INCORPORATION OF NEW PRODUCT DEVELOPMENT TECHNOLOGIES IN THE TRADITIONAL PEWTER SECTOR

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Abstract

The aggressive competition that companies, operating in different industrial sectors, are nowadays subjected is the result of manufacturing to a global market where consumers are continuously demanding more sophisticated new products with higher quality and shorter life cycles.

These new challenges demand capacities to internally develop new products using digital modelling, rapid prototyping, conversion technologies, rapid manufacturing and others tools that are already common in industrial sectors such as aeronautics, transportation, medical and others.

In this communication the authors present how the adoption of these technologies were fundamental to rapidly create new products in a traditional manufacturing pewter company that still has an intensive human labour and traditional way for product development, and how these new methodologies were fundamental to quickly introduce, with success, these products in the international market.

Introduction

Nowadays, the international competition puts companies on continuous pressure to be faster and to develop new products that have shorter life cycles. This new reality is incompatible with the traditional way of product development, which is based on paper drawing, intense human labour and trusts on decades of experience and specific skills of the SMEs workers. This traditional way only allows the introduction on the market of few products that the East low cost human labour copy very quickly, placing on the market the same products at much lower costs.

This new reality demands the compulsory introduction on new technologies on the product development, manufacturing and marketing strategies [1-3].

Portugal created in 1997 a National network for Rapid Prototyping. At that time, INEGI, as a partner of the network, bought a LOM Rapid Prototyping equipment, and started to use prototypes and conversion technologies to develop products and processes for different industrial partners. The contact with industrial partners, high schools and research institutions was very profitable, and earlier the collaboration between designers and engineers was identified as a key tool for product development. This new reality triggers an effective participation of designers from different schools in INEGI to develop products.

Design students, integrated in teams with competences that goes from rapid prototyping, composites materials to foundry and sheet metal forming processes, realized that they can understand the limitations and advantages of the different manufacturing processes, to quickly develop new products with challenging shapes and materials combinations.

This design students training in INEGI gave rise to a large number of products [5, 6] that never reached the market, essentially because that was not the goal. More recently, the RP INEGI group started to realize that the developed products were so interesting and attractive to die on INEGI shelves and that they should be commercialized. Considering this new reality, the group contacted a pewter company to challenging them to join INEGI team to develop together new products with the goal to introduce them in national and international markets.

In 2007, product design students, during their training in INEGI, participated actively in this project and developed functional and decorative parts to be produced in tin-based alloys (pewter) [6]. The success of this initiative opens the doors to new challenges for other students, now not only to develop products in tin alloys, but also to combine materials, develop packing concepts, company image, products presentation in fairs and other events. The motivation and success reached pushed already the team to search financial

support to implement a modern methodology for product development in the company. Other companies/institutions working with other materials had already challenging us to do the same kind of work with them.

This paper demonstrates how creative product design and versatile and advanced technologies are winner combination for companies to quickly introduce, with success, new products in the international market.

Projects development

The starting process was the visit to the pewter company to allow students to understand the flux line of the products since the materials reception until the packing and shipping. Detailed and long analysis to the production process was performed, to understand its limitations and define project specifications in accordance to the new products necessities of the company.

Students then did market research to foresee the state of art and tendencies related with the specified products, and also to benchmark some products that were already on the market.

After having developed design concepts, designers presented different proposals for each project and, after discussion and selection, build the product components in virtual 3D CAD modelling and the respective assemblies. Then, virtual parts were evaluated in terms of visual appearance and functional specifications. After approval, CAD files were exported to STL format to be sent to the RP equipment. The SLA equipment (Viper Si from 3D Systems, USA) built, layer by layer, the physical prototypes from liquid resin [7, 8]. After the layer construction was completed, the SLA parts were subjected to finishing operations to remove the support structures from the unbalanced regions. To increase the mechanical strength, the parts were submitted to a post curing treatment in a UV woven. Prototypes were then finished by manual polishing and painted to be presented to the company for approval and manufacturing the final functional parts.

Wine decanters project

An American company was pressing the pewter company to develop apparatus for decanting wine. In the decanting process, wine from the original bottle is poured into the decanter vessel to aerate the wine, allowing it "to breathe". When old wines are used, a funnel is also demanded to filtrate sediments. If these funnels also force the wine to travel a long way before reaching the glass decanter, an extra aeration is obtained.

The main functional requirements were that the decanting funnels must filter the wine and have a large exposed surface area, allowing wine to react with air.

