IMPLEMENTATION OF PRODUCT SEMANTICS IN THE CERAMIC SECTOR

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The objective of this communication is to present a project on the implementation of product semantics in the ceramic sector. The purpose of the project is to establish tools for applying product semantics in the Spanish ceramic sector. Product semantics is a novel technique for the development of user-oriented products with a highly innovative content. It is based on the analysis of product perception by consumers, through the adjectives and concepts employed to describe the products, thus enabling companies to act both at the design level and in terms of communication strategies, and to improve decision-taking with regard to what to sell/design and how to sell/design this. These tools also use Internet to integrate the users telematically in the product development cycle.

This project has a one-year duration and focuses on four sectors of the Valencia Region: footwear, furniture, home-textile and ceramics. The project has been divided into four modules: definition of the project; identification of the semantic space for each product; fine-tuning the computer system; and implementation and demonstration in the participating companies.

The first module consists of the selection of the participating companies, determining the products to be studied, targeted public and sale scenario, in order to adapt the computer tool to the ceramic sector. In the second module the semantic space is identified, through interviews with users, analysis of journals, shops, companies etc., keeping in mind the market segment and product to be studied. Thus the adjectives and concepts most widely used to describe the ceramic products are collected. This information will be used to adapt the computer system, developed previously by the Institute for Biomechanics of Valencia (IBV), to the needs of the ceramic sector. Finally, the tool will be implemented at the participating companies, carrying out a first tutored exploitation of its application there, with some company products.

With this project it is sought to bring the product design process closer to the end-user, and therefore to take into account market information, in accordance with efficient design management. This approach tries to detect the perceptions of consumers concerning already designed company products, competing products, or company prototypes. Therefore product design will approach more closely the needs of the targeted consumer, and on the other hand, since the consumer's perceptions are known, enable us to communicate this appropriately.

As the project is in course at this moment and is scheduled to conclude by the middle of 2002, the paper will fundamentally set out the importance of product semantics for the ceramic sector and the methodology used.

INTRODUCTION: PRODUCT SEMANTICS

Innovation is becoming more and more the path to follow, to consolidate and assure the competitiveness of industry, especially of small and medium-sized enterprises (SMEs). However, innovation is difficult in companies dedicated to product development for human use and especially of products with a high aesthetic and fashion component, as is the case of most of the traditional industry in Valencia. Thus the furniture, footwear, textile and ceramic sectors face more and more demanding consumers and a highly dynamic market, which demands new products of them in ever-shorter periods of time, in some cases in a matter of a few weeks. In this context, to take on the risk of innovating is a complicated issue, and the short available time, fear of product failure and high cost of the prototypes constrains innovation, thus also jeopardising the competitiveness and consolidation of the SMEs.

In this context, technological efforts has been directed in recent years toward the development of new Inverse Engineering tools, rapid prototyping, CAD, CAM and others, which have considerably reduced the time and cost of launching of new products. However, there is an important gap in tools for the management of product diversification, as well as for increasing the consumer satisfaction.

To design products that respond fully to consumer expectations in the most efficient way, it is not enough to ensure the durability, safety, efficiency, pleasant appearance and realistic product price, but rather it needs to be endowed with a extra quality that allows specific adaptation to the user's tastes and preferences. To provide this added value, product conception needs to go beyond a strictly functional evaluation and attempt to determine what the user's symbolic evaluation might be. This assessment is intimately

bound to questions of perception and related to the consumer's mental images and tastes, manifested through the words used to define and qualify the products. Therefore, in the process that tries to capture this symbolic evaluation on generating new products, it is of vital importance to know what the words are that define this perception. The set of all these words represents the product's Semantic Universe. Its configuration and structuring constitute the first step in attempting to develop a methodology capable of involving the user right from the first design phases, analysing user perception, and designing as a function of user subjective appreciations.

In this sense, to achieve total consumer satisfaction the development process must take more and more features into account, not only functional performance, but should also include emotional performance. This refers to the feelings and mental images that the consumers generate in their interaction with products. The products should not only possess features of quality, comfort, innovation, etc., but should also be perceived as such by the consumers in order to be accepted in the market. Investment in innovation does often not generate higher sales because the consumer does not understand it or perceives it in an incorrect way.

