Designers cognitive processes formalization and explicitation become a major topic for many scientific communities like design science, cognitive psychology, computer science and artificial intelligence. This growing interest is partly due to a certain pressure coming from the industrial context where the shortening of the development durations and the increasing variability of the offer expected by the consumer lead to a formalization and a digitization of the earliest phases of the design process. In this context, these three research areas tend to develop new models and tools that will help to progressively enable to digitize the early design process: (1) formalization of the cognitive design processes with the extraction of design knowledge, rules and skills (2) translation of design rules into design algorithms and (3) development of software tools to be used by the designers themselves and by other professionals involved in the early collaborative design process. This paper deals with the elaboration of an interactive software which enables to improve the design information process implemented by the designers. TRENDS system is positioned in the core of these evolutions and will be presented in this paper following three parts which are related to the aforementioned research areas.

1. Research Aims

Inspirational materials play an important role in the design process. The very specific activity of searching for inspirational material corresponds to a hybrid semantic search of text and images which was formalized through the Conjoint Trends Analysis method (Bouchard, 1999). This innovative
method needs however some improvements, especially for the phase of information searching. The main research advances presented in this paper are the digitization of this method in order to improve the precision and efficiency with which designers can access inspirational materials and particularly images. These advances are being met through the integration of three innovative technologies: meta-search-engine, semantic multimedia search-engine, and automatic image analysis that will be embedded into the graphical user interface.

This research was structured according to three main phases:

1) **Formalization of the cognitive design processes** with the extraction of design knowledge, rules and skills: a specific study was developed in 1997 which was a base for the Conjoint Trends Analysis method definition.

The Conjoint Trends Analysis method (CTA) has been moulded to the cognitive information gathering process that takes place during industrial design, taking into account the task-based requirements and the cognitive and affective processing of designers. What is most original in this approach is the identification and use of various domains of influence (nature, arts, industrial sectors, sociological end values) in order to enrich the design solution space. Finally it enables the identification of formal trends attributes (shape, colour, textures) linked to particular environments in order to use them in the early design of new products. It makes it possible to enrich and to inspire the designers and the design team when designing product. It is positioned in the earliest phases of the design process.

2) More recently, design knowledge and informational processes have been partly modeled, especially the **categorization phase of information** in the design watch process of the designers.

A core activity of a designer when selecting inspirational materials is the use of semantic adjectives in order to link words with images and vice-versa. This activity is very specific and appears as a hybrid search based on both text and images. Designers recognize that their activity deals with emotional content, although the process is not necessarily explicit. Their expertise consists in providing emotional effects through design solutions characterized by their semantic expression. Even when they are searching for inspiration sources, pictures they select explicitly or mentally often have a high emotional impact. The implementation of specific algorithms based on ontologies for the textual data, and also on clustering for linking the textual contents with images, constitute one of the major scientific advances in TRENDS project.
(3) **Development of a software**, TRENDS, which is a multimedia search engine dedicated to the designers, helping them in their informational process to gather information coming from the web and being filtered according to specific rules. This software corresponds to the digitization of the CTA method.

The TRENDS content-based information retrieval system aims at improving designers’ access to web-based resources by helping them to find appropriate materials, structure these materials in a way that supports their design activities and identify design trends. TRENDS system integrates flexible content-based image retrieval facilities based on ontological referencing and clustering components related to Conjoint Trends Analysis (CTA). The main functionalities of TRENDS system are the trends identification and the pallets generation.

### 3. Formalization of the cognitive design processes

The design process consists in reducing abstraction through the use of various successive levels of representation which integrate more and more constraints. It can be seen as an information processing activity that includes informative, generative, evaluative and deductive stages (Bouchard, 2003). The informative phase is crucial because design problems are by nature ill-defined and ill-structured (Simon, 1981) (Restrepo, 2004), and so refer to semantically impoverished tasks. In addition, the novelty of the design candidates during the generative phase depends mainly on this phase and of the manner to integrate the information.