Wine decanting funnels with incorporated filters, and unique original designs with channels that conducted the wine down to the inner walls of the glass decanter vessel, to quickly intensify the aromas that normally are developed with years into bottle (fig. 1), were conceived. The funnel grape shape of fig. 2 is an unusual approach that fulfils the same objective but has a simultaneous very attractive decorative function [5].

Fig. 1. Funnels with helical surfaces (design by Isabel Machado).

Fig. 2. Funnels based on the grape shape (design by Filipe Amaral).

The prototypes were then tested in decanters to verify functional and aesthetic requirements (fig. 3). This step allows the detection of conception mistakes and corrects them to achieve more functional and optimized designs in a short period of time. The final prototypes were then obtained and polished and painted with a metallic colour.

The prototypes and a promotional brochure (defining an effective marketing strategy) were presented in the industrial company that

expressed great interest to produce and commercialize the five proposals. Using the prototypes, the pewter company produced the respective moulds to get the final pewter prototypes to be sent to client (Fig. 4). Three of the five products were immediately approved and a 325 placement order was accorded with the customer.

Fig. 3. Functional tests with SLA prototypes.

The product development and manufacturing process involved the following steps [1, 5]:

1. Cad models – Concept evaluation using Solidworks software;
2. RP models and master patterns – Physical evaluation and testing of the SLA prototypes;
3. Mould halves production - Master patterns are placed on uncured rubber discs (in some cases traditional sand casting was used);
4. Vulcanizing the silicone rubber mould.
5. Gating and Venting - gates, runner system and air vents are easily cut into the cured rubber mould.
6. Spincasting machine. Centrifugal force drives the molten metal into all the cavities within the mould.
7. Parts removal and finishing operations, including welding, polishing, patine and packing.

Fig. 4. Final products in pewter.

Decorative parts project

This project was focused on creating fruit bowls, candelabras and other decorative parts embracing a wider range of technologies, material combinations and colours with the goal to attract young costumers which do not feel very attracted to whole pewter parts which have a monochromatic colour.

The use of different materials, like wood, glass or liquid resin, was aimed to get mainly more diversified visual colour and textures and aesthetic effects to promote added value and product differentiation [9, 10].

In the beginning of the project, the design group (manufacturing company, INEGI engineers and designers) identified several fields where there was a chance to interview to enlarge the range of the company products offer. Later, a more ambitious strategy was set seeking the development of an entire new line of products together with a products catalogue, labels, packing, advertising brochures and presentations in fairs and conferences.

After the creative phase [11-18], the first solutions gained raw shapes. Innovative products based on strong concepts were developed, which were very different from the actual market and company offer (Fig. 5 and 6).

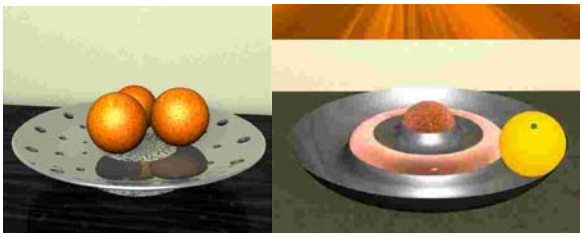

Fig. 5. Tin fruit bowls combining pewter and resin filled with different materials (design by Helder Faria and Vasco Sepúlveda).

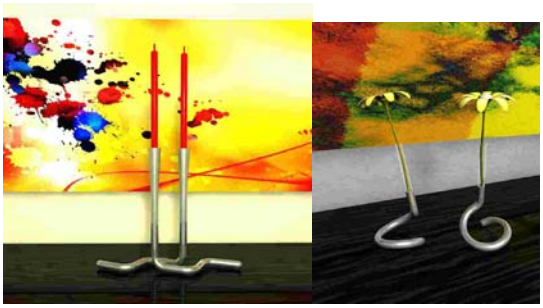

Fig. 6. Candelabra with curved tubes (design by Helder Faria).

A first choice was for the parts that could have more market or presented features that were more established on the company. These impositions derived from the short period of time that the team

had to produce the parts, which had to be presented in a fair.

The objects were inspired in floral motifs with organic shapes where sometimes it was seek the colours profusion existing in a garden, on the waves produced by a drop in the water and marine motifs. The *LoveStory* part is inspired in a poetic side of love, in the relation between couples (Fig. 6). The candelabra *Cube* (Fig. 7) is a mixture of two arts, the pewter and wood.

