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Form is Function

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It's said that the Finnish architect Alvar Aalto designed a concert hall foyer in such a way that people when walking across the foyer towards the concert hall would not have to interrupt the conversations they were involved in. They would not need to find and interpret signs or difficult room forms in order to find their way. Aalto put a light shaft at the end of the foyer. People walked towards the light and having done that found themselves just above the stairs to the concert hall. [Ejhed, personal communication]

So one function of the foyer is that it does not interrupt ongoing conversations. This function is not visible in itself but it depends on the real, visible forms. Form as function. What is interesting in this example is that the environment supports human behaviour. We can act without paying that much attention to what we do.

The foyer also needs other functions like the possibility to deposit coats, use a bathroom, etc. But these functions are placed in a way that doesn't intrude. And in order for this to be an environment in which you can go on being social, all the details have to be carefully designed as well.

Although I don't know if this saying is true or not, I regard it as a nice example of an environment that is well designed. This social function was probably not in the original specifications. And it was probably not even a specific request from a user. Designers often design solutions like this that are "more" than just a solution. What they do is to take care of and explore the possibilities that (usually) evolve during the work. [Gedenryd, Suwa]

Form is a medium through which function is expressed and communicated to the user.

Introduction

First I will explain in what sense I use the concepts of *form* and *function*.

> "A technological object has a function, which means that within a context of human action it can be used as a means to an end." [Kroes]

A *designer* usually intends an artefact to have some function(s). This influences the way (s)he designs the artefact and chooses to shape its form in such a way that it gives the user clues to the intended functions. Doing so the form itself becomes an intended function.

The *artefact* in itself is just a physical object.

The *user* is influenced by the form of the artefact, as well as its other properties. A user may or may not use the artefact for the same functions as were intended in the first place. But if (s)he uses the artefact for its intended functions, the form has probably helped. Then the form is a function to the user as well.

If a user chooses to use an artefact for decoration or bragging these are the artefacts' used functions at that time.

The concepts form and function are both seen in relation to people using an artefact, not really as properties of objects. Use and people are essential:

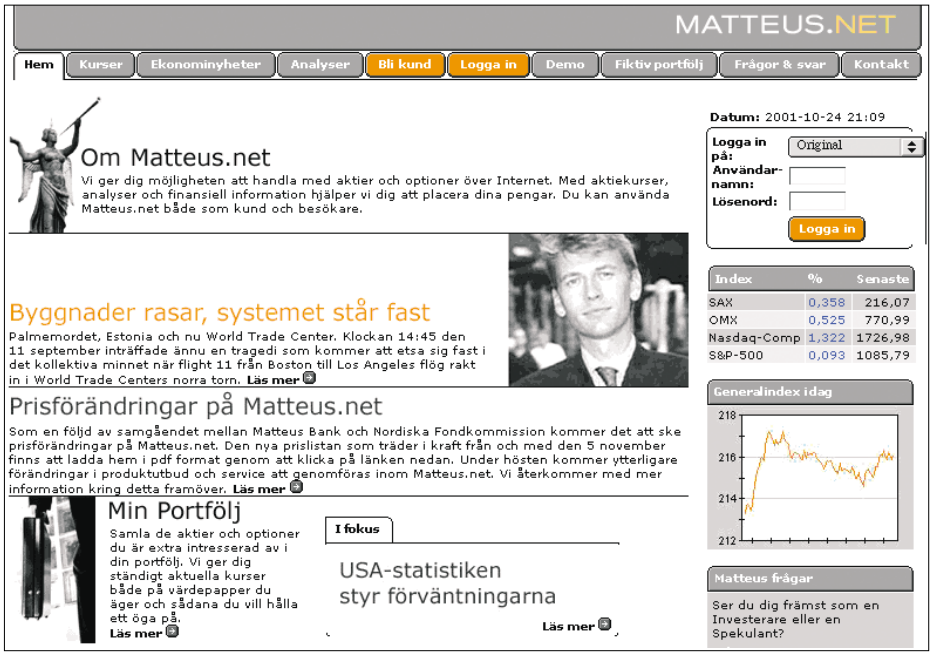


Figure 1. An internet site for stock trading. The two tabs in the middle attract attention due to their ibright orange colour.

