Accurate Colour Reproduction in Prepress

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Abstract: The adjustment of colour to achieve an acceptable match between the displayed (soft copy) and printed (hard copy) document is an important task in prepress. In order to achieve such match colour management systems are used, these systems implement standards established by the International Colour Consortium (ICC).
A key step of the colour management process is the calibration of display and output devices, the definition of the relationship between the native colour space of the device and a standard device-independent colour space. In this work the usability of the ICC colour management standard was investigated in case of flat panel LCD display calibration.

1 Introduction

1.1 Liquid Crystal Displays

Liquid crystal displays (LCDs) are replacing the traditional high quality and high contrast cathode ray tube monitors in the field of prepress, due to their ergonomic properties and low cost. Manufacturers contribute to the popularity of LCDs by specifying their product's critical parameters (response time, viewing angle) so that they appear more attractive to users less familiar with technical aspects. For example response time and viewing angle are specified as scalar quantities, although plotting the response time as a function of grey level steps or how the contrast ratio changes with viewing angle are more informative (Figure 1).

The transmission of an LCD pixel is controlled by the voltage applied to the top and bottom electrodes; an external light source is used to illumination is the array of pixels. The structure and technology of the LCD screens is diverse, the most popular is the twisted nematic (TN) structure, because of its short response time it is has a dominant position on the market among the 17-inch and smaller diameter LCD displays. The disadvantages of the TN LCDs are the small viewing angle and low contras ratio.

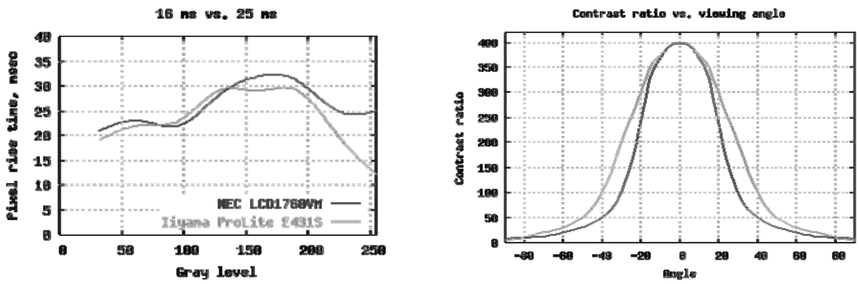

Figure 1

Pixel rise time as a function of grey level changes (left) and contrast ratio as a function of viewing angle in case of two LCD screens

In order to overcome these serious drawbacks other technologies, such as Switching (IPS), Multi domain Vertical Alignment (MVA) and Patterned Vertical Alignment (PVA) were developed. A common advantage of all three technologies over the TN displays is that if a pixel fails its transparency drops, appearing as a black dot on the screen [1]. All technologies have strengths and weaknesses, a summary of these is presented in Table 1.

Table 1

Advantages (+) and disadvantages (-) of LCD technologies

	TN	IPS	MVA	PVA
Contrast ratio			+	+
Response time	+			
Viewing angle	-	+	+	+

1.2 Colour Management in Prepress

As the colour document develops images are imported (e.g. originals are digitalized, displayed, edited, merged, etc.); during the process of prepress the use of colour management is necessary to adjust the colour scheme of the document to be printed.

Imaging, display and output devices have different primary colours and tone reproduction functions. It is the task of the colour management system to define the appropriate transformations between device primaries and tone reproduction curves to achieve accurate colour reproduction.

The majority of up-to-date graphical applications and computer operation systems are compatible with the colour management standard developed by the ICC (International Colour Consortium). According to this standard the colorimetric characterisation of the devices are stored in a separate file (ICC profile), which the users usually obtain by a colour measurement and management system, that generates and stores the appropriate profile automatically. The ICC standard allows two models to define the transformation between the device independent colour space of the monitor and the standard colour space (e.g. CIELAB): look-up table interpolation or the linear transformation of the device primaries together with the non-linear tone reproduction functions of each colour channel.