#### 3.1. DESIGN INFORMATION PHASE

Designers integrate many categories of information that will be gradually visually categorized and synthesized into design solutions. They get their inspiration in their personal life and through a more focused way in their professional life, in various sources like specialised magazines, material from exhibitions and the web, and in different sectors. They use a large variety of types of sources coming from different areas as comparable designs, other types of design, images of art, beings, objects and phenomena from nature and everyday life. Sources of inspiration are an essential base in design thinking, as definition of context, triggers for idea generation (Eckert, 2000), and anchors for structuring designers’ mental representations of designs. They help designers structuring mental representations of designs and also arguing the generation of design solutions. The designers also operate a more or less systematic watch which completes their natural inspirational process. The latter goes largely...
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over their professional activity. All related information will be memorized and potentially further evoked in design contexts (Gero, 2002).

There is little understanding of the requirements for information retrieval in the context of a creative process such as industrial design. For creative tasks it is possible that, instead of highly focused searches being optimal, some diversity in retrieved material is useful (Bonnardel, 2005). This idea is supported by the results of (Ansburg, 2003) who found that creative thinkers tend to use more peripherical cues (data not directly linked to the problem) (Hocevar, 1980). Of relevance is the theory of Conceptual Blending (Fauconnier, 1998) which proposes that the process of thought involves ‘moving’ between mental spaces that organise our knowledge of the world. Creativity can be conceived as the combination (or conceptual blending) of two, or more, conceptual spaces. This process requires both divergent and convergent thinking (Perreira, 2002). The generative phase of design is highly based on analogical reasoning (Bonnardel, 2005, Blanchette; 2000, Kryssanov, 2001, Visser, 1996). The originality comes from the creative distance between the sector of influence from which analogies were extracted and the reference sector.

3.2. SECTORS OF INFLUENCE

Sectors of influence are any sectors of analogy related to the reference sector (arts, nature, industrial design, etc) in which the designers are used to pick relevant information, and which integrate high-middle or low-level information (semantic adjectives, consumer values, shape, colour or texture), being potentially transferred as new references in the reference sector. Sectors of influence play a major role of filtering the information which is useful for the designers.

We launched a first experiment in 1997 with car designers (Bouchard, 1997). This experiment aimed to make explicit the designer’s watch process and their sectors of influence by studying the specialized literature/exhibitions and motor shows they are used to consider. It was also studied which elements they select in these types of sources (table 1). A more recent study achieved in 2006 enabled to verify that these sectors are long term indicators (Mougenot, 2006). Both studies were based on interviews and observations during sketching activities.
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<table>
<thead>
<tr>
<th>Year</th>
<th>1997</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designers</td>
<td>40 (10 professional, 30 students)</td>
<td>30 professional</td>
</tr>
<tr>
<td>Nationality</td>
<td>French, English, German</td>
<td>Italian, German, British, French</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sectors</th>
<th>1 Car design &amp; automotive</th>
<th>1 Car design &amp; automotive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Aircrafts, aeronautics</td>
<td>2 Architecture</td>
</tr>
<tr>
<td></td>
<td>3 Architecture</td>
<td>3 Interior design &amp; furniture</td>
</tr>
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<td></td>
<td>4 Interior design &amp; furniture</td>
<td>4 Fashion</td>
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<td></td>
<td>5 Hi-Fi</td>
<td>5 Boat</td>
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<td></td>
<td>6 Product design</td>
<td>6 Aircraft</td>
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<td></td>
<td>7 Fashion</td>
<td>7 Sport goods</td>
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<tr>
<td></td>
<td>8 Animals</td>
<td>8 Product design</td>
</tr>
<tr>
<td></td>
<td>9 Plants</td>
<td>9 Cinema &amp; commercials</td>
</tr>
<tr>
<td></td>
<td>10 Science Fiction</td>
<td>10 Nature &amp; urban ambiances</td>
</tr>
<tr>
<td></td>
<td>11 Virtual reality</td>
<td>11 Transportation (moto, trucks)</td>
</tr>
<tr>
<td></td>
<td>12 Fine arts</td>
<td>12 Music</td>
</tr>
<tr>
<td></td>
<td>13 Cinema</td>
<td>13 Fine arts</td>
</tr>
<tr>
<td></td>
<td>14 Music</td>
<td>14 Luxury brands</td>
</tr>
<tr>
<td></td>
<td>15 Travels</td>
<td>15 Animals</td>
</tr>
<tr>
<td></td>
<td>16 Food</td>
<td>16 Packaging &amp; advertising</td>
</tr>
</tbody>
</table>