> "design can be described as an inquiry into this future situation of use." [Gedenryd, p.157]

One reason for writing this paper is to encourage people engaged in the software development process to pay more attention to the aesthetics at an early stage. Aesthetic concerns will improve both usability and other goals that the application may have.

Example

We will now look at an example from the web. A stock trading site that guides the users by making use of colour. The two orange tabs near the top of the page are probably the first elements on the page that people notice. See fig 1. The left one guides the newcomers to the possibility of becoming a customer, ("Bli kund"). And the returning users are directed to the login function ("Logga in") by the right tab.

Because of the deliberately focused and "clean" design the visitor might also get an impression of the web site as one that is speedy and accurate. The same form element, or sign, supports several functions. The design both guides the user and gives her/him an impression.

The conscious designer knows that we often start by looking at the top of a page and that orange attracts attention. He has also chosen a typeface that fits into the same style as the rest of the site. If the typeface is not what you expect, it will attract your attention, distract you in your action and destroy the impression of speed, which was one of the goals for this site.

Character

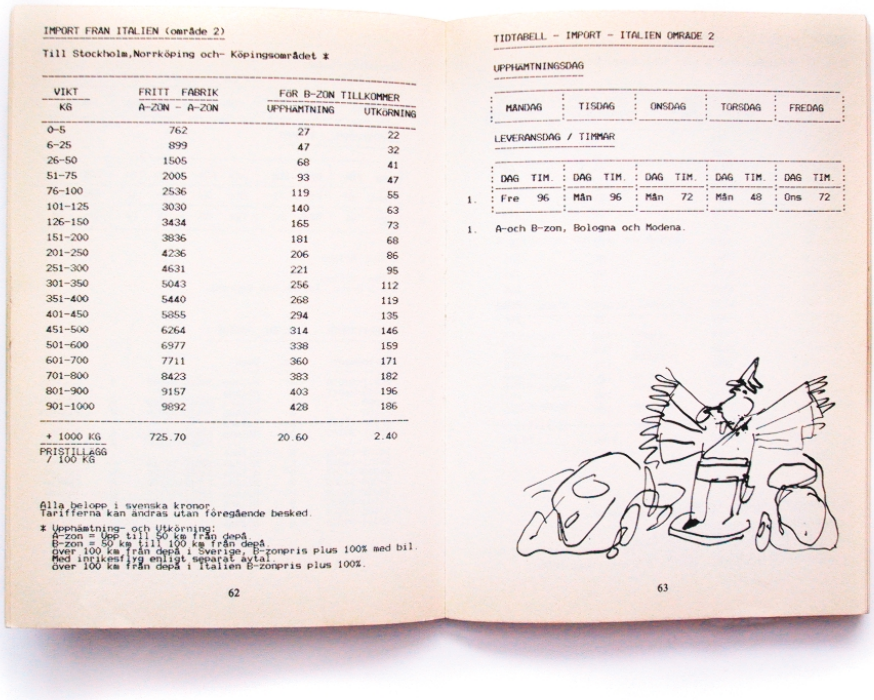
What we look at or use always gives us an impression. We construct a character that we associate with the artefact as soon as we encounter it.

> [Constructing a character is] "one of the basic abilities human beings has evolved in dealing with each other and things in their environment." (Janlert, et al. p.314)

This is inevitable but we are perhaps not always aware of it. What impressions we get depends on our previous experience, our culture, the context, etc. These impressions lead to expectations of our future contacts with the artefact because of the previous experiences we have with things that have similar signs.

Figure 2. A print shop window. SNABB TRYCK means QUICK PRINT.

Figure 3. A catering store.



IMPORT FRAN ITALIEN (område 2)

Till Stockholm,Norrköping och- Köpingsområdet *

VIKT KG	FRITT FABRIK A-ZON - A-ZON	FÖR B-ZON TILLKOMMER UPPHÄMTNING	UTKÖRNING
0-5	762	27	22
6-25	899	47	32
26-50	1505	68	41
51-75	2005	93	47
76-100	2536	119	55
101-125	3030	140	63
126-150	3434	165	73
151-200	3836	181	68
201-250	4236	206	86
251-300	4631	221	95
301-350	5043	256	112
351-400	5440	268	119
401-450	5855	294	135
451-500	6264	314	146
501-600	6977	338	159
601-700	7711	360	171
701-800	8423	383	182
801-900	9157	403	196
901-1000	9892	428	186
+ 1000 KG	725.70	20.60	2.40
PRISTILLÄGG / 100 KG			

Alla belopp i svenska kronor.
Tarifferna kan ändras utan föregående besked.