The standard offers 5 model tone reproduction functions (Table 2) including a simple power function ('gamma function'), the 'gain offset gamma offset' type function, which works well with cathode ray tube monitors, and the linear extension of the latter. In an ICC profile the number of the function and the calculated parameters are stored [2].

Table 2
Tone reproduction curves offered by the ICC standard

#	Function type	Parameters
1	$Y = X^{\gamma}$	γ
2	$Y = (aX + b)^{\gamma}$ $\quad X \geq -b/a$ $Y = 0$ $\quad X < -b/a$	γ, a, b
3	$Y = (aX + b)^{\gamma} + c$ $\quad X \geq -b/a$ $Y = c$ $\quad X < -b/a$	γ, a, b, c
4	$Y = (aX + b)^{\gamma}$ $\quad X \geq d$ $Y = cX$ $\quad X < d$	γ, a, b, c, d
5	$Y = (aX + b)^{\gamma} + e$ $\quad X \geq d$ $Y = cX + f$ $\quad X < d$	γ, a, b, c, d, e, f

2 Method

Eight desktop and laptop monitors were included in the study. We were looking for the ICC tone reproduction function that produces the best match with the measured tone reproduction curve. The manufacturer, type and applied resolution of the 8 displays are listed below:

- Compaq nx7010 15.4" LCD (1680 x 1050)
- Samsung Syncmaster 710N 17" LCD (1024 x 768)

- LG Flatron L1710B 17" (1024 x 768)
- HP Omnibook xe3 15" (1024 x 768)
- Fujitsu Siemens PA 1510 (1280 x 800) (2 db)
- Sony SDM S51 15 " (1024 x 768)
- HP L1702 17 " (1280 x 1024)

We used a commercial, market leader brand colour management system consisting of a measurement unit and application software that handles the measurement data, computes the colour transformation parameters, generates the ICC profile and copies it to the specified library of the operation system without user interaction. This file was used to obtain the tri-stimulus values of the monitor primaries and the tone curves of the colour channels. Non-linear optimization was performed on the ICC model functions to achieve a best match with the measured tone reproduction curve. The cost function was the average ΔE^{*}_{ab} colour difference between the measured sample and model output.

3 Results

Tables 3 and 4 present the average colour differences between the measured colour reproduction curves of the colour channels of each monitor and the ICC functions optimized for best match. However results are shown for only three curves: the measured tone reproduction curve (f_0), the 'gamma function' (f_1), and the 3rd tone reproduction function (f_3).

Values in the f_0 column of the tables indicate, that in many cases the linear transformation of the primaries already produces significant error even with the measured tone reproduction curve. This error is caused by the colour channel being non-independent of each other.

The importance of column f_1 (the 'gamma function') is due to the fact, that the profiles, generated by the colour management system contained exclusively this function to model the measured tone reproduction curves. However in many cases the 3rd model function results more accurate reproduction of the tone curve.

We have experienced no improvement with the 4th and 5th model functions of Table 2, therefore results are not shown to save space.

Table 3
Average ΔE^*_{ab} colour differences between the model output and the measured samples for each colour channel (Red, Green, Blue), f_0 is the measured tone reproduction function f_1 is the first, f_3 is the third tone reproduction curve of Table 2

	Colour channel	F_0	F_1	f_3
Monitor 1	R	1,6	1,9	1,4
	G	3,0	3,0	3,0
	B	5,9	5,6	5,6
Monitor 2	R	1,5	1,4	1,4
	G	2,9	2,9	2,9
	B	5,0	4,8	4,8
Monitor 3	R	3,3	5,4	3,4
	G	3,5	4,8	3,7
	B	5,8	5,7	5,7
Monitor 4	R	4,4	5,8	4,2
	G	3,5	4,3	3,6
	B	7,8	8,0	7,8
Monitor 5	R	1,5	1,4	1,2
	G	1,1	1,1	1,1
	B	1,8	1,5	1,3
Monitor 6	R	0,8	0,8	0,7
	G	2,4	2,4	2,4
	B	4,5	4,0	3,9
Monitor 7	R	1,6	1,7	1,3
	G	1,2	1,1	1,1
	B	2,4	2,2	1,9
Monitor 8	R	1,4	1,5	1,3
	G	1,3	1,7	1,4
	B	2,8	2,5	2,5