Product semantics is a tool developed by Osgood and co-workers as a measurement technique that allows analysing the affective meaning of objects (Osgood, 1957). It is a standard procedure that assumes a structure in the possible qualifications of products and it analyses these using factorial analysis (Osgood, 1957). If it can be demonstrated that a limited number of dimensions or factors is sufficient to differentiate amongst the meanings of a complete set of concepts, then these dimensions define a semantic base that enables expressing any concept. Although thirty years have passed since this was proposed as a technique, product or differential semantics is still the most powerful quantitative technique for analysing meanings, especially affective product meanings. This technique has been used both for assessing product design and analysing semantic structures (Jindo, 1997). Thus, applications are found in different fields such as design of facades, doors (Matsubara, 1997), telephones (Song, 1994), car interiors (Nagamachi, 1994), office chairs (Jindo et al, 1995), and mammary prosthesis (Maekawa, 1995).

It is thus a methodology of special interest and potential benefit for the SMEs of the traditional industry dedicated to product development. However, the implementation in these companies is hindered by a series of barriers due to their technical structure, human resources, R+D+I resources, training, etc. Nevertheless, product semantics presents a generic part that can be developed in a common way for a group of companies and in another specific way for each of these. Thus, a combined action can be undertaken among companies of the same sector and also with those of other sectors for the development of procedures, knowledge and computer tools for common use in design and design management, based on emotional performance, besides a system parameterisation process according to the needs of the ceramic sector and of each participating company in the project.

In this communication we describe product semantics, arguing its potential importance for the ceramic sector. Furthermore, we preview the process to be followed for its implementation in this sector through a computer application, even though certain phases are currently in development or soon will be.

REASONS FOR THE POTENTIAL IMPORTANCE OF PRODUCT SEMANTICS FOR THE CERAMIC SECTOR

The product semantics technique would allow improving the product design management process, by providing the company with more insight into the market, and specifically consumers. This knowledge highlights the improvement of the conceptual analytical phase of the design process, which is generally disregarded by companies.

Product semantics would enable companies from the ceramic sector to:

- Increase their innovation capacity.
- Control diversification by identifying homogeneous product lines.
- Develop new forms of working and organisation. New multidisciplinary, flexible work teams
- Leave behind the trial and error method.
- Reduce costs and times of design, production and new product launchings.
- Free designers from less creative tasks.
- Know how consumers will perceive a product before putting it on the market, which provides valuable information for the communication tasks.
- Create faithful clients by offering what is expected in their language.
- Know the weak points and the strong points of a product.
- Know and control the image of the trademark better.

THE METHODOLOGY OF IMPLEMENTATION IN THE CERAMIC SECTOR

The work will be conducted according to the following modules and tasks, each of which will contain a part common to all the sectors and a part specific to a sector and to a company.

1.- Identification of the Semantic Space.

2.- Adaptation of the Computer System.

3.- Implementation and demonstration in the participating companies.

4.- Presentation and dissemination of results

Module 1.- Identification of the Semantic Space.

The semantic Space is the set of independent concepts (axes) that defines the emotional structure of a certain product. The procedure to be followed to find the Semantic Space consists of compiling the adjectives and expressions that are used to define the product being studied (Semantic Universe). These are reduced to a number between 70 and 100, which are used to interview a group of users who are shown a wide and diverse sample of products. Appropriate statistical processing of the data allows identifying the semantic axes (Figure 1).

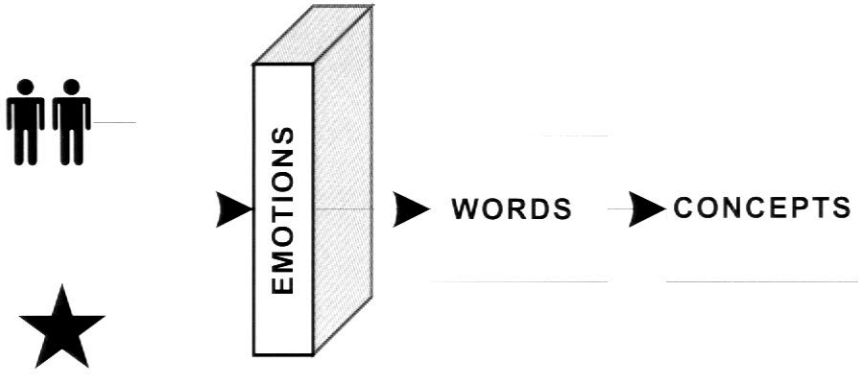

Figure 1. Schematic illustration of the product Semantics process.

