POLI.teca: a Design Knowledge Center at Politecnico di Milano.
A Physical Interface to Networked Knowledge

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Abstract. This paper describes the making of POLI.teca, a DesignNet pilot project of Design Knowledge Centre inside Politecnico di Milano. Poli.teca is the meeting place of laboratories and archives which provide documents and resources in support of design education and research. POLI.teca is a mix between documentation and a design centre. From design centres it has borrowed a highly research and business-oriented approach, keeping contacts and promoting collaborations with public and commercial organizations; at the same time it is the place where is collected the scientific production of the Department and the Faculty of Design. Such polyhedric identity has thus led to categorize it as a Design Knowledge Centre.

Keywords. Knowledge management, Design, Metadata description, Distributed environment.

1. Introduction

POLI.teca is a DesignNet pilot project of Design Knowledge Centre inside Politecnico di Milano. It is hosted in a building located in the core of one of the two main settlements of Politecnico in Milano, which comprehends about ten buildings. In that Campus thousands of students have classes to become engineers, architects and designers. A common approach of the studies at Politecnico di Milano is the "learning by doing" didactics, and the Faculty of Design have chosen to take this in greater value trying to make up several great instrumental laboratories. In these facilities students and researchers can find machines and tools usually too expensive and heavy for common people or a SME. The system of labs coming from the effort of the design faculty is called Di.Labb (Design Laboratories) and features several specialized disciplines such as Modeling, Virtual Prototyping, Movie, Exhibition, Light, Color. Besides these labs for training with specific tools and development technologies, there is a rising need to feed students with cultural issues. The DesignNet project develops the concept of a system to investigate and support methods and tools for information and knowledge management in design activities. The system is made of several components each one of it could be seen as a stand-alone with its goals and applications, but they all become meaningful in integration with each other. This framework project tries to involve many knowledge centres, collecting and selecting documentation for design in different places. A Knowledge Centre takes over where knowledge is concentrated, used and creatively recombined to create innovation. After this consideration and after the researches of the DesignNet group, the faculty of design and INDACO department supported the creation of a local Design Knowledge Centre to add value and promote the creative power of researchers, professors and students. As every innovative project do, this project produces itself knowledge on how to make up a knowledge centre, how to manage resources to keep it, how to promote it and share its intellectual heritage with other similar centres. POLI.teca is the place where these researches are taken to reality, tested, experienced.

2. POLI.teca and DesignNet Knowledge Centres

POLI.teca stands for 'theque of Politecnico's culture', referring to the different aspects of technological applications which are part of education and research tradition at Politecnico di Milano.

Design *gives ideas a shape*, from the concept to production, including engineering, cultural, promotional issues. To this purpose, designers need lots of up-to-date information about markets, materials, trends, innovation, patterns, to find the right solution for day-by-day mutating problems they encounter designing a product, a process, or a service. As a result of a research conducted inside the DesignNet project (Ciuccarelli, Innocenti and Vidari, 2003), many information services available at Politecnico di Milano gathered into a unique place located in the core of the Politecnico's Bovisa Campus. Several laboratories and archives are currently involved:

- Laboratory of Marketing Goods and Industry Analysis (MAST);
- Laboratory of Materials and Design (MeD);
- Building systems and components;
- Design Projects Archive;
- International Education Library (IntEL).

Like a web portal, these "content providers" share a unique point of access, a unique counter, where users refer to register, ask information, request documents, etc. Basic information such as addresses, event schedule, openings, news, newsletter, is also provided on a common website at

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http://www.politeca.polimi.it. Each of these laboratories and archives share consultation rooms, helpdesk staff, offices, promotion activities, but they keep on managing their own collections of documents and private resources, their scientific directors and technicians. They still use their own identity, budget, methods, ownship (some are from other departments), and they invest a percentage of resources into the development of common tools, mainly provided by the DesignNet team, and to promote them for financial support or larger diffusion when they are ready to be delivered. It could be well said that POLI.teca is a partnership project of integrated services made available by different promoters coming from academic information and knowledge providers for design scientific and learning activities at Politecnico di Milano .

Location is a major issue for such a service. Until 2002 the three pre-existing information providers were distributed in different buildings without having set up common goals and strategies to afford them. Now they have gathered in one space under a more recognizable name and location. Like a library in a small village, having an entire building where information and knowledge services are offered is very good, because users don't need to be guided to a special -or even hidden- room, but they identify the service with the building itself and this building has a simple name. As said, this is working well, also because the building is located in the core of the campus and the students can see it everyday and remind themselves that they have knowledge and information support for specific courses as well as a free service for no-matter-what project they have to carry out.

