Proceedings of TMCE 2010 Symposium, April 12-16, 2010, Ancona, Italy, ed. by I. Horváth, F. Mandorli and Z. Rusák

THE DEVELOPMENT OF AN INDUSTRIAL DESIGN ENGINEERING WIKI: WIKID

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ABSTRACT

Industrial design engineers use a wide variety of knowledge fields when making decisions in their design process. Obviously, designers cannot master every field, so they are therefore often looking for a set of rules of thumb on a particular subject. For this need a knowledge database in wiki format has been developed through a chain of studies: WikID, a portmanteau of wiki and industrial design. WikID aims to be a design tool. It offers information in a compact manner tailored to its targeted user group: industrial design engineers. The paper describes the development of WikID in a chain of studies. For a knowledge database the main issue is the labour and time consuming nature of collecting, selecting and structuring the contents for the database. For this issue, the focus is set on the use of wiki-software, and consequently on the importance of a user base, on the creation of an import wizard and templates for reducing the effort required to maintaining the database, and on the options to use semantic properties in a wiki. These topics are studied in literature and by means of a questionnaire amongst 70 respondents. One of the findings is that the targeted user group is willing to use a wiki based database. Other results of this study are an import wizard and a specified content for a materials properties template. After these studies the time had come to put WikID online: www.WikID.eu.

KEYWORDS

Industrial design engineering, design tool, design knowledge, Wiki application, Wiki user base, Wiki article templates, semantic Wiki forms

1. INTRODUCTION

Industrial design engineers are constantly searching for information. Usually they turn to technical literature or special websites provided by developers or suppliers and more and more Wikipedia is used. When using books, they are often confronted with a recurring problem: the information found in technical literature (or many websites for that matter) is often too detailed and sometimes outdated. Besides, the required information industrial design engineers need stems from a wide variety of research fields and will be used for making decisions that will eventually have significant impact on their designs.

Obviously, designers cannot master every field, so they are therefore often looking for a simple set of rules of thumb on a particular subject [2, 22]. For this need a knowledge base has been set up to accommodate the vast amount of information an industrial design engineer might need, and aims to do this in a way to help designers find information more easily [23]. The research and development of this knowledge base has been started in 2002. At first this knowledge base was named C-DET (acronym for Conceptual Design Engineering Toolbox). In 2008 C-DET is transformed into a wiki and has been re-

named to WikID. For the convenience of the reader the name WikID will be used throughout this paper.

There is a distinct difference between WikID and Wikipedia, whilst Wikipedia already offers a lot of this information. The difference is that Wikipedia aims to be an encyclopaedia, and therefore tries to be as complete as possible. WikID aims to be a design tool. It offers information in a compact manner tailored to its targeted user group: industrial design engineers.

2. THE HISTORY OF WIKID

The research studies and development of WikID have been taken place as a series of studies executed by industrial design engineering students. Several topics have been studied and WikID has been stepwise developed in a chain of prototypes.

2.1. Early prototypes

Knijnenburg and Braak [11] started the chain of studies with a literature survey and interviews to determine the first entrance category: the development process tree. Furthermore the first prototype was built (Figure 1) and used in a user survey. Amongst their findings was the recommendation to develop two other entrance structures being design aspects and related disciplines and product domains.

In the second prototype the entrance structure of the design process steps was combined with an entrance structure on design aspects in a matrix. The underlying assumption was that a designer might need different information about e.g. ergonomics in every design step. For example when a designer is setting up a program of requirements he might need different ergonomics information or materials information than when he is detailing a design proposal [12]. In this study, also some information or knowledge properties were determined. Designers would like to know in what language the information is available, if there is information about costs available (i.e. the costs of components, materials, etc.) and very important: is the information or knowledge appreciated by other designers. In other words a designers rating of the information was included.

2.2. Designers' information search habits

A third prototype containing three main entrance categories (design phases, design aspects and product domains) is used in a subsequent study, which is a study into the information search habits of industrial design engineers [13, 22]. The goal for this study is to seek the methods, problems and solutions designers have searching for relevant information.

To start with, literature has been searched for publications about information needs, searches and problems and also for information about existing toolboxes and knowledge portals. In literature some general problems in information and knowledge search items have been found. Based on these results, a field study has been set up to check whether the items found in the literature are the items that have significance in the process of design.

Some of the interesting findings of this field study are:

- There is a shift from lack of skill in searching the Internet to lack of skill in searching in other sources. The experienced designers have less persistence in searching the Internet, because they have more resources for information than the younger designers.
- If a new knowledge field has to be entered, then first general knowledge about the subject is sought for. Later the general knowledge is used to find what was needed.

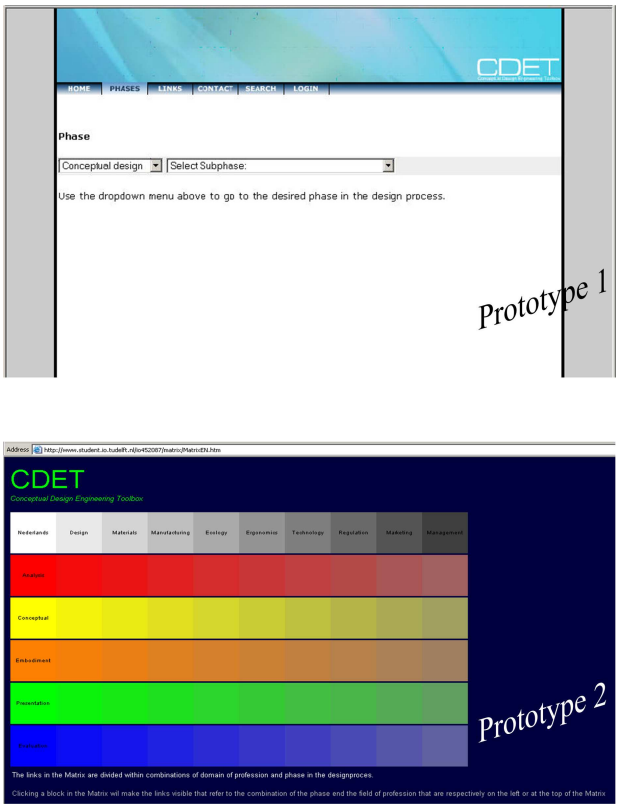

Figure 1 The first two Prototypes of the design database.