* Upphämtning- och Utkörning:
A-zon = Upp till 50 km från depå.
B-zon = 50 km till 100 km från depå.
Över 100 km från depå i Sverige, B-zonpris plus 100% med bil.
Med inrikesflyg enligt separat avtal.
Över 100 km från depå i Italien B-zonpris plus 100%.

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TIDTABELL - IMPORT - ITALIEN OMRÅDE 2

UPPHÄMTNINGSDAG

MÅNDAG	TISDAG	ONSDAG	TORSDAG	FREDAG

LEVERANSDAG / TIMMAR

	DAG	TIM.	DAG	TIM.	DAG	TIM.	DAG	TIM.	DAG	TIM.
1.	Fre	96	Mån	96	Mån	72	Mån	48	Ons	72

1. A-och B-zon, Bologna och Modena.

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Figure 4. A price list for a transport company printed 1986 from a pin printed original. It is complemented with drawings that have a simialar expression.

Therefore it is crucial that when we are developing a new product, we should design in such a way that the user can construct a reasonable character for it. This can facilitate the interaction for the user because (s)he gets the relevant expectations. A good character reveals the meaning a product is designed for. Krippendorff writes:

> "Design concerns itself with the meanings artifacts can acquire by their users."[Krippendorff, 1995]

This statement reveals a couple of interesting things to reflect a little more on. Krippendorff states clearly that it is the user that acquires or constructs the meaning, not the designer. Secondly designers know that and work on the signs that the users experience.

Now we will look at photos of things that give us strong first impressions.

Take for instance the print shop shown in figure 2. Many people would probably hesitate to leave their copying work there. The missing letters outside of the shop are interpreted as a result of bad maintenance. This acts as a sign to us that signifies uninterest and sloppiness. We interpret this as if the character of the shop is unengaged and that they do sloppy work even inside.

The catering company (fig. 3) has carefully designed lettering directly on the shop window. The letters are all white and placed in three distinct groups separated with thin lines. This style of typography is common on perfumes and other exclusive products. The handling of the typography and the carefully placed onions in the window signifies to many people that the company is expensive.

Another interesting example is the price list for a transport company in fig. 4. It's printed "back in 1986" when pin printers were common. As a complement to the typography there are some drawings that give the impression of being done rather quickly. Thus the price list gives me an impression that the company is deeply engaged with transporting my packages to different locations as quickly as possible. And on the side they've just thrown together a price list. We perceive a character that is engaged in and focused on the main activity of the company.

The pin printed typography gives both a fresh and an economic impression. The illustrations have a similar appearance. The character that the book lets us construct is in harmony with the content. This makes the statement stronger. We do not get contradicting impressions.

If for a moment we play with the idea that the courier price list had the same expression as the print shop. Then I guess we would give it a character that was too sloppy for most of us. Our experience would say us that there is a good chance that our package would be treated the same way as the lettering. It might just get lost somewhere on the way.

If the appearance of the price list instead had the same signs, expression, as the catering company I guess that we would instead think of the company as slow and expensive.

This implies that, for a specific content and function, some appearances, signs, give us more appropriate characters than other signs.

As a producer you should use all possibilities to direct the impressions and expectations, i.e. the character, that the user constructs. The best for the producer as well as for the user is probably if the expectations are in line with the content and goal of the artefact. When the design signifies the quality and purpose of the content, the user will construct a character that relieves her/him from consciously having to interpret what (s)he encounters.

You can of course not control the user, there is no guarantee that (s)he even catches your idea. This might be a good thing. The user can have even better ideas of how the product can be used and more appropriate in the users context. [Norman] The Vespa was designed to give women a means of transportation and even functioned as a political symbol of democracy. In the 60's Vespas were used by the Mods. Not only did they decorate the Vespa in a way that the designers never had thought of, they altered what it signified. [Sparke]

Internet banking example

A recent study of consumers and technology in a financial context shows that there are problems with the representation of banks on the Internet. One user says:

> "There is a whole lot of text and some boxes to fill out, the name of the bank of course. An image on the screen, that's what it looks like, if that's what you're after? …
> How do I know that it's a bank? I don't …" [Carlell, 2001, p 105]

It seems that the user does not get the impression that the web site is a bank's Internet service. This can have several reasons but here we will focus on the role that signs/form play.