At POLI.teca, users access knowledge in form of selected documents. The content managers of the archives involved provide up-to-date documentation that comes in most cases directly from production companies or institutions. There are product catalogues, house magazines, market data, special magazines, material samples, building components and exhibition systems, information on programs in other universities, disassembled real products, and the whole production of the department and the faculty from research and didactic activities: books and articles by professor and researchers, graduation works by students and soon PhD and Master thesis.

Metadata descriptions of these documents will be accessible through a web-based interface. Users will browse from the local catalogue as well as other's Design Knowledge Centre catalogues. Qualitative information on usage will be collected logging the activity of the users to feedback the community on how and who is using what. In this perspective, the Knowledge Centre becomes an interface between local knowledge, local users and the global network, made of distributed centres, where other users and knowledge meet. These centres will be connected with the same web-based catalogue, featuring front- and back office functions.

3.   The DesignNet System

DesignNet tries to consider knowledge from a designer's point of view, paying strong attention to the form as well as the content. The system does not have to try to bring tacit

knowledge to awareness, like some others do. DesignNet, because of its origin, field of application and objectives, does not need to really manage knowledge. The goal is to diffuse it, and promote *creative recombination* to achieve innovative ideas and solutions. At the same time the particular vocation to learning activities sets up the need to provide information the most possible contextualized, in a culture where a web search is often replacing certified knowledge providers. For this reason it has been decided to start from formalized knowledge in documents, including in the definition every object that is capable to have a cultural meaning because of its content, form, diffusion, and context. This definition makes happen that we consider valuable only ideas that have been translated into a form, a shape, a media format. It can even happen that the translation process from concept to document is as important as the content itself. Making examples of such documents, books, reviews, catalogues, material samples, pictures, movies, 3D-models, songs, objects, we can see that we are considering also artifacts having no content, such as furnitures or furniture's catalogue. These objects have a form/function relationship instead of a content/ media one; indeed, they have a *meaning* which can be so important from a cultural point of view. So the challenge is to relate that meaning within a context and link it to other meaningful documents to describe how knowledge is carried out and who designed it.

Figure 1. DesignNet process of knowledge extraction from documents.

4.   The DesignNet Components

The system-based approach is a typical vision of product development at the Metadesign Research Unit whom the DesignNet project belongs to.

The DesignNet framework project features different project areas involved into the study and development of several complementary components. These project areas are: Design Catalogue, Design Directory, Design Thesaurus, Design Gateway, Design Knowledge Centres.

The Catalogue describes documents, overtaking traditional cataloguing methods, with full compatibility with Dublin Core which is the growing standard for multi-media libraries. Selected resources are classified and entered

according to Dublin Core Qualified Schema defined by DesignNet after a phase of iterative testing. In this process of *knowledge extraction* documents are described not only because of their content, but also for the meaning related to their shape, form, format, and context of creation. In this way a document can become relevant because there are trustable people proposing it to the community. The Catalogue is strictly tied with the Directory: a database where information about the "players" of design activities is collected. These actors have been separated in two classes: People and Organizations. An Organization can be a company, an association, an institution, a group of research, and so on. This broad definition of "a group of people cooperating under a recognizable name" accords to ISO VISION 2000 generic description of an entity producing something. People and Organizations don't have simple relations like "Paolo belongs to Politecnico", but more meaningful like "Paolo is a designer at Nike" or "Paolo teaches at Politecnico". In this way relations bring the importance of role-playing between people and different activities in organizations.

Having seen that in the Catalogue it's possible to describe commercial products, the Directory will also feature Brand data as the relation between a product and its producer. This rule has led to give producers and publishers the same role of "the organization who brands a product". What is remarkable is that the Catalogue takes from the Directory all data already available, without time-wasting and risky data entry duplications. At the same time the Directory is a stand-alone information system providing a guide to the "who is who" in the design field.
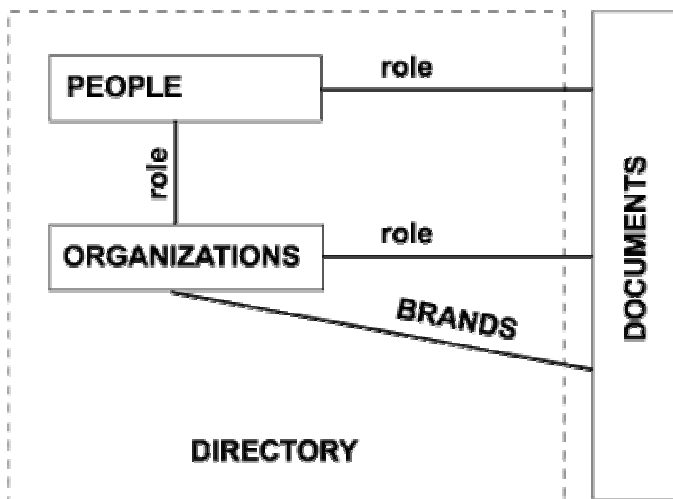