- People, who already had their search methods before the Internet was as common as it is now, use the Internet selectively. People who just started developing their search methods are highly dependent on the Internet, and trust it to find anything.
- There is a great similarity in the structure in what kind of information is searched and in what order. The structure looks like: 1) Finding out client wishes; talking with the client; 2) Search for market information, which can be split up in: Competition; checked out at exhibitions and on Internet. And Saleability; which is checked on a circle of friends or a circle of other selected people; 3) Searching for alternative solutions: materials and production technology; 4) Searching for producers; producers are searched for on the Internet, with support of the Yellow pages and company-guides; 5) Searching for suppliers is done simultaneously with searching for standard parts.
- Because there is a lot of information, it is important to structure the information. The different entrance structures in WikID can be useful when people do not know what they have to look for. It enables browsing without having to type in specific words.

2.3. The content's structure

To enable quick navigation to information and knowledge WikID needs an appropriate entrance structure. After several studies [25, 27], the following three main entrance categories to the database have been determined:

1. Design Theories. This category includes design processes, methods, techniques and design tools. Information about how to is to be found here.
2. Design Aspects. In this category one may find design aspects and related disciplines such as Ergonomics, Materials, Aesthetics, etc. These aspects could be used by designers as a checklist when creating the list of requirements. Usually a designer applies (almost) all design aspects in every design project. It is information and knowledge about what to do in a design project.
3. Products and product domains. This last category contains product specific knowledge about the related products and product domains that are relevant for the industrial design engineers, such as Office, Children, Medical, etc. For a specific design project a designer might use only one of these domains.

Besides these categories for browsing and inspiring the designer, WikID also includes a search function using keywords (search engine) for direct navigation to specific information.

2.4. Product domains tree

These entrance categories need to be detailed further. The grouping and structure for the category "Product domains" have been determined in a study by Herkel and Blomaard [25]. The structure is the frame and the grouping is the way the information is placed within this frame (see Figure 2).

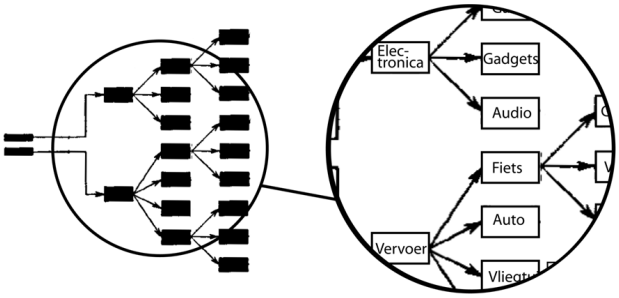

Figure 2 Structure (left) and Grouping (right).

The aim within WikID for the grouping of products is not to group every product (completeness), but to have a structure for the knowledge available. The grouping needs to be clear and logical in order to prevent the user from choosing a wrong search path. The structure and grouping is intended for users who need the search process to explore the design context. For them it is a way to gain insight into the design problem. Otherwise, a 'search engine' will be faster and more specific.

After a literature study in the field of structures and ways to group products, the Internet has been searched for sites containing product groupings. Seven of these sites have been analyzed. Based on the gained insights, two grouping alternatives have been developed as input for use tests with design engineers. The use tests focussed on two main aspects: the preference of the users and the findability of the products. Conclusion from the use test was that the integrated structure (see Figure 3) is the preferred structure for exploring the most information in the shortest time.

Furthermore, from the many grouping principles that have been analyzed, the grouping principle based on functionalities of the products appeared to be the unanimously preferred grouping principle for the product domains within WikID.