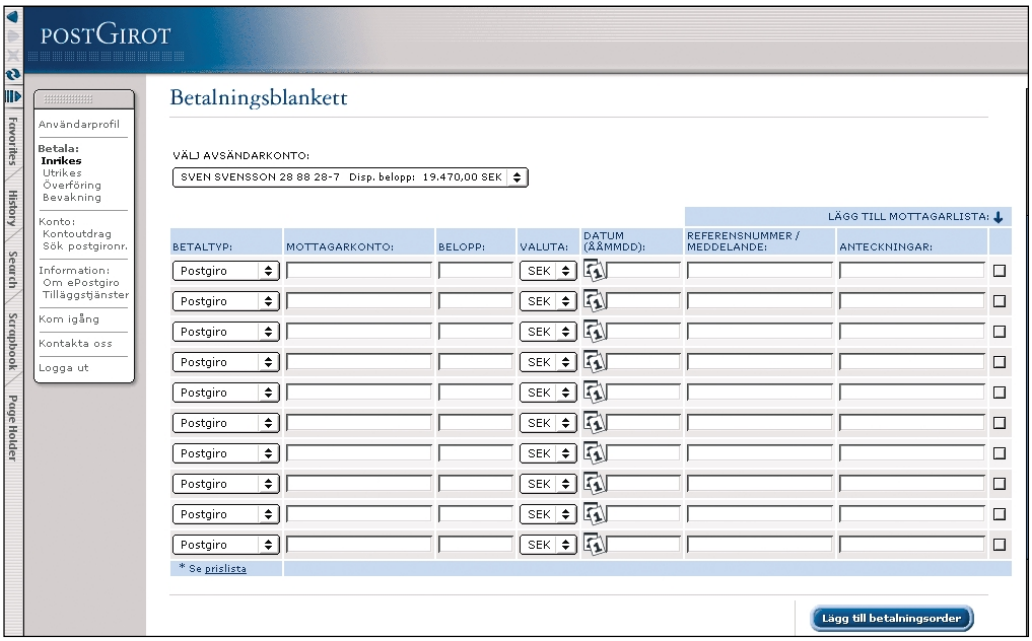

Figure 5. A Swedish Intenet bank's web site.

Figure 5 is a screen dump of a Swedish bank's Internet site. Some of the signs on the web page are those that we connect with the tools, HTML; drop down menus, form fields, etc. The layout seems rather ad hoc and nothing makes you think of banks.

For every bill that we want to pay here we have to use two drop down menus, one checkbox, five fields and interpret a calendar icon. This does not signify precision, which otherwise could be a good starting point. The designers have not provided the Internet bank customer with signs that show the security of the bank or that we could connect with banks or finance.

The Mistake

The mistake with the bank sites, and many other sites and software, is of course not to emphasise that the forms a product has are functional. Form can't be disconnected from functional aspects because form has a lot to do with how the user perceives the content. This mistake resembles the way that Descartes split people into body and mind. The later has been debated ever since and some people consider it a mistake.

The unfortunate effect of not recognizing the role that form has on development is that you tend to focus on only some parts of the product. When you have the "inside software" working you think that you are done. You just have to paste on an appearance.

In software development it is still common to split code between form and function. That's OK, but you must remember to develop ONE product.

The same problem with the "form functions" of products that weren't integrated with the technical functions used to be common in physical product development as well: When the engineers were through with the technical design they thought it was time to have some fun and do the form. Sometimes this resulted in artefacts that were so badly designed that users focused on the wrong parts and therefore had difficulty in constructing meaning and reaching an understanding. Donald Norman presents many examples of this in his books.

But over time the manufacturing industry has realized the importance of form and has been integrating industrial design in product development in a natural way for decades. There has even evolved a profession, design manager, whose role is to integrate design, technology, market, etc.

Industrial design methods

We will borrow a few of the methods that industrial design uses and see if they are applicable on software design. This seems more adequate than graphic design methods since a software product often is much more complex than printed design. From a human perspective software interaction in many ways resembles interaction with physical products. The user has to understand what the product can do for her, how to interact with it, manoeuvre it and also how to interpret the response. This should be easy to understand with the help of industrial design thinking.