Figure 2. DesignNet Directory relates People and Organizations to documents describing their roles.

The "missing ring" in the system as described above is how to set up links between documents starting from their semantic or morphological description. Without this, the system would be just a simple Document Management System, or an Information System, but we are challenging to build a Knowledge System. We could also do this by encouraging users to *play* with the catalogue and let them define lots of relations, but we also need to describe some analogies coming from a more objective and scientific

description. For example users can add a lot on a relation called "in that document is featured another document", frequent in movies and culturally meaningful as a reference in a book, but a good cataloguing process can give from the beginning, for example, a selection of furnitures made out of titanium and pvc, or distinguish between books written *by* Pininfarina, books *about* Pininfarina and cars *designed by* Pininfarina. This is done through a complex multy-layered network semantic structure: the Design Thesaurus.

Terminology affects human thinking and communication, both in the real world and in the world of ideas which are intertwined with three different aspects:

- objects: things with properties connected to a specific point in time and space, such as organisms, creatures, events, processes, phenomena of the real world and conceived objects;

- concepts: mental abstractions corresponding to objects and having relation with other concepts;

- representations: verbal and non-verbal representations of concepts, such as terms or other kinds of designations for denoting concepts, which are necessary to communicate concepts that correspond to objects. Good definitions of concepts (highlighting essential and distinguishing elements) are the basis for good subject standards and for improving communication.

Terminology in the design domain has not yet a established standardization or comprehensive dictionaries. A terminological tool could be used for mediation and linguistic/semantic consensus among the design community. The efficient standardization of terminology requires:

- a well-founded methodology;
- terminology project management;
- appropriate tools.

Within the DesignNet project framework, we have chosen to create a Design Thesaurus in Italian, according to the ISO 2788 and 5963, and to develop an in-house software to manage it. The Design Thesaurus represents an effective tool in support of design education and research, and a way of bringing together semantics between the documents described in the catalogue.

Figure 3. Personal Digital Assistant

Synonyms: handheld computer, palmtop, pocket computer, Personal Information Manager
Abbreviations/Acronyms: PDA
Broader Term: Wireless computers
Narrower Terms: PalmPilot, Pocket PC
Related Terms: wireless technologies, Personal Area Network, cellular phones

Scope Note: A small, handheld wireless device capable of storing and/or transmitting pages, data messages, voice calls, faxes and e-mails. A typical PDA can function as a cellular phone, fax device, Web browser and personal organizer.

All components have to make their knowledge available with coherent interfaces and modalities. Stand-alone or integrated, metadata descriptions in the Catalogue and data from both the Directory and the Thesaurus are conceived to be retrieved on a web-based interface. Using web multimedia capabilities in a Gateway, we can visualize informations and also the knowledge carried in data structure or by taking into consideration the context of data with metaphoric and more deep representations. Examples of this approach are academic (Treemap, DataLens and others Dynamic queries studies by University of Maryland's HCIL) as well as commercial products (themescapes, xplane's illustrations). For such a broad set of document types, there is no knowledge representation better than others: the challenge is to give users several ways to visualize the same data and let them adjust the one they find more meaningful in order to fulfill the need of knowledge they have, as well as to let them discover new ideas with a so called "serendipity" process or other predefined discovery paths made by other relevant users – i.e. e. professors.

However efforts have yet been made to develop new ways of visualizing typical of design knowledge and of the document collections present at Politecnico di Milano. As a result a "target" search tool has been prototyped
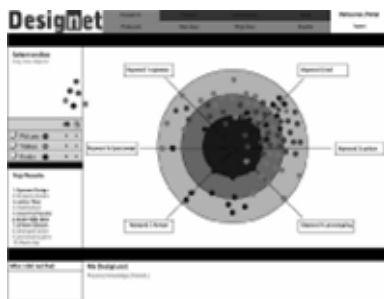

Figure 4. Prototype of *target* search tool.

