



Digital document management in the conceptual design process of product

T. Magal-Royo ^(a), J. Gimenez-López. ^(a), F. Brusola Simón ^(a), I. Lengua-Lengu ^(a), G. Peris-Fajarnes ^(a)

^(a) Research Centre in Graphic Technologies, Universidad Politécnica de Valencia, Spain

Article Information

Keywords:

Design
Product design,
Management design,
Collaborative design,
Internet,

Corresponding author:

Teresa Magal-Royo
Tel.: +34 963879518
Fax.: +34 963879519
e-mail: tmagal@degi.upv.es
Address: Edificio 8L. Camino de
Vera s/n. Valencia 46022 España

Abstract

This article confirms the rise of digital versus the analog document in documentary management related to the conceptualization and development of new industrial products. In the methodologies of design management and specifically in the conceptual stages and early development of an industrial product, we find that a fundamental part of the integral control is undoubtedly the documentation generated during the process creating a product. This documentation allows us to have before, during and after an informational descriptive "record" that should be stored consistently and efficiently by the organizations involved in its implementation, either the design professional who prepares it or the company who executes it.

Today we can find numerous administrative, technical or formal documents associated with an industrial product able to define the traceability of it in time to allow for future improvements by the company and serve the designer as a check on author's own work. The existing documentation today's increasingly working more directly in digital media and its transmission over the Internet offers enormous possibilities to multidisciplinary teams located in different parts of the world that promote collaborative design in products. Therefore, there will be a list of the main existing types of digital documents and the technology applied in each case on-line transmission based on the different tasks involved in the conceptual process of industrial design to demonstrate its future importance.

1 Introduction

Today we can find numerous documents of administrative, technical or formal associated with an industrial product able to define the traceability to allow for future improvements by the company and serve the designer as a check on author's own work. In fact, today most of the documents that were previously generated in analog form by typewriter, drafting tables and pencils, etc. have given way to the use of digital documents created by applications of various kinds. This new concept of different types of digital document formats generated by specific applications, are arbitrarily stored in the computer for most of the designers without a real unifying criteria, depending in most cases in good craftsmanship of the person who administers it.

Currently the management of digital documents on a product design in collaborative multidisciplinary collaborative groups needs direct and effective synergies that allow global search of classified, authentic and truthful information.

The aim is to encourage the exchange of documentary resources on the network within this group to help them through the process of industrial product design and also to allow them to promote your authorship on the network. The importance of grouping or sort in some way the documents that have been generated is justified at present with the technological advancement of software capable of managing the computer internally in digital

documents according to the prior establishment of folders, search engines by type, metadata creation related to the

internal properties and descriptive of the digital document, etc. ..

However, the use of these conventional methods has been investigated in depth during the 90's, in an attempt to adapt systems to work the technological processes [1] required for each industrial product (Product Data Management), PDM, to plan globally the processes in terms of applied technologies (Workflow Management Systems) and to create the industrial product through a system of Computer Aided Design CAD integrated production-level technology advances in CAM, CAE. In this article on the one hand it will be established the classification of digital documents that the designer needs to create in the early stages of product development and other kind of task that can develop with the use of Open Source software currently available to do so.

Our aim is to present the tools that can be used for conceptualizing a new design from the strategic approach in managing existing digital information, not only internally but also externally of each end user. This will help designers and engineers in the early stages of product conceptualization and that as far as possible be set for future monitoring of the entire creative process. The traceability of industrial product information may be found and verified in a systematic way through the network, under the formal and technical criteria to facilitate the end-user information.

2 Types of digital documentation geared for use by designers.

The digital documentation is required and is generated throughout the design process, including the life cycle of a product in a company.

The type of information used in product engineering sometimes offered conflicting aspects [2] based on the definition of what we mean by knowledge, information and data. Knowledge is defined as the act or condition of knowing something through experience or learning. Information is defined as the transformation of knowledge to be communicated or transmitted to someone. The content of the information can be encoded as data, worked with software and stored in encrypted form in general or specific databases.