**Tab 1:** Sectors of influence classified by frequency of quotation by designers

### 3.3. TREND BOARDS

To finalize the information phase, designers build trend boards in favourable contexts in order to structure their inspiration sources. Trend boards offer a visual and sensorial channel of inspiration and communication for design research and development, which could be considered to be more logical and empathic within a design context than only verb-centric approaches (McDonagh, 2005). They are usually a collection of images compiled with the intention of communicating or provoking a trend or ambience during the product design process. The matter used for the elaboration of trend boards is extracted from the sectors of influence.

### 4. Conjoint Trends Analysis method

CTA method was built after studying the cognitive designer’s activity (Figure 1). This method enables the identification of design trends through the investigation of specific sectors of influence and the formalization of trend boards and pallets. These pallets put together specific attributes linked to particular datasets (e.g., common properties of images in a database) so that they can be used to inspire the early design of new
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products. Trend boards offer a good representation of the references used by the designers before idea generation. They also constitute a powerful representation tool valuable to designers to identify, investigate and represent the link between semantic universes and styling elements, so as to understand their structure (Eckert, 2000) (McDonagh, 2005). CTA results in the production of trend boards that can represent sociological, chromatic, textural, formal, ergonomic and technological trends.

Fig1: ‘Conjoint Trends Analysis’ method.

The Trend boards convey identified homogeneity in terms of style and consumers’ sociological values. Indeed kansei words including values words, high-level and low-level descriptors are used coherently with the pictorial information. They result from the frequent occurrence of certain properties within a dataset. From this analysis, images and relevant associated keywords are selected and formalized in the form of ambiances. Global and discrete design elements are then extracted from these ambiances under the form of pallets. These design elements are used for the generation of new design solutions.

Each new selected image is classified, categorized into various groups according to particular harmonies (colour harmony, but also texture and shape). In figure 1 we can recognize a common colour harmony in the different images, mainly characterized by the presence of very saturated purples, pinks, oranges. Shapes similarities can also be recognized (rounded forms, like distorted plastics…). Specific keywords come into our mind when watching these images: pop, inspired by seventies, plastics … There are sometimes subcategories, in this case there is more chic and luxurious version of pop characterized with more shiny textures. A specific name and keywords are then given to each category by annotating sticky notes. Sometimes they come directly from a magazine. The passage
from words to images and vice-versa is iterative and very dynamic. The proposed names combine usually semantic adjectives, one or several object attributes, and sociological values. Only the strongest categories and elements (images and keywords) are kept. Strong means: a strong emotional impact, a high aesthetic level, a high coherence level of the elements together, a minimal number of represented sectors in the category and finally an obvious character.

5. Translation of design rules into design algorithms

The exploitation of the information process described in the CTA, and the results of both studies of the cognitive activity of the car designers led in 1997 and in 2006 enabled to extract essential data for the development of TRENDS system. The following elements were specified:

- Designers sectors of influence (table 1),
- Domain specific knowledge (semantic adjectives, Kansei information)

The way the designers search for information was investigated formalised and transferred into procedures. The latter gave birth to specific trends functionalities like the TRENDS search capabilities going from open, i.e. serendipitous, to focused search. The design cognitive structures and the domain specific knowledge were integrated into Pertimmizers. The categorization processes are investigated with specific clustering algorithms using similarities and also harmony rules.

5.1. DOMAIN SPECIFIC KNOWLEDGE FROM CTA CASE STUDIES

In order to link the images contained in the database with the relevant keywords by taking into account the expertise of the designers, it was first necessary to define the links between high-level and low-level vocabulary in a manner which reflects the cognitive structure used by the designers themselves. This part consisted in the extraction of the design knowledge from previous design processes based on the CTA method and also from specific tests of images annotation by the designers (figure 2).
The results of three previous CTA case studies in car and shoes design were used to build the design ontology. Design information search is based on a conjoint search of images and words. From the earliest stages designers use keywords which encompass mainly semantic adjectives. They cover a space going from high-level information (sociological values, abstract semantics), to middle level (style) and low-level features (colour, shape, texture), through also object and metaphor names. The sociological values are sufficiently abstract information for highly stimulating creativity in the generation of new design solutions. They are of great interest for the designers in anchoring the consumer needs. Some specific supports like advertising pages are extremely rich because they are able to show all these levels on the same support at the same time (values and related attributes). In the perspective of digitizing the method, it seems interesting to use the advantages of the World Wide Web in order to gather relevant information about the evolution of sociological values on specialized websites. The identification of strong sociological values can further help in linking the three previous levels (low-level features, semantic adjectives and values words) according to the values-functions-solutions chain (Bouchard, 2007).