I will not argue that this replaces any other method but that it does contribute to the understanding of what the form of the product/website/application signifies.

On one level this approach is rather simple: You describe what the product should do and then check if the form supports that functionality with its signs.

First we need to describe the product as a whole, not split into different specifications. We need one concept that covers all aspects of what the product shall offer and do for the users. Industrial designers use the concept "function".

Gedenryd writes:

> "The artifact's function equals the role it will play in this changed, future situation. This role will usually be quite complex, as the artifact will have aspects in many dimensions: social, organizational and others as much as the physical domain."
> [Gedenryd 1998, p 156]

Functional analysis

Industrial designers often use functional analysis as one of the tools in the product development process. This is a good method for describing an artefact with the help of its intended functions. You describe the intended functions by using only a verb and a noun for each function.

The different functions are then classified into three categories. One function is Head Function, others are Necessary Functions and Desirable Functions. Besides a verb and noun you can also make a note, for example specifying weight or temperature. [Landqvist] [Löwgren]

When you make a functional analysis of an artefact you try to describe every aspect of its use, in its widest sense. A screwdriver's head function is to "turn screw". And it should probably also "fit screw", "fit hands", "enable leverage", "minimize damage", "save environment", etc.

This provides you with a list of short but accurate descriptions of all the intended functions related to the artefact. This list can be used throughout the design process. Naturally it has to be updated when new aspects are discovered.

There are three especially nice features with functional analysis. One is that it covers the whole product. It can include legal, technical as well as aesthetic aspects. An other really important feature is that you describe the functions, not the solutions. You state what you want the product to do, not how. The third one is that it is an activity that easily can be done together with users and people of different disciplines. This means that it's rather easy to get information and opinions from everyone involved. And this shared activity can make people more involved in the design process.

Product semantics

> "Product semantics is the study of the symbolic qualities of man-made forms in the context of their use and the application of this knowledge to industrial design." [Krippendorff, Butter]

Rune Monö, Klaus Krippendorff and Susann Vihma are some of the people that have written about product semantics. It is important to notice that the focus of interest here is when the artefact is *in use.*

Some effort has been made to translate these thoughts into the area of Human Computer Interaction:

Peter Bøgh Andersen says:

> "..., semiotics is helpful for bringing insights from older media to the task of interface design, and for defining the special characteristics of the computer medium." [Bøgh Andersen]

Signs

The concept of a sign is essential for design. The sign is a relation that has been described in many different ways and there is of course disagreement about the definitions of the different sign models. We shall not go into that discussion here, only mention enough to make the reader understand the rest of the paper. One model is develped by Charles Sanders Peirce.

> "A sign... [in the form of a *representamen*] is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen". [Peirce 2.228]

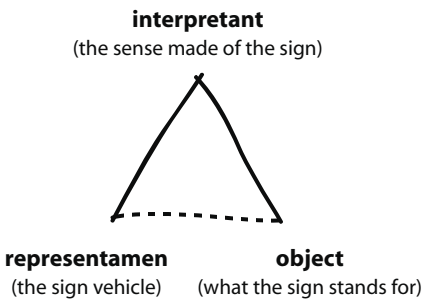

Figure 6. The three aspects of a sign relation according to Peirce. The dotted line is meant to show that there does not have to be any direct relation between the form of the sign and what it stands for.

The quote as well as the figure may seem rather complicated and raise several questions. We can look at an example instead: If we come across some footsteps in the snow, most of us will get the sense that somebody has walked there. One sign in this example is the "dent" made by the shoe (and person). The shoe would be the object, the dent the representamen and our interpretation the sense. But if we never have seen snow or shoes before, we would of course have difficulties making sense of this. The interpretation of signs always depends on the interpreter's experience, social class, age, gender, ethnicity and so on.

In this example there is a direct connection between the object (shoe) and the representamen (the "dents"), but this is not necessary for all signs. Peirce identified three different categories of signs.

In an **indexical sign** the object has really affected the sign vehicle. Examples of indexical signs are recordings, (photography, video), the footprint example above.

In an **iconic sign** the representamen (or sign vehicle) is perceived as resembling or imitating the object, like a portrait, cartoon or scale model.

In a **symbolic sign** the connection between the object and and the sign vehicle is arbitrary and must be learned, e.g. traffic lights, the alphabets.