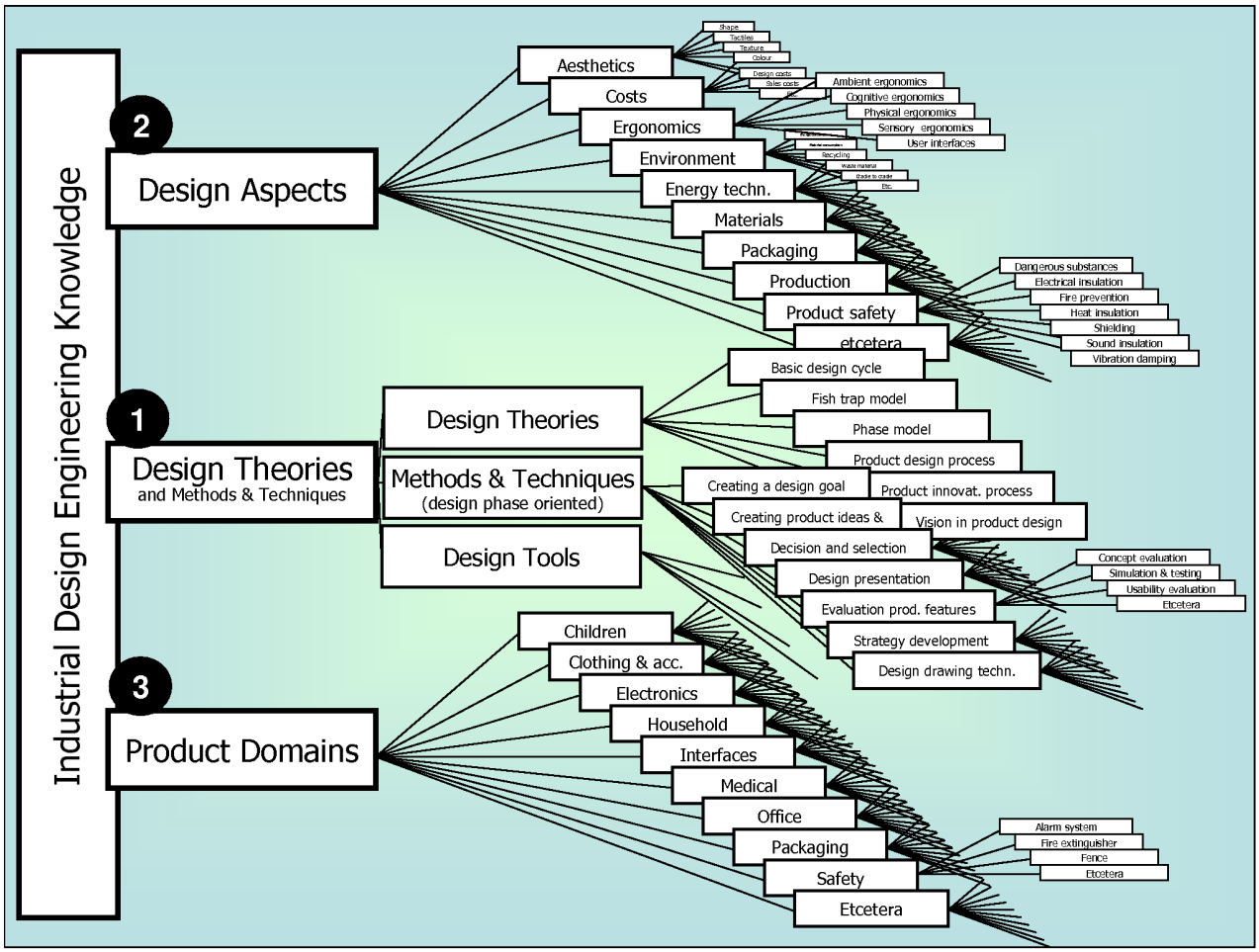

Figure 4 Contents structure for database browsing in the field of industrial design engineering.

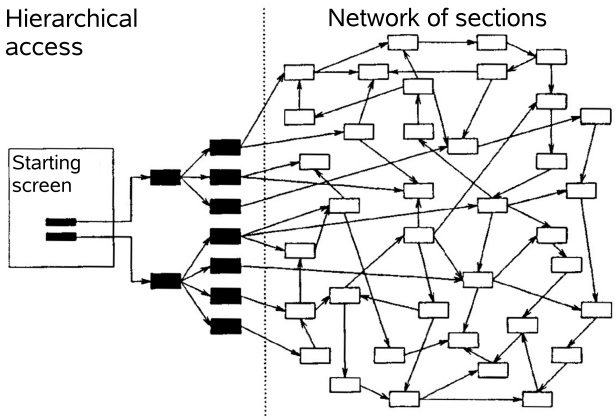

Figure 3 Diagram of the integrated network in WikID.

2.5. Design aspects tree

In another study, done by Pape and Vulpen [27], the classification of the main category "Design aspects" has been developed. This study started with a survey to similar initiatives concerning knowledge portals for industrial design engineers and to existing classifications of design aspects. For the evaluation of these classifications also review criteria are searched for. The classification should help the industrial design engineer to find the information that he is looking for and keep him from a large number of attempts before finding the desired information. Based on the findings a proposal for a classification of design aspects has been developed. Subsequently a study to the usability of this classification in practice has been set up. The resulting design aspects tree consists of 14 aspects which are one to four levels deep. Figure 4 shows the levels of the complete structure for browsing the database of WikID.

2.6. Search for contents

In order to give the knowledge database structure some contents there have been studies focused on searching sites useful to designers. Dell'Acqua and Iraci [3] searched the internet and found almost 2000

relevant sites. These sites had to be implemented followed by a brief review, to give the user an idea on the content of the site and the correspondence to his needs.

The researchers started to write reviews per site in which the subject of the site is described and a few short details (language, practical aspects on accessibility, etc.) are given. Every review took about 15-40 minutes. Conclusions from this study:

- Although there was an idea of what the most important details and aspects of a site are, there was a need to further analyze and standardize the review contents before this huge amount of time was spend. Besides there was a need for a list of key words to be used for the search engine. In other words a study into a method of reviewing and rating was required.
- It would be useful to realize a certain degree of interaction and feedback with the user. To find a way for the designer to add information and create a setting in which the tool can evolve constantly.
- Another finding of this study was that it would be useful to find some real criteria to select the web sites for the toolbox.

Another study into the contents has been done by Maas and Nieuwenhuijzen [26]. They discussed the question whether the Dutch concept of "start pages" on the Internet could be a good starting content for the Product Domains category.

At www.startpagina.nl, keywords can be used to find a daughter page. The daughter page contains a large number of links to sites that are relevant for that topic. The daughter pages are controlled by daughter administrators. They monitor how often a link is used to further improve the daughter sites for their visitors. Visitors can send their favourite links to be included at the start page [16]. Robots check weekly if every link is still "alive". On January 12, 2010, there were 5974 daughter pages.

Although the combination of WikID and start pages could be a good solution for finding information in the main category of Product domains, the concept of start pages is not sufficiently elaborated in other than the Dutch language. For WikID it is only fruitful if this concept is equally developed in English language contents pages, which is not the case at the time of this study.

The creation of a bilingual knowledge base which would use both Dutch and English articles has been explored by Geerts and Dos Santos Gomes [6]. They found that linking Dutch and English articles could be done in an automated way using Nnexus and Babelfish [1, 5]. However, Nnexus is only able to link new articles to existing ones, and not the other way around. After close examination of this issue it is decided that only English will be used.

De Jonge and Legerstee [9] studied the way to keep the database up-to-date. They have compared a number of programs to find and remove dead links such as Weblink Validator. Their conclusion was however that a group of editors would be able to reach higher quality of the knowledge base.

2.7. Criteria for designers' ratings of websites

There are plenty websites, but how to determine which ones are useful for an industrial designer? The goal of a next study, performed by Eekhout and Vos [4], was to determine criteria for selection and rating of websites. The researchers made a structural analysis of the different design aspects to find discriminating criteria to allocate the websites. Before analyzing which criteria a design specific website should conform to, a set of rules was taken from literature to evaluate the quality of websites in general. These ten include criteria on language use, author qualifications, readability and so on.

Subsequently a literature study was conducted to apply design specific demands to the web site evaluation criteria. In this study the scope was limited to the first six design aspects. The study resulted in a list of criteria per design aspect. The criteria were then transformed into questions to be used in a user survey amongst peers to validate the interpretation of the design specific criteria. The conclusions from the user survey have been transformed into a list to be used for rating websites for each design aspect. See Figure 5 for an example.

3. PROBLEM AREA

After all the studies for a knowledge database a major issue remained, being the labour consuming nature of collecting, selecting, structuring and updating the knowledge for the database. In 2006 the decision was made to use wiki-software for building and maintaining the database so that the users themselves could select and maintain the contents of the design knowledge base [31]. A fourth prototype has been built by Frolich and Zinkstok using MediaWiki software.