We measured relatively small average colour differences between the measured samples and the model output. In cases when the ΔE^*_{ab} value was not greater than 5 we also calculated CIEDE2000 [3] colour difference values (Table 4.), this novel formula predicts perceivable colour differences more accurately. Laptops are among the first 4 monitors in the list, it can be seen, that the other desktop LCDs can be modelled better according to the ICC standard.

Conclusions

In our experiment with LCD monitors we have found computed colour differences between displayed samples and the output of the ICC model predictions well within the visible range. The main cause of the errors was the lack of colour channel independence.

The investigation of the generated profile ICC profile found out that the automatic colour management system uses the simple power function to model measured tone reproduction curves in all cases; however we have achieved better matches using the 3rd function ('gain-offset-gamma-offset') of the ICC standard.

Table 4

Average CIEDE2000 colour differences between the model output and the measured samples, f_0 is the measured tone reproduction function f_1 is the first, f_3 is the third tone reproduction curve of Table 2

	Colour channel	f_0	f_1	f_3
Monitor 1	R	1,6	0,9	0,7
	G	1,4	1,4	1,4
	B			
Monitor 2	R	0,7	0,7	0,6
	G	1,3	1,3	1,3
	B	2,4	2,7	2,7
Monitor 3	R	1,7		2,0
	G	1,8	2,8	1,9
	B			
Monitor 4	R	2,5		2,4
	G	1,7	2,3	1,7
	B			
Monitor 5	R	0,6	0,6	0,7
	G	0,5	0,5	0,5
	B	0,7	0,7	0,8
Monitor 6	R	0,4	0,4	0,4
	G	1,1	1,1	1,1
	B	1,9	2,1	2,4
Monitor 7	R	0,6	0,7	0,8
	G	0,4	0,4	0,4
	B	1,0	1,2	1,3
Monitor 8	R	0,5	0,9	0,8
	G	0,6	1,0	0,7
	B	1,2	1,7	1,7

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Lyocell, The New Generation of Regenerated Cellulose

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Abstract: For the majority of the last century, commercial routes to regenerated cellulose fibres have coped with the difficulties of making a good cellulose solution by using an easy to dissolve derivative (e.g. xanthane in the case of viscose rayon) or complex (e.g. cuprammonium rayon). For the purposes of this paper, advanced cellulosic fibres are defined as those made from a process involving direct dissolution of cellulose. The first examples of such fibres have now been generically designaed as lyocell fibres to distinguish them from rayons, and the first commercial lyocell fibre is Courtaulds' Tencel.

Keywords: cellulose, fibre, lyocell

1 Introduction

The cellulose fibers produced by direct dissolution have the generic name of lyocell.

Cellulose is one of the most abundant natural resources on earth, and there has been extensive research on the films, plastics, and fibers from this material.

The history of cellulose fibers dates back to the 1860s, when the first rayon fibers were commercialized by Courtaulds. But the so-called rayon process includes toxic chemical treatments to block hydroxyl groups of cellulose to prepare a spinnable solution, sometimes causing ecological problems.

Many attempts have been made to invent new solvents to directly dissolve cellulose, and some successful results have been reported [1]. Among these, N-methylmorpholine-N-oxide (NMMO) hydrate turned out to be the best solvent, leading to the commercial success of cellulose fibers under the trade name of Tencel by Courtaulds in 1994 (Figures 1 and 2).

Other lyocell processes include Lenzing Lyocell and TITK Alceru [2]. These processes are advantageous because they are environmentally benign, using nontoxic NMMO hydrates instead of toxic carbon disulfide, which can be almost totally recycled.