Susann Vihma made a subdivision of these three and concretised these into twenty "modes of sign functions". These aspects can be used as a checklist when analysing typical design products. As all checklists they can be very useful but must at the same time be used with great caution since they don't cover all interesting aspects.

Icons related to industrial products:

The tradition of form, is normally used as a reference for the new product. Conformity with tradition and especially any divergence from it will be noted and can function as a sign.
Colour, may often refer to a quality: e.g. white can refer to cleanliness.
Material, e.g. gilding indicates wealth; - concrete, emotional coldness.
Metaphor, the resemblance of form to a not designed object. For example, the front of a car may have features of a face.
Style, e.g. the period styles like art nouveau; moreover geometric classifications like "spherical" vs. "square" styles. Here again, conformance and divergence from well known styles (if any) will be salient.
Environment, some industrial products are designed for a specific environment, e.g. kitchen; others may have the (false) appearance of being so designed, e.g. a sports car appearance.

Indices related to industrial products:

A pointing form, arrows and pointers are often found on the operating buttons of machines; sometimes the product itself has such a form.
Traces of tools, used in manufacturing.

Marks of use, abrasion, dents, flaws, dirt etc.
Other traces, e.g. rust and corrosion. Drops of water on the surface of bottle indicate cool drink.
Light and sound signals, often indicate technical functions of appliances and computers.
Noise, sound of use of a product.
Smell, of a product. If the original smell is disagreeable, it can be altered.
Touch, of the material may indicate quality. By lifting a container you can find out if it is empty or not.
Graphic figures, if they are integral parts of the product. An example is the yardstick with scale and numbers. Today, most graphics on products are really symbols, see below.

Symbols related to industrial products:
Graphic symbols, e.g. logotypes, on-off-buttons, washing instructions on textiles.
Symbolic colour, e.g. the red carpet.
Symbolic form, e.g. uniforms.
Position and posture, closeness, above or below
Material, e.g. of a dress indicates social status and the character of the social event. [Vihma, comments from the web site]

Surprisingly many of these signs are relevant even for software. It is only smell, touch and material that aren't useful. All the others give interesting contributions.

The bank site from a semantic point of view

We will now describe the bank's web page in figure 5 with the help of the semantic properties above:

Iconic:
The tradition of form. Logotype in the top left corner. Menu to the left.
Colour. A few different blue colours.
Metaphor. In the date column there is a calendar icon on every row. These are actually buttons that open a new window containing a calendar, but they don't have the different thickness on the lines that the other buttons have.
Style. A mixture of styles: The top resembles the reflexes and shadows that appear on physical things. In the left part there is a menu that has "shadows" and therefore seems to be floating, i.e. able to be moved. In the center is a structured spreadsheet in a style that seems to come from an office application. The place where the user's "input text" should go seems to be behind the "surface". And in the bottom of the page there is a button that is somewhat in the same style as the top of the page, but it also has an extra round frame.
Environment. This is definitely produced for use on a computer connected to the web.

Indices:
A pointing form. Two arrows on all 21 drop-down menus and one above the checkboxes.
Traces of tools. Drop down menus with standard appearance and uncontrolled typeface. Fields with borders for typing information into. Checkboxes.

Symbols:
Graphic symbols. Several different typefaces and treatments of them. logotypes, There are several buttons where the contour lines have different thickness, resembling the light coming from the upper left part of the screen.
Symbolic colour. Blue is probably the most common colour for text in logotypes and on business cards. It signifies a corporate context.
Position and posture. The logotype is at the top signifying importance. In the greater part of the screen is the area where the user shall type in information.

Reflection over what the banking site signifies

The only place where somebody has put some conscious effort into creating a form is at the top of the page, where the logotype is accompanied by vanishing lines and changing colour. This takes care of the brand only on a very shallow level. It totally ignores the reactions the user has when trying to pay her bills.

No effort at all seems to have been made to design the area where the user "works" in a way that would guide, lead and ensure her/him. All the boxes and fields make the user feel lost and neglected by the bank. The form signifies a dull and "efficient" accounting application.

It is of course *possible* to pay the bills in a technical sense. However the different styles give the user a split and contradictory impression. It is impossible for the user to construct a single character that signifies a safe banking system.