For instance, in an example of everyday footwear, the reduced universe was formed by 74 adjectives that were finally reduced to only 20 independent concepts (Figure 2):

Adjectives: Semantic universe			
STYLISED	SPORT	GRANDMA/PA	SAFE
DAILY	FOR WALKING	CONVENTIONAL	GOOD FINISH
TRANSPIRING	NON SLIP	ELEGANT	FRESH
DISCREET	SHOWY	RIGID	HANDCRAFTED
FLEXIBLE	SOFT	ROBUST	SELLABLE
COMFORTABLE	BEARABLE	CLASSIC	SYNTHETIC
DARING	MODERN	EXPENSIVE	SHELTERED
DELICATE	SIMPLE	USEFUL	ECOLOGICAL
RELAXING	PRACTICAL	DURABLE	STABLE
MASCULINE	FEMININE	ANATOMICAL	STRONG LINE
HEAVY	PADDED	DYNAMIC	MOULDABLE
FUNCTIONAL	ORTHOPAEDIC	SPORTING	LIGHT
TECHNICAL	URBAN	GOOD	ERGONOMIC
INNOVATIVE	DRESS	JUVENILE	WIDE
EXTRAVAGANT	TRADITIONAL	EVOLVED	TIMELESS
VULGAR	RATIONAL	POPULAR	NATURAL
HARD	FORMAL	SOPHISTICATED	OLD FASHIONED
CHARACTERFUL	INFORMAL	STYLISH	
SOBER	COARSE	SOFT	

Concepts: Semantic space
Daily use
Dress
Modernity-innovation
Pure comfort
Thermal comfort
Quality
Safety
Sport
Gender
Technical-ergonomic
Conventional
Ecological
Handcrafted
Synthetic
Orthopaedic
Daring
Vulgar
Sobriety
Urban
Timeless-sellable

Figure 2. Semantic space of everyday footwear.

It is necessary to bear in mind that the semantic space, although it presents axes common to families of products, is characteristic of each product and depends on the product presentation scenario as well as on the targeted public. Thus, it is necessary to have a good definition of the product, scenario and users to be studied.

The work of this module is generic for the group of participating companies in the project and for the sectors. There will be a study for each sector as follows:

Sector	Product	User	Scenario
Home-textile	Base cloth	End	Shop
Ceramics	Heavy traffic floor	Technician	Trade fair
Footwear	Ladies footwear	End	Shop window
Furniture	Dining room tables	End l	Catalogue

Table 1: Participating sectors.

This approach offers great advantages for the development of the methodology. The products to be studied exhibit differences in the importance of their functional, aesthetic, quality characteristics, etc. Thus, footwear combines fashion and functionality, while in furniture ergonomics predominates and in textile and ceramics quality and design are highly featured. Furthermore, an important variety of scenarios and users will participate in the different studies. All this is expected to make the results of the project, as well as the tools, sufficiently rich to enable readily extrapolating them to other products, scenarios and users.

A work team will be formed with personnel from IBV, scholarship holders, subcontracted intermediate organisations and companies to carry out the field studies and work with users. The tasks to be conducted in this module are:

T1.1.- Fine-tuning protocols and procedures. Training

The objective of this task is to design the field studies, as well as to establish common work procedures and methodologies for the different sectors. In this task scholarship holders as well as subcontracted intermediate organisations will be trained in the necessary tools and procedures for the attainment of project objectives.