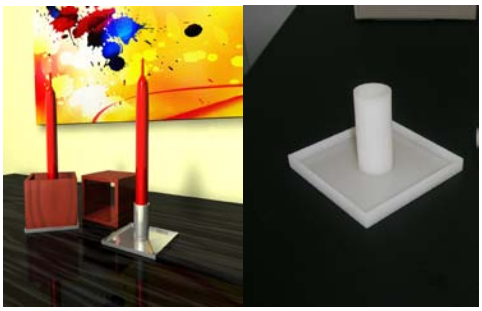

Fig. 7. Candelabra with noble wood (panga-panga and others) parts (design by Helder Faria) and SLA prototype.

Other part seeks the promotion of light effects and textures obtained with the contrast among tin, glass or aluminium, and others have the particularity to join an innovative material in its conception, the epoxy resin mixed with others, creating an innovative profusion of colours. Fig. 8 shows a thematic explored in this work which is sculptures that can be obtained with colour melted wax that can be created for decorative purposes in tables of restaurants and others.

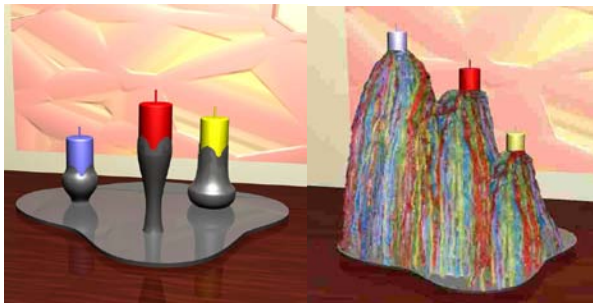

Fig. 8. Candelabra. The melted wax is accumulated on the base (made in pewter or in composite), producing coloured wax sculptures (design Vasco Sepúlveda).

Parts definition and respective characteristics were defined using 3D CAD modelling (in this particular case SolidWorks 2007). For a better final perception of the final aspect of the objects, they were renderized using Cinema 4D software.

During the development process, some SLA prototypes were produced to test dimensions and design. The production of these parts had the objective to facilitate the communication between the team members and to be used on the manufacturing processes.

Concluded the development creative phase, a multimedia presentation was done to the company. All the developed proposals were presented in a digital format, with simulations of the objects in house environments. Together with the presentation, the SLA finished prototypes were presented (fig. 9), which made a strong impact on the company head, which immediately got motivated to produce the parts. At the same time allowed a very interesting discussion involving manufacturing possibilities and limitations and it was immediately obvious that many adjustments had to be done, essentially because of the “lack of feeling” about the tin mechanical resistance, drafts on the moulds, joining limitations (this aspect opened another possibility of collaboration to develop joining procedures using adhesives), etc.

Fig. 9. SLA prototypes.

With the objective of attracting different costumers, some of these products were developed to have the possibility to engrave companies or institutions logos, in a clear strategy to be used as conferences gifts and other commemorative events (fig. 7).

From more than 20 object designed, 13 were approved and produced to be exhibited in an international fair. It should be mentioned that this project was developed in around two months, during the curricular training of the Product Design students from IPVC in INEGI facilities. The training had 16 weeks, and it was the first students experience in an external environment to the school.

The Project was received with great enthusiasm by the students that after the first visit to the company identify several areas where they could directly interview to increase the company portfolio. Furthermore, this project allowed them to put in practice a projectual methodology which goes directly towards what they learned during the 5 years studies: the development of one product, since the first sketches until the moment that the product is packing and exposed in a shelf.

Although students had already some experience with other curricular projects, where they directly contacted with industry in product

development (*Project Nuance* – jewelery project presented in Porto Jóia 2007), this Project revealed itself a bigger challenge and motivation, not only by the contents dimension to be worked but also the short period of time available to conclude the project.

Simultaneously they elaborate chronograms and defined deadlines for each project stage. In parallel some supports were developed that sustain and promote the parts developed. A catalogue for the new products line was developed, where the history of the company is described, its objectives and vision, and the added value of integrating new tools for product design associated with the creative force and motivation of young designers, in an association to Universities and Research Centres.

Individuals labels were created, hands-outs and packages for the products, and finally a short movie.

Conclusions

The two projects presented in this communication are the result of a straight collaboration between a traditional pewter company, a research institution and young motivated designers that were concluding their studies.

The final result is that companies, when have the courage to open their doors to the innovation can speed up product development and be more competitive.

The traditional pewter company introduce new products in the international market, in a short period of time, due to the adoption of modern technologies, namely CAD 3D, rapid prototyping, rapid tooling and conversion processes, combined with design of young designers.

Innovation speed-up the development process and proved that design and the new available tools for product development can constitute a valuable resource for traditional companies, operating in different industrial sectors, to be more aggressive in the actual international market.

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Keywords

Rapid Prototyping; design; tin, pewter products; product development.

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