Data and documents can not be analyzed and described fully without considering the working process in which they have been created for example using computer programs or applications.

The information covered in the field of design and its realization in digital documents is large and diverse and sometimes forces use layering techniques to data parallel design processes and tasks [3].

If we take the three basic types of a product such as Business Process Re-engineering (BRP), New Product Development (NPD) and one-of-a-kind manufacturing (OKP [4] in general, there are four fundamental issues that directly impact the document management of a project. They are:

- The definition of objectives and / or skills to create in the phase or task.
- The techniques and associated processes.
- The type of documentation.
- Programs and / or digital technology used in the phase or addressed task.

2.1 The process of product development

COTEC Foundation [5] [6] for Technological Innovation to assess the impact of new technologies in the processes of innovation in the Spanish companies indicates in several annual reports that the product development process is divided into three phases: Ideation, development and launch. (See Figure 1). If we focus on them we can see that there are numerous software applications and general digital environments that can directly help the designer in carrying out their work digitally and share them over the network immediately.

This immediacy should be assessed by the designer from the projective approach to the project which may involve internal or external access to it [7].



Figure 1. Adapted from the report "Casos de desarrollo de Producto. Informe COTEC, 2009"

3 The strategic definition of a product

As a starting point, the conception of an industrial product needs a strategic definition designed to assess aspects and prerequisites that the designer provides through its knowledge or prior experience. Many of the necessary aspects are considered multidisciplinary and can be treated by a project manager or through the creation of a working group [8]. Since then the use of digital documentation is essential to establish the flow of initial information that will raise the real feasibility of a project and its execution [9].

The more conventional methods of communication are still internally in the company intranet or internal email and externally (eg with suppliers), email and fax. However, there is an increasing tendency to evaluate the possible impact of the product by assessing the expectations of a product on the network by establishing ex ante with industry experts including designers who can establish patterns of consumption or needs prior even before creating the product, as discussed in the following point shall be materialized in the conceptualization phase.

Conventionally, it has made a summary of the main tasks of developing at this stage as:

- Define the problem to solve.
- Plot the strategic direction of the project and develop the Strategic Plan.
- Identify potential buyers and users of the product, sales and distribution channels.
- Investigate industrial property law and related product.
- Identify factors related to the sustainability of the disposal process and product.
- Document the needs will be met with this product and type of user to address to.
- Define product communication and its relationship with the corporate image.
- Analyze and across the different sources of information.
- Create a multidisciplinary design team to accompany every stage of the project.

The techniques and methodologies in the engineering associated with these phases focus on issues such as:

- Knowledge Management.
- Knowledge of the target.
- Competitive Analysis
- Map product.
- PEST Analysis (SWOT Matrix).
- Analysis of trends.
- Analysis of economic viability.
- Analysis of technological feasibility.
- Product life cycle.
- Analysis of patterns related to eco-design.
- Ergonomic analysis user-centered
- Functional analysis, and commercial utility of the product, the usage environment, product-user.
- Economic and financial analysis, profitability, market and trends.
- Analysis of existing or future legislation.
- Control of intellectual property.

Therefore, the digital documents to which we can face are:

- Report a product's functional requirements.
- Report technical requirements of a product.
- Report of outsourcing, alliances and synergies for the implementation of a product.
- Develop a work plan.
- Schedule time for the project.
- Gantt chart of times and processes for carrying out the project objective.
- Document valuation and costs.
- Report on the communication plan product.
- Legal documentation associated with the product through outsourcing. Contract / Royalties.

4 The concept design

This phase includes the first formalization of industrial output when is given the compliance and feasibility for implementation. This work is assumed by the designer from their more direct professional skills and tries to analyze and resolve product functionality [10]. We find an increasing tendency to promote products and services offered on the network by the designer through a private label, and sometimes comes down to a concept design study or what the designer may offer companies or the general public [11].