The procedures to be harmonised and fine-tuned are:

- Compiling the initial Semantic Universe
- Criteria for obtaining the Reduced Semantic Universe
- Selection of the product sample
- Selection of users
- Protocol of semantic evaluation
- Statistical processing

T1.2.- Identification of the initial Semantic Universe

The objective of this phase is to gather as many adjectives and expressions as possible of those used to designate the emotions, feelings, etc. generated by each of the products to be studied.

The sources to be consulted are:

- Specialised journals, both technical and commercial
- Web sites of sector companies
- Interviews with at least 25 users
- Shops
- Sales, marketing and design departments of the participating companies

Around 500 terms will be collected for each product.

This work will be done for each of the four products to be studied. The work will be conducted by the IBV team in co-operation with the subcontracted intermediate organisations and companies, which will be in charge of providing sources (journals, Web sites, etc.) and words.

T1.3.- Identification of the Reduced Semantic Universe

The words gathered in the previous phase will be reduced to between 50 and 100 for the following phases. This reduction will be made by work sessions eliminating antonyms, synonyms, jargon, expressions specific to a given type of product, etc., paying special attention to terms of interest for the companies.

This will yield the Reduced Semantic Universe for each product.

The work will be carried out by the IBV team and the results shared with the rest of the participants.

T1.4.- Selection of a sample of products.

In each sector, a selection of products will be made according to the product segment being studied. This sample should stimulate the users a variety of ways, i.e., besides products of the collaborating companies, models are to be included of upscale and downscale ranges, traditional and highly innovative products, etc. The size of the sample shall not exceed 40 products, and can include 4 from each participating company.

The selection of the sample, finding of products and images will be done with the help of the companies and subcontracted intermediate organisations.

T1.5.- Semantic Evaluation

The purpose of this phase is to collect the opinion of the users regarding each product in the selected sample. Thus, for each sector, 40 users will be selected meeting the profile defined by the participating companies, and these users will answer a questionnaire concerning the words of the Reduced Universe regarding each product.

Thus, the first step will be to establish a user profile. This will be done with the outside collaboration of a company specialising in consumer management to carry out the different surveys.

The questionnaires will be random and be made with a specially designed computer tool for this purpose.

To facilitate product evaluation, which will be assessed by images, a Web application will be used developed in the frame of IMPIVA, so users can evaluate products telematically. This application will be adapted for each study.

T1.6.- Identification of the semantic axes

In this phase the statistical data will be processed of the semantic evaluation to identify the semantic axes of each product to be studied. The result of this phase will be a semantic space for each of the participating sectors in the project. This is highly useful information in itself, since it defines the concepts or fundamental performance of the perceptive space of each product.

In the first place, it is necessary to introduce all the surveys in a database for their subsequent statistical processing. This means (40 products x 40 users x 4 sectors) no fewer than 6400 surveys, which justifies the acquisition in the frame of the project of a survey reader to speed up the procedure, which will also be of great use for future work in this field. Statistical processing will be done at IBV and consists of Factorial Analysis of Principal Components. Data fusion will subsequently take place with the Intervening Centres.

After finding the semantic axes, it is possible to address the specific application for each company in terms of its needs.

Module 2.- Fine-tuning the Computer System

The application of Product Semantics requires appropriate management of products, users and resulting data of the semantic evaluation. Moreover, data analysis is based on statistical techniques and its presentation should be easy and quickly interpretable by designers, innovation managers, marketing experts, etc.

In this sense, for this new methodology to be applicable and readily implementable in the SMEs, it is necessary to have computer tools that facilitate its application and interpretation of the results. In the project, IBV has developed a computer system for this purpose.

This consists of a series of modules and databases to be installed in a computer, designed to cover the Product Semantics application needs. Furthermore, teletraining tools will be prepared for subsequent implementation in the companies. The modules to be developed are one for Management and another for Exploitation of results.

The created databases will serve the later exploitation of results. These will be the DBs of users, products, perceptions, words and product types. This module will also include a computer tool to generate questionnaires in a random way (Figure 3).