A web gateway enables the access to documents, information and knowledge from online, no matter where in the world, and it is a concentrated collection of data in one (virtual) place that belongs to a modality (web browsing) more than a territory. The *alter ego* of the web gateway, located and distributed in many but well defined places on the physical territory is the Knowledge Centres Network.

A Knowledge Centre is a physical interface where people come to contribute to culture creation by using, by feeding with documents, by creating new knowledge. A centre have a meaningful liaison within its territorial reference, even when proposing documents coming from far, because it cannot act without its context: place, people, organizations, events, social situation. Having a book or an exhibition in New York is not the same as in Berlin: the two different experiences are far from being the same. Indeed we need to connect

documents, or at least their descriptions, into a network to achieve the first success when learning something new: awareness. The DesignNet network will let people know that other people have something interesting, why and how they are using it and how to access it. Being in a bookshop in the next block or thousands kilometers far from the Centre the user usually references. Library OPAC's do connect in a similar way documents, but they usually have in their approach two problematic issues contrasting with designer's needs:

- they do not classify "everything", and of course not enhancing the meaning of *form*;
- their rooms and spaces are not designed to give users chances to be creative while manipulating documents.
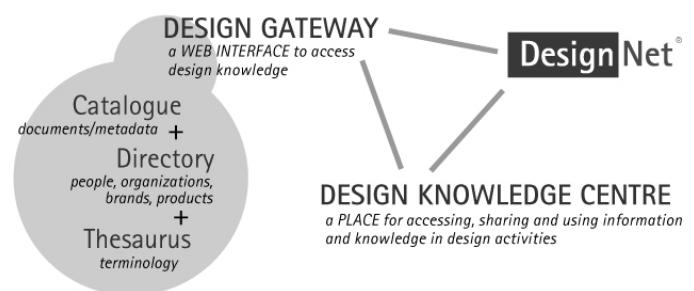

Figure 5. DesignNet framework system.

5. Knowledge Centres: Concept and Design

A concept for Design Knowledge Centres has been conceived and later adjusted to the needs and the practices experienced in the day-by-day activity of POLI.teca. This concept is a basis to make up other Knowledge Centres where a significant critical mass of documents, continuously renovated, is available. Not only universities are places where this could happen, but in general *districts* are concentration of activities with similar or complementary nature. That means, for example, in Milan there are several places where different aspects of design can push the growth of such a centre. We could say that the technological district in Ivrea could meet such requirements, as well as the studios of Cinecittà in Rome could be relevant for movie design, fashion and advertising communication.

Design Knowledge Centre specifications:
- recognizable reference in its territory
- name related to its subjects
- hall for exhibition, self promotion (show windows)
- relax space (such as cafeteria or coffee corner)
- access control
- wardrobe
- unified help desk and customer care (website)
- "trends" room / media access (magazines, sat TV, web)
- access to the DesignNet Gateway
- offices for administration, management, etc.
- temporary storage for incoming/outgoing documents

- workplaces for cataloguers
- storage space for non-public documents
- room for the collection of in-house created documents
- workplaces for free documents manipulation and creative team working, with paper and digital documents (also with user's notebooks)
- document exchange place (similar to "book crossing")
- disassembling: discovering what's inside things

The rooms have to be designed or selected following in most cases interior design rules for libraries. For example if the documents are mainly written papers such as books, reviews and magazines, thesis and similar works, it is reccomended to choose zenital natural lighting and very diffuse illumination. In this case computer monitors would have big reflection problems, resulting in a serious lack of performance while reading on-screen documents. It is better to split computer and books in different rooms, although it is always good to have an open space room with everything available on shelf for free.

Working on venues: in the next future we will publish a calendar of projections for audiovisual presentations including some short documentary on industrial production processes, as well as showing multimedia presentation used by students to discuss their thesis work. This offer will join the disassembling series of venues during which a selection of product are being completely made in their original pieces, to show students the complex interaction between different components and system (electrical, mechanical, hydraulic, ….) and between different coupled materials.