This phase within the context of more conventional design process sometimes requires aesthetic, functional and technical knowledge designed to generate a product based on a specific trend which is viable for a particular market. Therefore, the digital communication environments such as social networking and collaborative environment geared to Web 2.0 are shown as an interesting alternative to provide the first assessments in the field of aesthetic trends feasible for a possible future customer. The utility is twofold, first promotes the sharing of experience in the group of designers and other encourages direct contact with users. In both cases, the exchange allows you to mature and redirect future industrial product to success.

Conventionally, at this stage we can find a number of essential tasks such as:

- Generate alternatives for product design based on the requirements and definitions of the product and communication to develop.
- Define the technology and materials to use based on potential suppliers.
- Evaluate the technology and materials selected in relation to the capabilities of the company.
- Make a selection and feasibility study for implementing the ideas generated.
- Generate a description of the concept developed, including the characteristics and general parameters to use technology and performance and morphology of the product.
- Establish criteria for the review and evaluation of selected concept throughout the project life.
- Assess the characteristics of users and consumers.

The most important associated techniques that can be used during this phase are summarized as follows:

- Brainstorming, informal meetings, etc. ...
- Analysis of design trends.
- Analysis of trends in materials and processes.
- Artistic expression of conceptual and formal ideas.
- Techniques for generation analog / digital concept sketches.
- Techniques of representation generation analog / digital formal and aesthetic product.
- Development techniques generation analog / digital models and prototypes and formal aesthetic.
- Development techniques generation analog / digital models and prototypes and formal aesthetic.

The most important documents to be developed in this phase are:

- Reports and studies of trends.
- Sketches formal aesthetic (analog / digital).
- aesthetic representations of the product. (analog / digital).
- Technical Specification.
- Technical drawings related to the product.
- Presentation realistic product from the aesthetic point of view.

4.1 Product Launch

At present and as discussed in the ideation phase of product and strategic assessment, the future promotion of a product or service using a shorter time for implementation and in fact sometimes arises from the generation itself of the idea that once introduced to the public can purchase a trend toward allowing its future production [12]. This kind of trend has found in the digital world its most powerful media network since sometimes it can be found online virtual products, waiting to be manufactured and even create fictitious visual and formal expectations in buyer.

The launch of a product must be in accordance with the actual project carried out by the company or the designer following a plan of technological feasibility and production that guarantees the traceability of it and its life cycle as a guarantee of strength of the image company that manufactures it.

The launch should be influenced by a marketing plan that includes the immediacy of the online services that can be offered by the company so the customer can get as an added value on the final product. There are increasingly

digital environments such as direct marketing promotional naming sites, blogs of opinion about a product, consumer networks on Facebook, etc. .. trying to come to the end user to get their more personal opinion about a product.

5 Applications technology OS, process-oriented conceptual design of an industrial product

Therefore, and in view of the phases and tasks and documents to be developed by the designer, it is important to know the tools or applications that can be more suitable to their needs.

The use of computer applications as tools to aid the various activities of the design process has become so important that today it is inconceivable to survive in a competitive world without its use.

It has been taken as a reference for programs related to Open Source applications, OS corresponding to applications or distributed software that have been freely developed and whose source code is publicly available. The following tables (Table 1, Table 2), have established the general descriptions of the tasks of the designer in each of the phases defined above showing the types of software needed for their development and some of the Open Source Applications currently in use for such tasks.

Table 1 Description and type of Open Source applications related to the strategic definition.

	Task Overview	Types of programs used	Open Source Applications
Strategic definition	The designer collects information available online	Browsers	Mozilla Firefox Opera
	The designer classifies digital information available	Document Manager	
		Image Viewer	gThumb GQview KuickShow Gwenview MyACDSee Phoenix Slides
	The designer makes a comparative analysis of products.	Text Editors	OpenOffice Abiword Lyx
	The designer generates reports on the analysis of competition and the market.	Text Editors	OpenOffice
Viewers and generators of electronic documents.		Xpdf PDFCreator Evince	
	Layout	Scribus	

Table 2 Description and type of Open Source applications related to the design concept.