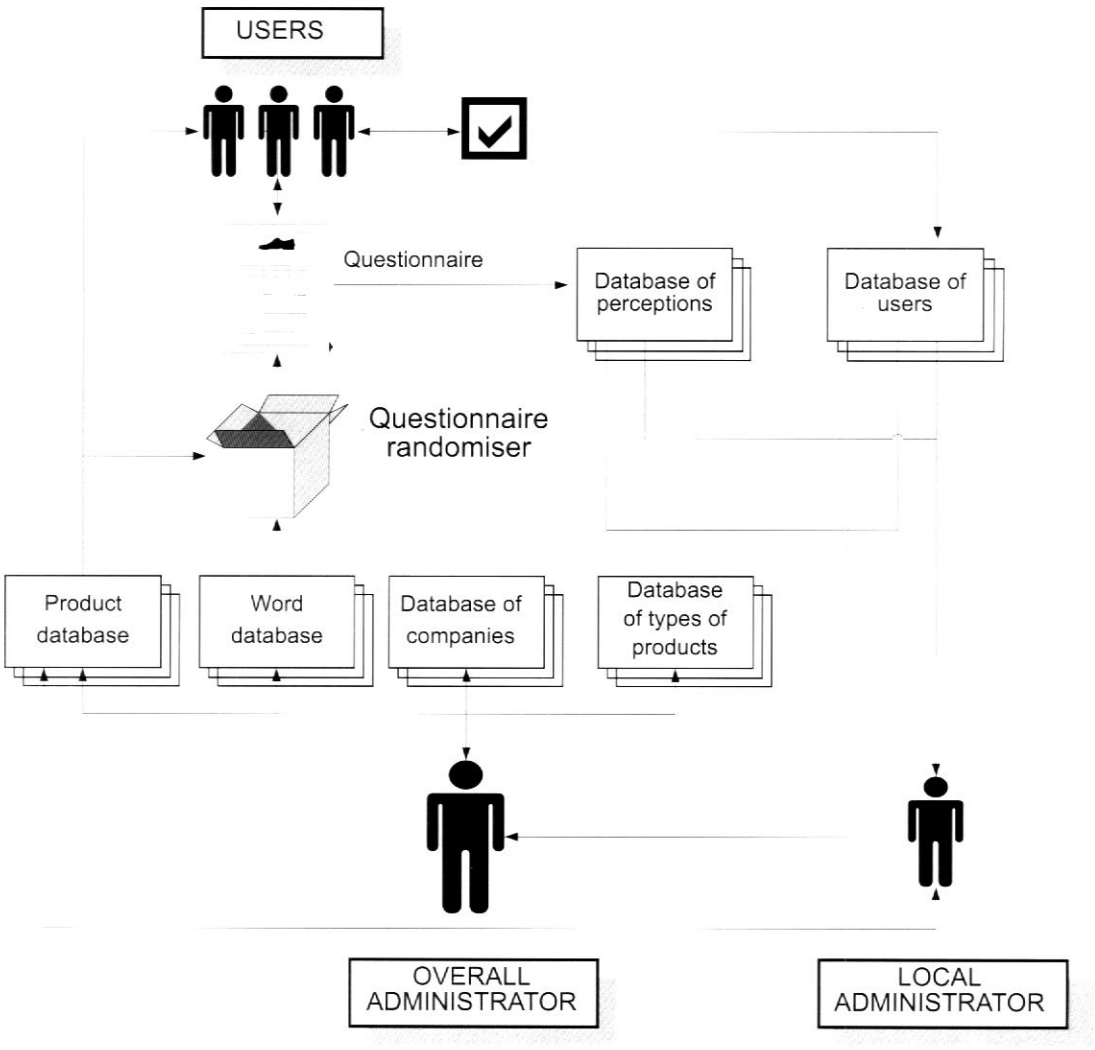

Figure 3. Internal structure of the management module.

Module 3.- Implementation and demonstration at the participating companies.

In this module the necessary work will be conducted to implement the tool at the participating companies and to train these in handling it. At the end of this phase, the company will have the computer system developed in the frame of the project installed, besides having personnel trained in the methodology and the tools, access to teletraining and the results of the concrete practical application according to the needs of the company.

The tasks to be developed are:

T3.1.- Presentation to the companies, definition of requirements and implementation procedures at the company.

A presentation will be made in each sector of the results of the first phase and of the tools developed for each sector, in each case defining the way of working for the implementation. The tools, procedures and work methods to implement the tool will be defined and fine-tuned.