1: Which category do you think this website fits best?	Ecology					
	nothing	A little	enough	A lot	plenty	Fits phase category
2 Are design methodologies available?		X				1
3 Information on team structure?	X					1
4 Information on planning processes?			X			1
5 Environmental methodology?					X	1
6 Does the site include examples of environmental applications?				X		1234
7 Does the site include relevant graphic models?			X			234
8 Advanced specifications of materials and manufacturing?				X		234
9 Related environmental issues?			X			234
10 Are there potential problem areas indicated?				X		234
11 Environmental laws and guidelines?				X		34
12 Does the web site describe any negative side effects?			X			234
13 Are alternatives for manufacturing techniques given?			X			34
14 Are alternatives for materials mentioned?		X				34
15 Environmental technical information?					X	34
16 Is there any information available about eco tools?					X	34
17 Are environmental costs indicated?		X				4
18 Are tests and results included on the web site?				X		4
19 Is the technology available in the Netherlands?	X					4

Figure 5 Rating a site for the ecology design aspect .

There are however some downsides to the Wiki concept, such as the image of Wikipedia in the academic world, because of the potential incorrect information it contains. This image might lead to WikID not being used. Furthermore the Wiki concept was not designed to have a tree-like structure as depicted in Figure 4, and therefore some study is necessary to see whether the Wiki concept would actually work well with the tree-like structure and to see whether there are alternatives. At this point three studies are started:

1. An analysis into the usage of wiki software for WikID which has to work well with tree-like structures. (Chapter 5).
2. For the contents problem and in order for a wiki to be successful it needs a strong and active user base (community). The question is whether such a user base is present at the targeted user group. (Chapter 6)
3. A study to facilitate the creation of articles in WikID. There is an idea whether it is possible to let a program automatically add general information on materials from Wikipedia. For articles on some aspects it might be better to prescribe the content format. For example, designers need specific materials properties and they would like to make comparisons between materials. How to support this in a Design Wiki. (Chapter 7)

These three topics will be discussed in the remainder of this paper. A fourth subject is: To keep the tool a design tool the information stored has to be design relevant for the area of industrial design engineers. The question about the definition of “design relevance” is the topic in [24].

4. METHOD

The software issue is studied by setting up a set of criteria, collecting the software options and evaluate these options with the formulated criteria. The issues of community building for the viability of a design engineering wiki, and the contents and the lay out of the materials templates, and semantic properties have been studied in literature.

For the application of these theoretical results on WikID an online questionnaire will be used. This questionnaire will have two parts. The first part contains questions about the willingness of subjects to contribute to a wiki, as well as whether people really have as much problems finding desired information quickly. The second part contains questions to find out what information designers find useful, to enable the creation of a usable template. This questionnaire will be held amongst peers, being students and staff in the area of Industrial Design Engineering. The results of these studies will be implemented in WikID.

5. WIKI OR OTHER SOFTWARE

The original idea for setting up a WikID database used wiki-software, MediaWiki to be exact. This decision was based upon earlier research [31], however there are some concerns on the usability of this system. The main concern is its ability to cope with the tree-structure in which all articles should be placed. This poses the question: Should we use wiki-software to implement WikID? We decided to look for other possibilities to easily implement a design database. Several solutions are available, we will need to first make a selection from those and put them through a thorough evaluation.

5.1. Literature survey Wikis

Salustri [18] poses that Wikis can provide substantive support to the design research community. The key feature of Wikis is that in principle anyone can edit content; this changes the dynamic of collaborative interactions in a way that generally facilitates the emergence of bodies of knowledge. Wikis are compared to other tools, including email lists and sophisticated content management systems (CMSs). It is found that Wikis offer a far richer functionality than email lists without the administrative overhead associated with full-blown CMSs. Wikis have a number

of advantages over email lists or news groups. They allow content to be refined over time, for proper revision histories of documents to be maintained automatically, and for logically grouping similar information items. It can be extremely difficult to track the progress of online discussions via archives of email lists or news groups; a classic problem is that "Subject Lines" in email and news messages tend to remain unchanged even if the discussion itself changes completely. Wikis eliminate such problems while maintaining the capacity to let the entire user community contribute. Wikis can also be searched with more intelligent algorithms than can email list or news group archives.

A wiki in the area of industrial design engineering is xiki (http://deseng.ryerson.ca/xiki/) which is a design engineering wiki specifically for lexicography. Xiki could provide a good implementation vehicle for a design dictionary [19].

A survey of wikis as a design support tool is described in [28]. A wiki was provided for 500 engineering students (5 students per team) who worked to solve a challenging design problem. Surveys and interactive feedback sessions were used to analyze the wiki use upon completion of the design project. The results conform that wikis are a useful and easy to use tool, but certain improvements would increase the utility of wikis for design projects such as a feature for easier integration of graphics.

At www.wikimatrix.org, existent wiki software can be compared; over a hundred of wiki engines are listed there.

5.2. Software options

The software that will be used as a frontend to the design database will have to comply with the following criteria:

1. Free of charge (for non-commercial use).
2. Open-source software or publicly available API.
3. Handle tree-like data structures.
4. Handle structuring of data through templates.
5. Easy information editing by users (WYSIWYG).
6. Proven reliability.
7. Maximum implementation time of 2 months.

After applying these selection criteria, only a few valid options remain, on which will be elaborated below.

MediaWiki. MediaWiki is the base of, for instance, Wikipedia. It has proven to be stable and reliable even under high usage levels. Furthermore it is open source software, with a vast number of extensions to increase functionality. The categorization of articles can be used to create a data tree. The software itself is freeware and can run in any environment capable of running PHP5 and MySQL or PostgreSQL. All known vulnerabilities have been patched [15].

phpBB. The phpBB-package is originally software to run bulletin boards on, however, through the years; several extensions have been developed to use the forum as a fully featured CMS. The forum-structure can be used for creating the data tree, creating subfora for the deeper branches of the tree. phpBB, like MediaWiki, is open source software, and is multiplatform as well, supporting a wide range of SQL-servers and HTTP-servers alike, its only real requirement is PHP5. It is also known to be quite reliable and stable, although it did suffer from some major security issues in the past [17].