Functional and semantic analyses combined

Using a combination of functional analysis and product semantics several groups of students have successfully analysed some web sites. The groups of students were from the Institution of Applied Communication Science at the University of Stockholm and from the Royal Institute of Technology. These groups of students are not being trained to become designers. But the first group will be likely to order web sites. And the latter group will most likely produce software. Therefore it is of great importance that they have tools that help them understand the aesthetic aspects of software.

First they made a functional analysis and guessed the ten most important functions that the web site should achieve. Then they looked at all the signs on the web pages following Vihmas list. Finally they analysed whether the different signs supported the intended functions or not.

This proved to be a good eye opener. The students said that they would never have "seen" so much on a page without this approach.

There are of course several functions that are not covered by semantics, like the time it takes to get a response.

This approach also works well when designing new web sites. Then it is possible to analyse whether the elements that you put on the page support the desired functions or not.

An amusement park's website

One of the sites that the students studied was an amusement park's web site. The following is an example of the method using "Gröna Lund", a popular amusement part in Stockholm, as the subject. See figure 7. It is naturally a subjective description. To make the method more clear, the results of the analysis is somewhat shortened here.

Figure 7. The web site of Gröna Lund, a popular amusement park in Stockholm. Gröna means green.

Functional analysis of the Gröna Lund site

Facilitate visits (physical)
Supply information (open hours, directions)
Encourage visiting
Have character (funny, simple and serious)
Have expression (playful, carnival)

Semiotic analysis of the Gröna Lund site

Icons

Traditional form: menu on top, company symbol to the top left.
Colour: the green colour associates to nature, parks.
Style: circus, amusement park, the headings on the three boxes to the left have name-signs that might makes you think of wooden ones on a circus wagon.

Index

A pointing form: arrows in front of menus.
Traces of tools: radio buttons, form field, drop-down menus
Light and sound signals: there are sounds and light signals in some fields. You can listen to recorded radio ads.

Symbols

Graphic symbols: Gröna Lund logotype, Tyrol logotype, send button, ”sale” star, Brittish and Finnish flags.
Symbolic colour: bright colours can signify play, children.
Position and posture: the animated illustration of the park is rather big, in the left centre and therefore attracts interest.
The form and position of “buttons” and “links” are designed in such a way that they guide people to the information they are after. The different elements have a similar style and help the user construct a character of the web site that resembles the character of the actual park in many ways. The site inspires and makes it easier for people to visit Gröna Lund.

The conclusion is that the different elements support the desired functions of the web site.

Summary

To make a useful artefact we need to show its functions to the user. The meaning a user constructs from interacting with an artefact depends both on its form, the context and on the user’s experience, background, etc. The artefact’s form is a key function that can help the user in finding, understanding and using the other functions an artefact offers, i.e. **form is a function**.

It helps to have one concept, function, to describe everything that a software or an artefact is intended to offer. By identifying, what the most important functions are and how the user should react to them, it is more likely that these intentions are communicated to the user. The form or signs help the user both in finding content and in understanding the character of the artefact, especially what the relevant expectations might be. It’s important that all people involved in software development recognize the importance of the form.

It is a good idea to involve a designer in the team right from the beginning since a designer is trained in and has experience of the meanings users acquire from interacting with artefacts.

Acknowledgements

I thank my colleagues at CID both for contributing to a multidisciplinary environment where interesting questions are discussed and also for providing me with helpful comments on this paper. I also thank the reviewers for pointing out some good and bad features of the first version of this paper.

Keywords

Design, user, sign, product semantics, semiotic, industrial design, function, functional analysis, web.

Figures/Notes

Artefact is spelled in UK English. But the quotes have their original, often US English, spelling: artifact.

"'Semiotics' was the term that originally tended to be used in North America, 'semiology' in Europe, but now they seem to be in effect interchangeable." [Medway, et al, p185]

Figure 1. This web page was accessed in september 2001. The site is now changed.

Figure 4. This price list is reproduced with kind permission from TNT Sweden. The illustrator and designer are unknown (to me).

Figure 5. This web page was accessed in march 2001 at: http://www.postgirot.se/epostgirodemo/main_demo.html. The red text "DEMO" that appears on the original demo web page has been erased in order to resemble what the actual users meet.

Figure 7. This web page was accessed in december 2001 at http://www.gronalund.se/

Photographs and drawing by the author.

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