engineering environment are outlined.

Rapid prototyping and manufacturing are important technologies for product development as shown by the second paper from Terry Wohlers. In this paper, Terry gives a general overview about the profound impact of rapid prototyping on the way companies produce models, prototype parts and tools. The growth number of installed systems, its major applications and trends for the future are also discussed.

The next three papers focus on two novel and important fields, where rapid product development will greatly benefit through the use of rapid prototyping.

The paper of Heinzl and Paspas describes the use of rapid prototyping in micro systems technology. Several micro-fabrication technologies are currently available and are used to fabricate micro-components and systems. These technologies comprise silicon micro-machining and very complex lithographic processes. For early prototypes, Heinzl and Paspas show that laser ablation and micro-stereolithography are important techniques helping to reduce the development time, the costs and the risks of failure of the final product, especially when these technologies are being used together with computer simulation.

The use of rapid prototyping for medical applications is the main topic of the two following papers. Tahar Laoui and co-authors describes an improved technique of laser processing of Ti powders to fabricate dental roots where bone in-growth tests were performed. This technique consists of a combined laser sintering/laser melting processes. Due to this combination, implant samples were made with a structure composed of a re-melted compact core structure and a sintered porous shell. The results presented in this paper shows that it is possible to produce dental root implants having the geometry, structure and strength required for medical applications.

Chee Kai and co-authors investigate in their paper the use of rapid prototyping and rapid tooling techniques to fabricate polymeric stents used in medical applications for relieving constricted respiratory tracts and colons. The results shows that there are a great potential for the use of rapid prototyping and tooling to rapidly and effectively produce suitable stents for medical applications.

The final paper is a two parts paper that introduces the concept of BioCAD (Biologically based CAD) for reverse engineering of large objects. This concept is based on both the biomimetic approach of the human vision process and the use of appropriate algorithms from both photogrammetry and computer vision for the automatic production of three-dimensional digital models from two-dimensional photos. In the first part, Alves and co-authors focus on the accuracy of obtained models. Particular attention is given to the calibration procedure, as errors arising from this process will have a great impact on models. In the second part, the authors describe the use of BioCAD for the generation of digital models and the subsequent information in the form of a tessellated model for rapid prototyping. Two historical buildings were chosen as case studies.

We hope you agree that these papers are both interesting and informative. We are particularly grateful to all authors and reviewers of selected papers and to Dr. Mohammed Dorgham for his support regarding this special issue.