Homebrew software. Homebrew software can be made as extensive as one would like; however, developing a stable platform with rich functionality may take quite some time; software like MediaWiki and phpBB took a number of years to reach their current level.

Evaluation

Having explained the options, the decision on which frontend to be used can now be made. This decision will be based on the list of criteria, which will have to be normalized: For our first criterion, freeware will receive two plusses, restrictive freeware (e.g. for non-commercial use) will receive one plus, all others will receive two minuses. With our second and third criteria, open source software will receive two plusses, closed source with a well documented public API receives one, closed source with a badly documented or non-public API will receive a minus and all other closed source software will receive two minuses. For criterion four, we award native support for data trees with two plusses, support through extensions/modifications with one plus, and no support with two minuses.

The same method will be used for criteria five and six. As for criterion seven, having open vulnerabilities automatically results in receiving two minuses, having less than 25 closed vulnerabilities in total will be awarded by two plusses, while more than 25 closed vulnerabilities will result in just one plus. The

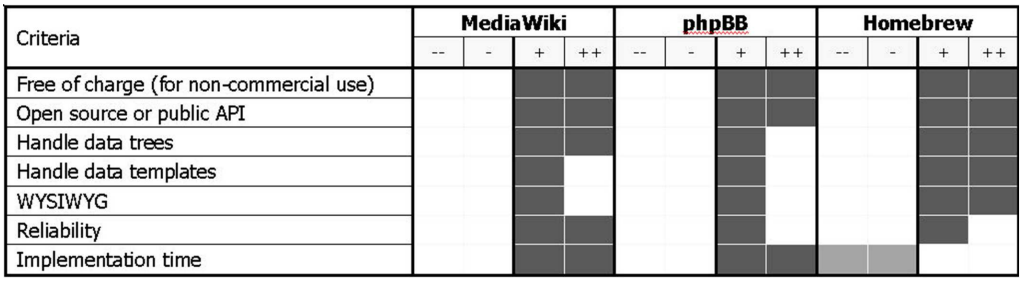

Figure 6 Table Harris-profile for software evaluation.

last criterion will be judged on the amount of time needed to implement the software: More than two months will be awarded with two minuses. Between two months and one will result in one plus, less than one month will be given two plusses.

Conclusion

The use of MediaWiki as a frontend was questioned, but after evaluating the options, the same system is chosen; the default version already has a lot of the desired functionality, and for the extra functionality one can either install existing extensions or develop one's own. Its structure is more intuitive than viewing the entire contents of WikID through a bulletin board, mainly because bulletin boards were not developed for functioning as a database filled with articles. WikID is meant to function as a reference library, somewhat like an encyclopaedia, and MediaWiki has proven to be up to that task for years now as the stable and reliable system for Wikipedia and other wiki-websites.

5.3. Implementation

There are some extensions available for the MediaWiki software to provide the functionality of creating forms with a fixed structure for the ease of use of the design database. The same goes for a specific field of our research, the material templates. By using a semantic method for assigning material properties to the templates, we are able to use the information entered by users throughout all of WikID by simply querying these properties. The use of forms and templates helps us with this, as it makes the method of entering information more standardized than when our users are simply allowed to just about enter anything about a material, except the information that the questionnaire will show as being relevant to our respondents.

But, not only do we need extensions that are beneficial to our material templates, we also need extensions that will improve the usability of other parts of the design database. The implementation of a semantic extension will help us in offering the wanted semantic functions. The following extensions have been installed to add new functionality to our setup of MediaWiki:

- Semantic MediaWiki
  - Create types.
  - Create properties based on types.
  - Restrict the allowed values of a property.
  - Create queries based on the existence or value of a property within an article.
- Semantic Forms
  - Create form-based templates for articles.
  - Lets users pick from allowed values for a property.

6. VIABILITY AND USER BASE

The second topic of our study is the viability of WikID in terms of the user community. In literature it is described that the key element in a successful wiki is a strong community. Therefore it is important to find out whether there actually is a user base that is willing to contribute to WikID. Other wiki projects show that approximately 1 to 2 percent of the users contribute to the wiki and therefore a main issue is how to reach a critical mass in the available information so users can actually find what they are searching for and will be stimulated to add their information.

6.1. Literature survey

According to [29] a wiki goes through several stages in its life. These stages go from 1) Founding. Selecting, installing and configuring software through 3) Seed posting by founder(s). Initial posting on several subjects to get starting mass to 10) Crossing the Tipping Point. This tenth stage is characterized by the arrival of new members that have not been invited by former members. Knowing that the founders need to do seed posting in order to get a wiki alive, it

is interesting to get an idea of the number of articles WikID requires to become successful. The starting amounts of articles of other successful wiki's have been looked up.

Wikipedia [7] started without articles. After a month it passed the 1000 article milestone. This extreme growth had several reasons: Wikipedia was one of the first to use the wiki concept, and therefore sparked curiosity. Wikipedia promoted its concept on SlashDot, a very large technology news community. Since the community of SlashDot liked the concept, and a lot of members had specialist knowledge, the growth of Wikipedia became explosive. CitiZendium [20] started off as an alternative to Wikipedia, founded by one of the co-founders of Wikipedia after a dispute. The goal of CitiZendium is to create a wiki that contains reliable articles. CitiZendium already had a starting user base.

The potential user base of WikID is roughly estimated as follows. In the Netherlands we have several design institutes, of which we estimate that there will be about 7,000 designers and design students. Worldwide there will be at least ten times as much being 70,000 potential users of WikID. Wikipedia has a total of 6,781,735 registered user accounts [21]. Of which 75,000 users are active contributors [30]. This means the percentage of active users is: 1.106%.

As becomes clear in the orientation, the success of a Wiki is mostly determined by the quality and enthusiasm of its community. There is no real rule for creating a successful wiki; there is no checklist that ensures success. The number of starting articles seems to be not important. The success of a wiki depends on its community. That is why it is useful to pay attention to building a stable and enthusiastic community, and to create a sense of pride to participate in the wiki.

6.2. Questions and results

The next step is the questionnaire to see how these theoretical results apply to C-DETwiki specifically. This questionnaire has been held amongst peers. At some questions the results are sorted by experience in the design field. The total group of subjects consists of 70 persons. Below is a pie chart that shows the experience levels of our respondents:

Are you in this point in time interested in using a design wiki as a reference?