5.2. STRUCTURING KNOWLEDGE: ESTABLISHING RULES THROUGH THE VALUES-FUNCTION-SOLUTIONS CHAIN

In the framework of the Conjoint Trends Analysis method, it is proposed to structure the heterogeneous corpus of keywords used by the designers according to the cognitive chain, values-functions-solutions chain (Figure 2).
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3) established in the field of advertising (Valette-Florence, 1994). Indeed this cognitive chain is a quite realistic tool to formalize the link the designers intuitively do when they mentally link product attributes semantic adjectives and end values.

Fig3: Principle of Values-Functions-Solutions chain.

The method of cognitive chaining of means-ends scrutinizes the value-attribute relationship of the product through a train of hierarchical cognitive sequences graded into ascending abstraction levels. It lies on the hypothesis that high-level of abstraction attributes (semantic terms as “fresh”, “light”…) and low-level attributes (colour, price, …) are interdependent and bring about functional and psycho-sociological consequences for the consumers helping the latter to attain their end values. The semantic space can be determined by considering the frequency of appearance of individual items in the various types of chains, then by carrying out a multiple factor analysis dealing with the compatibility between individual items and types of chaining. A chaining is all the more coherent that the total number of links of which it is made up is limited. This method is fundamental for the translation of abstract values into tangible product attributes or vice-versa.

Trend panels including user’s values, products and their attributes constitute a good representation of the values-functions-solutions chain. In order to do that the work team has to precise the retained semiotic products as well as the behavioural values to which they refer.

The value-function-attributes chain is an explicit formalization allowing to link marketing and design universes. This support integrates specifically the early marketing initial brief, with the brand values, and more generally the dominating sociological values.
Table 2 shows a representation where the value-function-solution chain appears at the top of the table, and the values are listed in the first column. The terminal values come from the Rokeach’s list (Rokeach, 1973) which provides a finite number of values like comfort, pleasure, etc. Each of these values is defined into words following the values-functions-solutions chain. It uses semantic adjectives which are used by the designers when working with images and sketching new concepts of design. The highest level is that of values, the lowest level is that of products attributes.

### 5.3. BUILDING TRENDS ONTOLOGY IN PROTEGE

The introduction of ontological referencing in design science is quite recent. Some research was undertaken in this field, touching as well the earliest phases of design (Chi & al, 2007) (Ogawa & al, 2007) as the detailed design phase (Li & al, 2007). Expert design information is characterized by heterogeneous data insofar as they are more or less formal or informal, structured or unstructured, and abstract or concrete.

The interest of a formalization of knowledge in form of ontology is precisely that it constitutes a meta-model of expert knowledge in design as a whole (Yang & al, 2005). It is useful in early design for the formalization of Kansei data to establish a classification and a conceptualization of the knowledge of the designers on the basis of semantic links. Particularly ontologies allow the designers to insert and quantify semantic and emotional descriptors for evaluating design candidates directly by

<table>
<thead>
<tr>
<th>Terminal Values of Rokeach</th>
<th>Behavioral Values of Rokeach</th>
<th>Other values</th>
<th>Trends</th>
<th>Semantic adjectives</th>
<th>Related semantic adjectives</th>
<th>Metaphors</th>
<th>Functional attributes</th>
<th>Visi-o-tactile attributes</th>
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<td>A Comfortable Life</td>
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<td>ergonomic</td>
<td>adaptation to the morphology of the driver</td>
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<td>assistance to the vehicle going automatically to the garage</td>
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<td></td>
<td></td>
<td>facility of driving</td>
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</tbody>
</table>

Tab2: Values-Function-Solutions chain
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annotation. The advantage of this type of tool was shown to explain, formalize and share expert and subjective knowledge by taking into account inter-individual variability. Applications touch principally the indexation and research of unstructured information in large databases of pictures, digital libraries and multimedia archives (Reidsma & al, 2007). Most of the time approaches based on manual annotation proved to be more efficient for the time being than automatic approaches.