The lyocell fiber has a highly crystalline structure in which crystalline domains are continuously dispersed along the fiber axis. This offers good wet strength as well as excellent dry strength, which makes lyocell water-washable. Further, it shrinks less when wetted by water and dried than other cellulose fibers such as cotton and viscose rayon [3, 4, 5, 6].

Recently, a new lyocell process, the Cocel process [7], was devised, which has some characteristic features similar to the Tencel process. The new process dissolves finely powdered cellulose in molten NMMO hydrate within 5 minutes by means of a pasting stage, which causes much less decomposition of cellulose. Further, this process can use NMMO hydrates with a hydration number (n) greater than 1 because it adopts a plasticating extruder. The value of n plays a significant role in the phase behavior of cellulose solutions [8, 9]. It also affects the physical properties of the fibers spun from the solution [5, 6, 10].

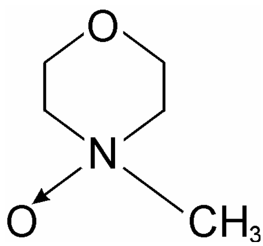

Figure 1
Structure of N-methylmorpholine-N-oxide

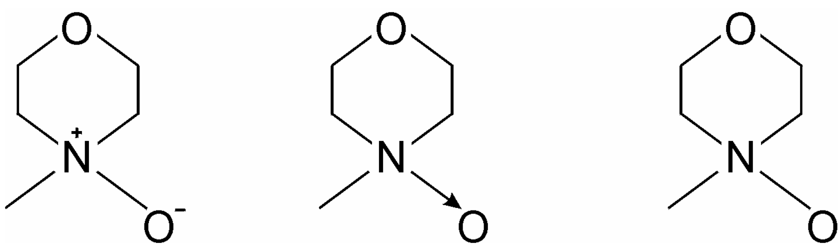

Figure 2
3 Possible Formulas of N-methylmorpholine-N-oxide

2 Direct Dissolution in Amine-Oxide

NMMO emerged as the best of amine-oxides and Neil Franks and Julianna Varga [11] developed a way of making a more concentrated and hence economical solution of cellulose, by carefully controlling the water content of the system. Figure 3. shows that the concentration of water and cellulose where complete dissolution of the cellulose occurs (at 95%), lie between lines B and C. Between lines A and B there can be 95% confidence that the solution would be free from undissolved cellulose fibres are bound to be present. Similarly, between lines C and D there is a 95% chance that crystals will always be present to the left on line D. Figure 4 shows the same information in he more familiar ternary diagram form.

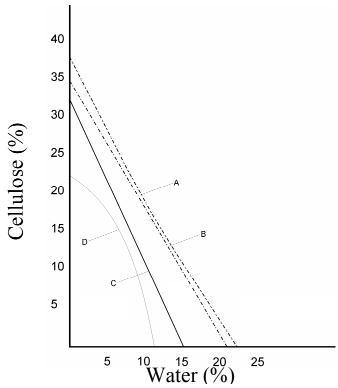

Figure 3

Dissolving Cellulose in NMMO and water mixtures

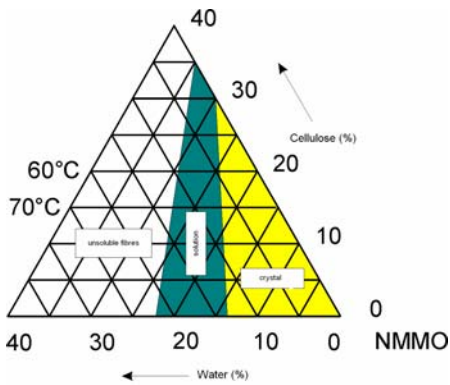

Figure 4

Ternary diagram showing the effect of temperature on the dissolution cellulose in NMMO

3 The Properties of Lyocell

Comparisons of lyocell with viscose in both laboratory and test markets proved that the fibres were sufficiently different to deserve separate marketing strategies.