Result The vast majority of respondents, regardless of experience, are interested in using a design wiki as a reference (83%). The older generation is less interested than the young generation.

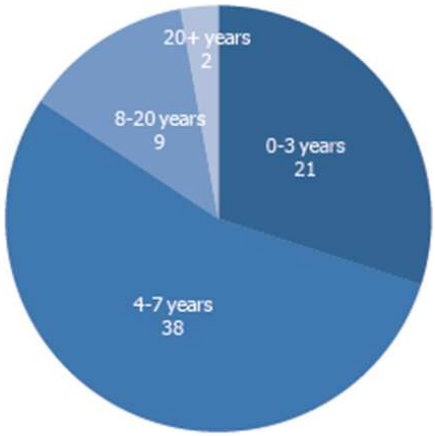

Figure 7 Respondents based on years of experience.

Are you prepared to add or edit information in the wiki?

Result 67% of all respondents claim to be prepared to add or edit information to a wiki. This number is a lot higher then is common in other wiki's. Probably a lot of people will say they are prepared, but the actual adding/ editing is a different matter.

Regarding the negative answers, the most common response was that it would take too much time and that it takes too much effort. Another reason was that the respondent was not sure his information is correct. A third reason was: "Not always, preferably designing should be Open Source, but sometimes specific design knowledge is too closely linked to a product idea, so one likes to keep it to itself."

Are you prepared to submit information you have previously written for another purpose?

Result The purpose of this question was to find out whether people would be more eager to offer information they have written before, even though they know it can then be copied freely. 80% Says they are willing to do so.

Would the existence of good Templates make it more attractive for you to submit new information to the wiki?

80% would appreciate good templates.

Are you afraid of finding unreliable information in a wiki?

The word afraid is used to question whether they suspect to be negatively influenced by possible unreliable information.

Result 64% of all respondents claim to be fearful of finding unreliable information in a wiki. The least experienced group of respondents is most afraid. Probably due to the fact that they are told not to use Wikipedia as a source, and are therefore extra weary.

Would you edit information if it was marked/ flagged as unreliable?

We wonder whether the ability to mark or flag unreliable information will invite users to make changes to a wiki. If this is the case, such an option would improve the active user base.

Result A slight majority (59%) is willing to edit flagged information, which is a lot more than is common in other wikis.

From which sources do you regularly use information about materials during the design process? (You may give multiple answers)

Result 0-3 Years Experience use books (mostly required textbooks for their design studies) and internet, more specifically Google and Wikipedia.

4-8 Years Experience answered books, they seemed to use a wider variety of books than the 0-3 years respondents group, internet (Google and Wikipedia are mentioned explicitly, suggesting they don't have fixed websites).

8-20 Years Experience answered books or study books. It seems this group still looks back at the books they obtained during their college years. Only 3 also mentioned internet, suggesting most users in this group do not need to Google for information, as they already have a solid group of sources they can turn to. Subjects in this user group also use fairs and business contacts as an information source.

20+ Years Experience: This subject group prefers human connections to other sources; they are more inclined to ask colleagues or friends for information.

If you ever had the problem of not finding the information you needed within reasonable time boundaries, please describe the situation

The main problem mentioned concerned the finding of materials that meet all the criteria they needed. They subsequently used different, but similar, materials. Another problem mentioned is finding prices for materials. Some of them claimed it takes so much time they usually do not even bother looking for information.

7. IMPORT WIZARD AND TEMPLATES

In order to get basic information in WikID, a tool for automatically copying design relevant information from Wikipedia to WikID might be a helpful tool.

Another tool that could be helpful is the implementation of templates for certain categories of articles. These templates could indicate what the desired information for designers is. The final result of this chapter is a design proposal for the template for articles in the materials section.

7.1. Copying relevant information

It is fairly easy to copy a whole article from Wikipedia to WikID, but this is not our goal. We want to copy only the design relevant information from an article in Wikipedia to the corresponding article in WikID. For this we have implemented a copy support tool: the import wizard [8]. Using this tool, the user is enabled to select the paragraphs from Wikipedia or any other wiki to be copied to a corresponding article in WikID.

7.2. Templates

We assume that WikID will benefit from a fixed article structure. A more fixed structure within articles might speed up the information finding process and 80% of our potential users have answered that the existence of good templates would make it more attractive for them to submit information to the wiki. A fixed structure will also make the use of the Semantic MediaWiki-extension more user friendly.

To determine the structure for articles in the materials section, the question is: What information is considered to be design relevant? Part two of the questionnaire is used find some suggestions to decide between either or not design relevant information. It includes questions at three different levels. The first -in a top down view- is showing the various areas of industrial design engineering. The second level focuses on one design aspect being the area of materials, because we expect this area to benefit greatly from a fixed structure. Finally we zoom in to specific material properties, so we receive detailed content for the template proposal. To determine what information is considered to be design relevant, we posed the following questions:

1. From which areas of design engineering do you regularly search for information? See Figure 8.

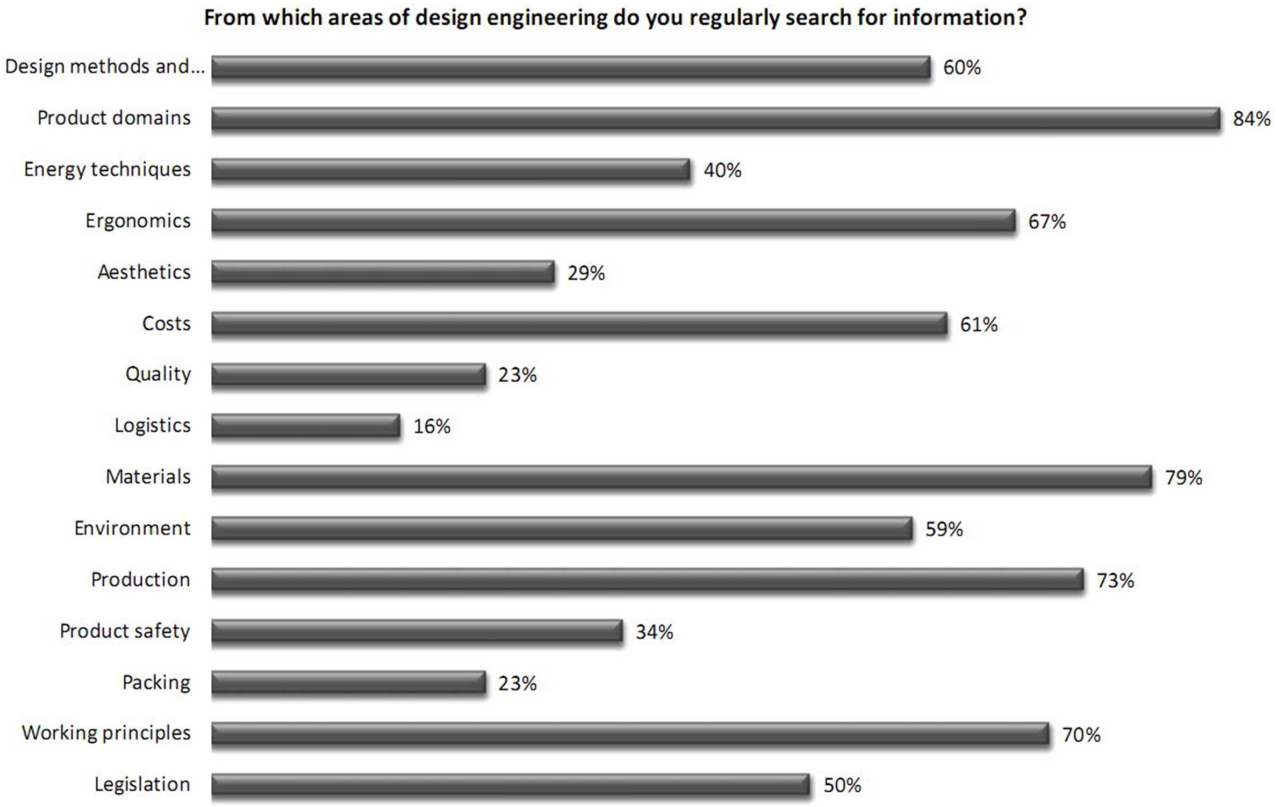

Figure 8 Search frequency per design aspect.

2. In which information related to materials are you interested as a designer?
3. Indicate which material properties you use regularly.

#1	Technical properties	81%
#2	Production possibilities	77%
#3	Costs	76%
#4	Related materials	73%
#5	Current applications	70%
#6	Recycling	66%
#7	Examples	61%
#8	Safety	47%
#9	Legislation	44%
#10	Manufacturers	43%
#11	Emotional properties	40%
#12	Experts	30%
#13	Related books	26%
#14	Distributers	26%
#15	Chemical structure	9%

Figure 9 In which information related to materials are you interested as a designer? (multiple answers).

With each question the respondents are given a number of options to choose from and the opportunity to give an answer that was not listed as an option.

The first question lists the classification of design aspects as conceived by previous research. The specific purpose of the question was to determine where the focus for future research on templates in WikID should be. Most people regularly search for information on materials and only a few people search for information concerning logistics. Interesting results that we did not list as options were: Development, recycling, user culture, new technology, user experience, visual aids, marketing, target groups, consumer research, electronics, software, future vision and standards.

To determine in what materials information the users will be most interested in we gave our respondents options that were generated by studying many material pages in Wikipedia and the MiPS method in [10]. To minimize our influence on the results we also listed options of which we expected that little interest would be expressed, like chemical structure.

We used the List of materials properties page on Wikipedia [14] and in Van Kesteren [10] to gener-

Physical properties	%	Sensorial properties	%	Corresponding physical
Thermal Conductivity	50%	Transparency	69%	Transmittance
Electric Conductivity	49%	Weight	66%	Density
Yield Strength	47%	Stiffness	64%	(for materials) Young's modulus
Tensile Strength	46%	Hardness	63%	Hardness
Melting Point	46%	Ductility	56%	Ductility
Color	44%	Brittleness	50%	Fracture toughness
Ductility	43%	Roughness (light)	49%	Roughness (too ambiguous)
Density	43%	Brightness	49%	(Only digital)
Corrosion Resistance	43%	Warmth	49%	Surface conductivity, not same
Machining speeds and feeds	43%	Texture	47%	(none)
Impact Toughness	41%	Softness	47%	(none)
Toxicity	41%	Durability (color)	44%	(none)
Young's Modulus	39%	Smoothness	40%	Roughness, sense unclear
Fatigue Limit	39%	Scattering	39%	Roughness, sense unclear
Extruding temperature and pressure	39%			
Reflectivity (optical)	37%			
Hardness	37%			
Toughness	36%			
Flammability	34%			
Shear Strength	33%			

Figure 10 Percentage of designers interested in Physical and Sensorial property results.

ate options for our third question. The structure used to list the properties in our sources was maintained in the question.

Figure 10 shows which physical and sensorial properties are considered to be interesting by most of our respondents. Interesting results that we didn't list as options are: Paintability/ dyability, biodegradability [time to decompose], food-approvedness and Eco Index

7.3. Template design

Many material properties are best displayed as a list of physical quantities with corresponding values and units. Some properties are determined by a specific test, but these can be mixed in a list or table. Lists generally are vertically shaped, so it is convenient to place these properties in a table on one side of the article. In order to create a good template for this table, we use the lists of Figure 14 with the –for industrial designers- most interesting physical and sensorial properties. A problem arises when you consider these properties for inclusion in a template. Colour (physical) can be expressed as a wavelength spectrum, but generally the values for material colours are not known. Of course an approximation can be made, but expressing the material colour in this unit creates a false feeling of certainty. Also, many of the top-rated sensorial properties can gain certainty by expressing them as their corresponding physical property. Properties marked in red should therefore not be included in the template design. Colour however, will be included as a sensorial property instead of physical.

Figure 11 shows a design proposal for the template of articles in the materials section. This template has been implemented in WikID, so regular use will indicate what its strengths and weaknesses are. This natural evaluation will probably also indicate how possible problems can be solved.