	Task Overview	Types of programs used	OpenSource Applications
Design concept	The designer formalizes ideas using digital sketches	Editing and retouching digital image Fotografias analogicas/digitales.	Gimp CinePaint Paint.NET Pinta Picnik
		Scanning documents for further editing	Gimp
		Vectorization of bitmap images	Sodipodi Inkscape Xara Xtreme
		Image Path	Potrace
	Rendering 3D	Blender POV-Ray	
	The designer gives presentations on the first ideas.	Text editors and presentations	OpenOffice Powerbullet Presenter
The designer translates the design requirements to technical specifications.	Display techniques of Quality Function (QFD)	Quickoffice Premier	

6 Conclusion

As a conclusion, we can say that the use of computer programs and applications that currently exist in the market should be known by designers from an objective standpoint to try to optimize and effectively cover digital document management through the use of digital environments network [13]. Increasingly oriented philosophy of change to the use of Open Source software and social implications of social networks in open environments can be used to manage information that is currently focused on designers' own computers and do not come to light.

Contact with professional networks and access to the buyer via internet by accessing digital documents that the designer can share will permit in the future to be new social networks and digital environments to promote products and services designed for businesses and for users.

References

[1] Z. Kovacs*, J.M. Le Goti and R. McClatchey. "Support for product data from design to production". Computer Integrated manufacturing Systems. Vol. II, N. 4, (1998). pp. 285-29.
 [2] B. Bayer and W. Marquardt. "Towards integrated information models for data and documents". Computers and Chemical Engineering 28 (2004) pp.1249-1266.
 [3] M.D. Giess, P.J. Wild, C.A., McMahon. "The generation of faceted classification schemes for use in the organisation of engineering design documents". International Journal of Information Management 28 (2008), pp.379-390.
 [4] E. Elorantaa, A. Hamerib, M. Lahtic. "Improved project management through improved document

management". *Computers in Industry* 45 (2001) pp.231–243.

[5] COTEC Diseño e innovación. La gestión del diseño en la empresa. Documentos COTEC sobre oportunidades tecnológicas. N° 25. Fundación COTEC para la innovación tecnológica. 2008.

[6] COTEC Informe "Casos de desarrollo de Producto. Informe Fundación COTEC para la innovación tecnológica. 2009

[7] R. E. Giachetti. "A decision support system for material and manufacturing process selection". *Journal of Intelligent Manufacturing*. Vol. 9, N.3, Kluwer Academic Publishers. (1998) pp. 265-276.

[8] P. Lara and J. A. Martínez." Outsourcing documental: organización de futuro". *Fesabid* 2000. Servicio Editorial de la Universidad del País Vasco, Bilbao, pp. 49-55. <http://www.fesabid.org/bilbao2000/> accessed 20 Jan 2011.

[9] S. Ha, G. Pahng, M. Chang, S. Park, H. M. Rho. "Managing Design Knowledge: Active Document System. *Annals of the CIRP* Vol. 48/1/7999.pp.89-92.

[10] A. Hameri and J. Nihtilä. "Product data management-exploratory study on state-of-the-art in one-of-a-kind industry". *Computers in Industry* Vol. 35. (1998). pp.195–206.

[11] P.S. Ramalhete, A.M.R. Senos, C. Aguiar. "Digital tools for material selection in product design". *Materials and Design* Vol. 31 (2010) pp. 2275–2287.

[12] K. G Swift and J. D Booker." Process selection: From design to manufacture". Butterworth-Heinemann Ed. 2nd (2003). Oxford, United Kingdom.pp.3

[13] R.V. Rao, V.J. Savsani, D.P. Vakharia." Teaching-learning-based optimization: A novel method for constrained mechanical design optimization problems". *Computer-Aided Design* 43 (2011). Pp. 303–315.