Protege is an open-source platform that provides a suite of tools to construct domain models and knowledge-based applications with ontologies. Protege implements a rich set of knowledge-modeling structures and actions that support the creation, visualization, and manipulation of ontologies in various representation formats. Protege can be customized to provide domain-friendly support for creating knowledge models and entering data. Furthermore, Protege can be extended by way of a plug-in architecture and a Java-based Application Programming Interface (API) for building knowledge-based tools and applications. Currently there are two ways provided by Protege to model ontologies: by using Protege-Frames editor, or by using Protege-OWL editor. The former is frame-based, in accordance with open knowledge base connection protocol (OKBC); the later is based on the stand recommended by W3C’s Web Ontology Language (OWL). The later is adopted in this paper because it is more suitable for building ontologies which will be later used on the Web and with Web Services.

The CTA ontology is developed by creating instances and linking them in terms of the abstraction, aggregation, and dependency-based semantically-rich relations using Protege. As shown in figure 4, the top class “thing”, as defined in OWL contains 5 subclasses. In the figure, the asterisk sign “*” indicates that there may be zero or many instances for the corresponding attribute value. “Value” class defines the three types of values in CTA, which are “behavioral”, “terminal”, and “other”. These three types are defined as three mutually exclusive instances of class “Type”. An instance of class “Value” is shown as “comfortableLifeValue” in figure 4. The class “Attribute” has two subclasses, “VisualTactileAttribute” and “FunctionalAttribute”, “colouredVis” is an instance of

1 Stanford Medical Informatics, The Protege ontology editor and knowledge acquisition system, http://protege.stanford.edu/


“VisualTactileAttribute” and “durabilityFunc” is an instance of “VisualTactileAttribute”. The class “SemanticAdjective” is defined as a class, whose instances are attributes in class “Value”. “Ergonomic” is an instance of the class “SemanticAdjective”, which has several associated instances of “SemanticAdjective”, such as “soft”, “lightness”, “easy” etc. In particular, there is an attribute “hasWordId”, which will be later linked to a concept ontology “OntoRo” (Setchi, 2007) to enrich the CTA semantic adjectives. The instances of class “Metaphor” will also be used as attribute values of instances of “Value”. Currently the CTA ontology contains 10 classes and 503 instances.

Fig 4: Illustrative diagram to show the relations in the CTA ontology.
6. Integration into a Content Based Information Retrieval system

6.1. TRENDS REQUIREMENTS

The main requirements towards the TRENDS system defined on the base of the designers’ needs are the following:

- TRENDS system shall correlate high-level dimensions like concepts, semantics and affective reactions with low-level image features.
- TRENDS system shall use semantic adjectives for retrieving images.
- The keywords used shall be structured according to a purpose built domain ontology dedicated to design expertise.
- The domain ontology shall be linked to the established sectors of influence following the Conjoint Trends Analysis (CTA) methodology.
- The mental categorization shall be supported by a clustering algorithm using harmony rules.

6.2. DEFINITION OF A WEB-BASED DESIGN EXPERT DATABASE FROM DESIGNER’S SECTORS OF INFLUENCE

The preliminary analysis of the designer’s natural cognitive processes enabled to define a list of designer’s sectors of influence. From these sectors, specific websites were identified by the designers. Then the database was elaborated. This part falls within the competence of the data mining specialists. It consists of gathering the content of the database from the internet using a crawler. This software explores the list of websites that have been previously pre-selected by the designers. Then it makes a local copy of the sites: html pages and images are copied on the computer’s hard drive. The first complete list of sites was harvested. The related overall and detailed procedure for identifying and extracting the design and sociological trends through the web was formalized and delivered. The database includes websites, images and words related to the sectors of influence. In the coming developments of the system, the major issues will be related to the huge quantity of data available in TRENDS, and the automatic exploitation of the database. The current version of this database gathers approximately 500.000 good-quality images that illustrate products in many sectors: automotive, architecture, aeronautics, fashion, sailing, sport, among others.
6.3. TRANSLATION OF NEEDS RANKING INTO GUI SPECIFICATIONS