8. CONCLUSIONS

After analyzing MediaWiki and various alternatives we have concluded that MediaWiki is the best frontend for WikID. Adding extra functionality with extensions will help to create a user-friendly environment for the end user. The technical implementation of the project is at this point at a level high enough for use by the public. The project has gone alive: WikID is put online at www.WikID.eu. In order to get a successful wiki we need a strong commu-

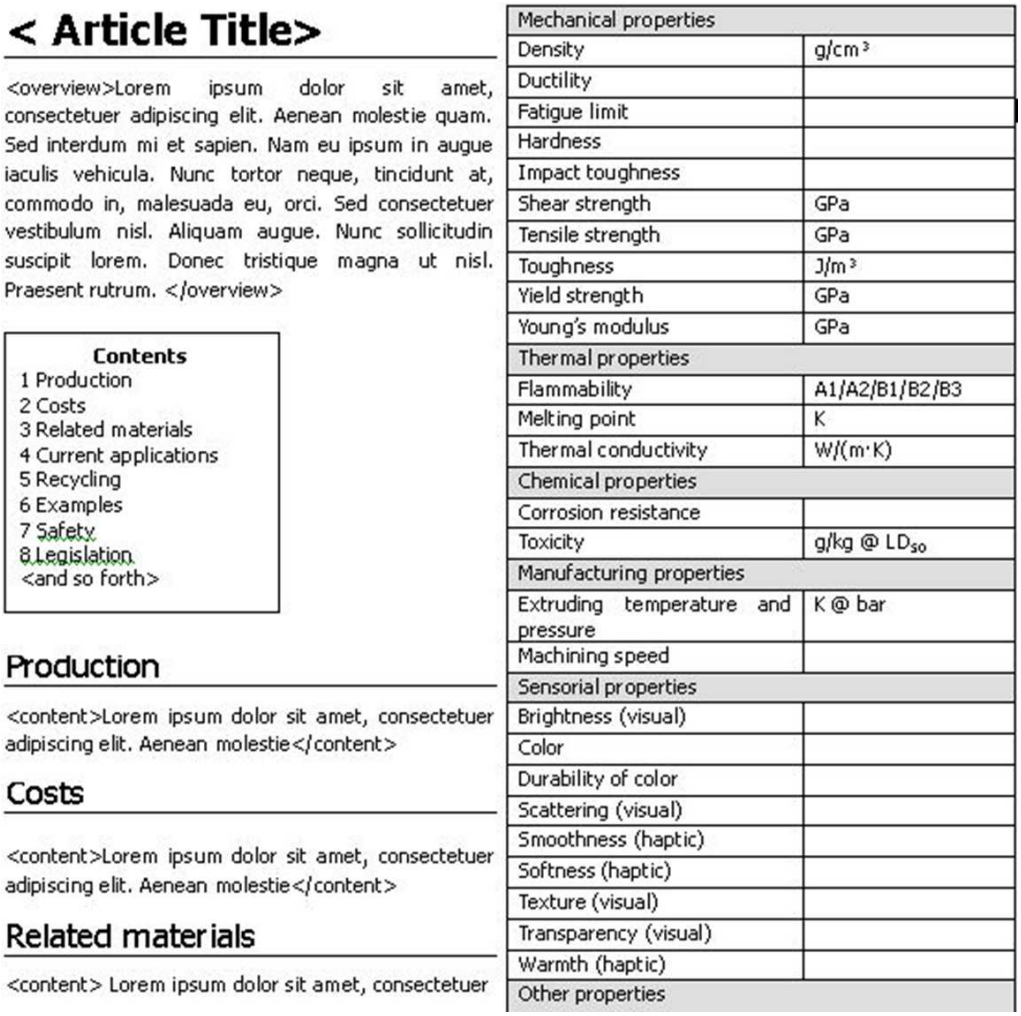

Figure 11 Template design proposal.

nity. As becomes clear from the results of the questionnaire, 67% of all respondents who completed the questionnaire claim to be willing to use and attribute to WikID. Our research shows the existence of templates will improve the willingness to contribute and use WikID. Furthermore the image of Wikipedia seems to have little effect on the target group. Only the relatively inexperienced designers are afraid of finding unreliable information in a wiki.

From the open questions it becomes clear that there are two main reasons why people would not add or edit information in a wiki; time is the most important: it is imperative to make sure adding and editing information takes as little time as possible. Furthermore a lot of respondents stated they are insecure about their knowledge on design subjects.

Due to the lack of structural guidelines for articles in Wikipedia, it is very difficult and certainly not practical to fully automate copying design relevant information to WikID. Because the main problem lies in the fact that it is hard to find design relevant information in a source article for a computer program, it is conceivable that you leave this task to a human, while automating a great deal of the copying process. This could be seen as a tool for copying information to WikID from a Wikipedia (or other wiki) article, designed to minimize effort for the user and thus decreasing the amount of time that is necessary to create new articles in a given amount of time. This tool is developed and implemented in WikID and is given the name “Import Wizard”

Most industrial design engineers and IDE students search for information in the areas of materials, production and working principles. Information on quality, packing and logistics is least frequently sought. In the area of materials, most respondents are interested in technical properties, production possibilities

and costs. Only a small number is interested in related books, distributers and chemical structure. Article templates should be designed with this data in mind.

Based on the data received from the questionnaire we have created a template that makes it easier for users to add information that is considered to be relevant by our user group. This template should help users reduce the amount of effort needed to contribute to WikID.

9. FUTURE RESEARCH

For the materials template, one problem lies in the selection of units for the various material properties. The actual physical quantities have a corresponding SI-unit, but other properties, such as hardness, are often determined by a test, of which several variations exist. Experts in the field of materials science might be able to indicate which test is most common in the area of design engineering.

Sensorial properties pose a more serious problem. Since the use of sensorial properties is quite new, no consensus has been reached on units to express them. Van Kesteren [10] offers an extensive list of these properties, with extreme values, but expresses them verbally. This could of course also be done in WikID, but it greatly reduces possibilities for the use of the Semantic MediaWiki-extension. Sensorial properties will always retain a great deal of subjectivity, but expressing them in numbers instead of words, could (with enough user input) possibly create a certain inter-subjectivity, which is more desirable then the personal subjectivity of the author.

Extra research is needed on the WYSIWYG-extension, there are a number of them, and it should be investigated which is the most useful for our purpose. Current and future research topics for WikID are motivating people to become active users; collaborative improvements of the ontology of design engineering; the graphical options, semantic properties.

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