Similarly, the needs of the companies will be identified in order to define the practical applications to be developed in each of these in the later tasks. These will be unified as far as possible for the four sectors.

T3.2.- Preparation of the technical and tutored exploitation work plan

Based on the work done in the previous task, a timetable and work plan will be drawn up with the companies for the implementation of the tools at the companies and for the practical application.

T3.3.- Implementation of the system

The computer system developed will be implemented at each of the companies, which will include teletraining for its handling. The tool will be installed in a PC of the company, which will have a key for its use. In the companies connected to Internet, the WEB application will be installed for the semantic evaluation. The implementation will carried out by IBV.

T3.4.- Tutored exploitation for each company

The results of the semantic evaluation will be exploited and the tools applied according to the needs identified in each company. The prospective results of this task are, on one hand, practical experiences based on the reality of the industry and on the other, products and collections resulting from considering the emotional performances. The exploitations will be co-ordinated from IBV and executed in collaboration with the subcontracted intermediate organisations.

T3.5.- Sectoral data fusion

An evaluation of the computer tools, practical experiences and results will be made. Information on the practical applications at each company will be disseminated, when this is considered convenient. This will be done by workshops and presentations of experiences by the subcontracted intermediate organisations.

T3.6.- Overall data fusion

An evaluation of the computer tools, practical experiences and results will be made. Information on the practical applications in each sector will be disseminated. This data fusion will yield a catalogue of examples and applications of the methodology, of great use for demonstrating the possibilities of the tools and methodology.

T3.7.- Evaluation of the tool

As a result of the previous tasks, the features needing improvement of the computer tools will be identified, and set out in an improvement plan.

Module 4. Presentation and dissemination of results

In the project, dissemination of the new methodology is considered very important and for this a series of demonstration actions of its possibilities will be planned, especially on the dissemination of the results of the project.

The dissemination will be based on the Milestones of the project, communication routes, agents and targeted public, using different tools for this purpose.

The tasks to be developed in this module are:

T4.1. - Development of tools and identification of dissemination routes

The subcontracted intermediate organisations will participate actively in the dissemination by means of different activities However to unify the efforts, it is planned to develop tools for disseminating and demonstrating the methodology and results of the project.

Dissemination will be done from the beginning of the project, identifying milestones for this purpose, such as project commencement, finding semantic spaces, development of computer tools, development of teletraining tools, completion of the project and results of the project.

As for the dissemination routes, each participant in the project will contribute the routes to which it has access, besides the general ones. With the collected information, an action timetable will be programmed. The routes will include general and trade-specific magazines and journals, Webs, trade fairs, conferences, etc.

CONCLUSION

This project focuses on four of the most important traditional industrial sectors in the Valencia Region, namely Footwear, Furniture, Ceramics and Home-textile. The project is divided into two different parts: A generic one aimed at developing and adapting the procedures and tools required for applying product Semantics to any sector and/or company, and a specific part for adapting these to each sector and/or company so that the participating companies have the tools and necessary training for their application in the development of their products. For this, the following partial objectives have been set:

- Identifying the semantic Space of products of 4 traditional sectors in the Valencia Region.
- Developing computer tools for the application of product semantics in parameterisable way.
- Adapting the tools to the needs of each sector and company.
- Demonstrating and implementing these tools and procedures at the companies.
- Disseminating and making the results known to other companies of the sectors involved, as well as to other sectors that could benefit from this methodology.

The expected Results of this project are:

- The Semantic space of products of 4 of the most important industrial sectors in the Valencia Region
- A novel computer System for product development management focused on product emotional design, which will be of general use and readily adaptable to the needs of any company

- Methodology and procedures for the application of product Semantics
- Demonstration, dissemination and teletraining tools
- A network of centres and companies that use product Semantics as a differentiating and innovative element
- A network of centres and companies that serve as a base structure for future collaborative R+D+I actions
- A new generation of highly innovative ceramic, textile, furniture and footwear products, on including emotional performance in their performance features
- A solider image of the companies in the Valencia Region by controlling the image perceived through their products.

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