To develop the functional requirements for the GUI and the technology behind, field observations and analysis were performed at to study end-users needs. Another major output from the needs analysis was the list of ranked expected functions expressed by the professional designers (Figure 6) coming both from the current situation and their expectations for an ideal computational tool, for trends analysis, idea generations and design activities. Designers put emphasis on visualization, quality and freshness of information, mainly under the form of images in various sectors. The most important function they expect is storing. In fact they are limited by their own memory in their usual activity. The storing function could help them to find and retrieve adequate information. In addition, designers would like to store information everywhere and at every time. This function could be fulfilled by mobile devices. But then they want to visualize high quality images with high resolution, which is more appropriate on big screens.
6.4. TRENDS INTERFACE

Creativity sessions enabled TRENDS end-users and project members to integrate their needs and opinions into the definition of the TRENDS-tool interface. Through these work sessions, the graphical interface and the functional sequences behind the latter were progressively defined. This result comes from a specific methodological approach including both a highly user centred approach and creative collaborative thinking.

Thus a list of around hundred functions coming from the needs analysis and from the Conjoint Trends Analysis was transferred into design solutions. This was done during a one-day creative session which involved all the work team. The proposed ideas were refined before the development of the initial version of the non-interactive GUI.
The first of TRENDS GUI was used as support for the expression of the design and ergonomics specifications. After the first testing session by the end-users, the main improvements were the addition of personalisation capabilities, and the visual integration of the technologies of text and image retrieval on the GUI. Also the lightening of menus visualisation, the differentiation of spheres types by colour, and the integration and the illustration of multiple functionalities in the search module. Finally, taking these improvements into account, the TRENDS system will be composed of the following main functions: SEARCH, STATISTICS, PALLETS. The workspace is an additional function enabling the transfer of images into writing mode.
6.5. ARCHITECTURE

The architecture has been designed in order to support the numerous functionalities that have been collected and defined in the user need and functional analysis (Figure 9).

For the system to be able to store and search information, with a good
level of interaction and still remain feasible, it was important to design an architecture based on a scalable and open platform. As components develop, the system will require a high level of resources (memory, data storage, processing); we oriented the system architecture towards the collaboration between multiple specific servers supporting the various specific functions of the system: image and text retrieval, data storage, mappings, communications and exchange, etc. For the system integration to remain simple and cost efficient, we based our system architecture design on standard communication protocols and request formatting languages.

7. Conclusion
TRENDS system is a user interface enabling image retrieval through Kansei words. This paper outlines an approach for building the TRENDS GUI and the related outputs. Main outputs so far were the sectors of influence used by the designers for searching trends, and the semantically structured tables of words reflecting the expertise and knowledge of the designers. The later constitute the main input data for the elaboration of design domain ontology. Through the integration of the main functions of the CTA method, of the designers needs analysis, and of the expectations for an ideal computational tool, functional specifications were defined and translated into GUI design specifications. The next steps will be the whole integration of technology behind this GUI. In this way, specific tools like hierarchical clustering, ontological referencing and multidimensional scaling are being used.

The current prototype is the first interactive software which aims at demonstrating the feasibility of the technical architecture and assessing the first version of the interface and its functionalities: random search, search by image sample, search by relevance feedback, and search by text. It is currently improved with the integration of mixed text/image search. It is made of the GUI and two servers: the text search engine and the image search engine. The basis of the communications protocols and formats for the exchanges between the modules are defined to match the requirements of the functionalities implemented. Semantic developments such as ontology tags, pertimizers, co-occurrences are present in the text search engine but not visible from the user interface. In this prototype, the database index is built by steps integrating text indexation, images validation and ontology tags.
Acknowledgements

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References

9. McDonagh D, Denton H: 2005, Exploring the degree to which individual students share a common perception of specific trend boards: observations relating to teaching, learning and team-based design. Design Studies, 26: 35-53.
C. Bouchard, JF. Omhover, C. Mougenot, A. Aoussat, S. Westerman