POLI.teca opened in march 2003 in a smaller version than now, but the increasing needs to deliver information in several ways and on different subjects led to acquire more space. In march 2004 the POLI.teca has taken all rooms in the AR building: 2 in ground floor (main consultation, offices); 2 in 1st floor (in-house production archive, International Education Library and other international information) and the underground with the disassembling space and the special activities. In march 2004 there are 1094 students, 1 contracted professor, 2 PhD students, 15 master students registered. 1024 students come from the Faculty of Design (3736 students are currently registered to Design at Politecnico di Milano), 61 students from Architecture and 9 from Engineering. 69/ 94 Erasmus students (EU student exchange program) have visited the International Education Library.
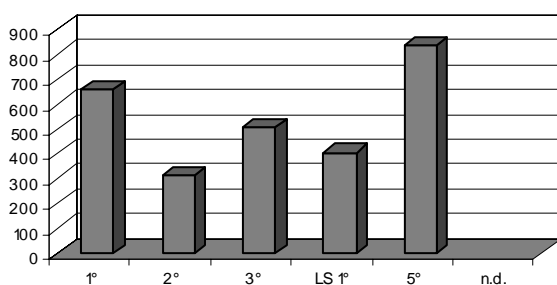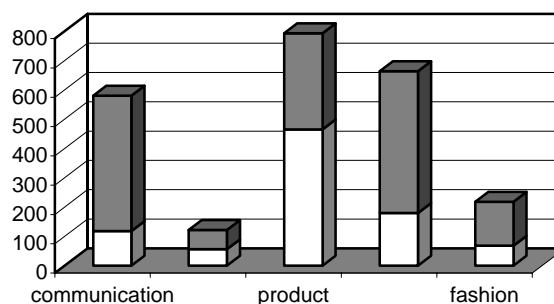

Figure 7. Design students during 3rd year by address of studies.

Table 1. most requested subjects and documents

Subject	Document type
contract	catalogues, magazines
home furnitures	catalogues, magazines
lighting	catalogues, magazines
Children products	products, catalogues
polymers	samples, technical sheet, books, magazines
fabrics	samples, books, magazines
woods	samples, technical sheet, books, magazines
metals	samples, technical sheet, books, magazines
curtain walls	catalogues, magazines

POLI.teca has a newsletter which is sent per eMail by the staff every 14 days to professors, researchers and students. The newsletter promotes brand new documents and in general everything is available. With the website, it is the only way to give up-to-date information on events and the opening of new services.

6. About Partners

In addition to the main partners involved in the make up of POLI.teca, there are on-going partnerships for the selection of documents and their description problems. Photography Lab, Video Lab, Digital Media and Virtual Prototyping Lab, Color Lab, Maquettes Lab, Ergonomics Lab, Children Design Archive and all others laboratories belonging to the Department of Industrial Design, Arts, Communication and fashion at Politecnico in Milan and Como, cooperate to collect the most useful documents for learning and research. Moreover, there are partnerships with other academic groups and off-campus cultural institutions who own *design oriented* collection of documents, such as the Permanent Collection at Milan's Triennale, the Tremelloni fashion collection, and some specialized bookshops.

Communities of interest cooperating in the project validate the descriptions proposed by cataloguers which are then included in the gateway database. To write definitions in the Thesaurus and put terms in relevant structure, some committee of experts, both local and off-campus, are being involved.

Figure 6. Design students at POLI.teca analysis by year of studies.

A customized classification system is provided for each laboratory's need, preserving compliance and interoperability with the shared repository. Our qualifiers in the metadata schema are as universal as possible, but in some cases we decided to add some data to accomplish the needs of our local archives. The same will happen in the future when we will map data from other databases: we will try to associate databases, but we will let visible all data that would not be mapped in our standard schema.

A periodic review of resources is planned to ensure that items are still meeting the selection criteria and are up-to-date.

Technical and theoretical documentation of the system will be available online through custom interfaces diversified for project team members, content engineers, content providers and users. Privacy policy, Intellectual Property and other legal issues are currently under investigation in a commercial perspective to offer a professional service with the possibility to reuse documents for commercial purposes.

7. Conclusions and Future Goals

The POLI.teca is being continuously monitored and tailored on users demands. As the system evolves, efforts will entail:

- increasing integration with the Politecnico's Library System (SBA);
- the development of DesignNet framework and software applications;
- starting new collaborations with other partners to enrich the POLI.teca collections;
- accounting to connect other Knowledge Centres into the network or making consulting for the growth of brand new Centres in selected districts;
- further investigation on visual knowledge interfaces;
- improvement of the workplace layout, computer supported collaborative work (both local and distance);
- promotion of the community of practice around knowledge activities;
- investigation on access with mobile technologies.

In a longer-term perspective, DesignNet aims to provide an integrated interface to knowledge for design education, research and professional activities by stimulating a large community of practice to share knowledge exchanging documents and information on their use.

8. Acknowledgement

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