Lyocell is:

- stronger than any other cellulosic fibres, especially when wet
- easy to process into yarns and fabrics alone or in blends
- easy to blend (unique fibre presentation)
- easy to spin to fine count yarns
- very stable in washing and drying
- thermally stable
- easy to dye to deep vibrant colours
- capable of taking the latest finishing techniques to give unique drape
- comfortable to wear

4 The Courtaulds' Lyocell Process

The Courtaulds' semi-commercial production system is illustrated in Figure 5. Dissolving grade woodpulp is mixed into a paste with NMMO and passes through a high-temperature dissolving unit to yield a clear viscous solution. This is filtered and spun into dilute NMMO, whereupon the cellulose fibres precipiate. These are washed and dried, and finally baled as staple or tow products as required by the market. The spin-bath and wash liquors are passed to solvent recovery systems which concentrate the NMMO to the level required for re-use in dissolution.

PULP
↓
NMMO → MIXING
↓
DISSOLUTION (HOT)
↓
FILTRATION
↓
SPIN / STRECH
↓
WATER → WASHING
↓
DRYING
↓
STABLE FIBRE OR TOW

Figure 5
Direct Dissolution: Courtaulds' Lyocell

5 Lyocell Conversion

Lyocell is similar in strength to polyester and stronger than cotton and all other man-made staple fibre cellulosics. It also has very high dry and wet modul for cellulosic fibre in both the dry and wet states. Thes properties allow customers great scope for making strong yarns in blend with virtually all the other commercially avaiable staple fibres. They also lead to excellent efficiencies in converting these yarns to woven add knitted fabrics.

All man-made cellulosics lose strength and modulus when wetted, but lyocell reduces by much less than others. This is important in determining how properties of the fabric are developed during dyeing and fnishing. However the fibres do fibrillate during the abrasion and thus specific techniques are required to achieve the best results, these are discussed later.

Once lyocell fibre has been producted, either as cut staple fibre or continous tow it will be converted to yarns and fabrics by a range of conventional textile processes. The most common way of using lyocell fibre is as cut stable, with 1,4 and 1,7 dtex fibres being cut to 38 mm and converted into a spun yarn using machinery developed over many years for handling coton fibres which are similar in linear density and length to lyocell.

The following comments apply to the processing of Tencel fibres. The Lenzing Lyocell is made by a wet cut route and has very different processing characteristics //12, 13, 14/.

5.1 Yarn Manufacture

Tencel can be produced via established yarn manufacturing routes, uses conventional machinery with few major changes to settings or procedures.

Its processing performance is influenced by the following properties:

- it possesses a non-durable crimp
- it has a high modulus
- there is a little fibre entanglement

Thus lyocell will open easily with little nep. In sliver and roving the fibres packs together, give high cohesion and require high draft forces. In yields yarns with high tensile strength and few imperfections. In blends well with other fibres, especally other cellulosics. In adds strength to the final yarns and enhances the perfomance and aesthetic values of final fabrics.

5.2 Lyocell in Nonwovens

A nonwoven is broadly defined as a textile structure made directly from fibre rather than yarn. The fabric is usually made by pruducing a web of fibres which is then strengthened by bonding using various techniques, for example:

- Thermal bonding
- Hydroentaglements
- Needle bonding

The key properties of lyocell which make is suitable for nonwovens are:

- high strength
- biodegrability
- easy processing
- absorbency
- potential to fibrillate

Preparation of fibre web can be done in many different ways, however two main methods are carding and wet-laying.

Not all webs are sutable for bonding by all methods, however, both wet-laid and carded webs are suitable for hydroentanglement. This is area in which work has concentrared on lyocell, owing to the fibres'ability to fibrillate in wet processes. Hydroentanglement produces bonding entangling the fibres together. This is done by passing the web under rows of high pressure water jets. As this is a wet abrasive process lyocell can be made to fibrillate at high water pressures, producing submicron fibrils, which enhance filtration properties.

Hydroentanglement gives strong lyocell fabrics, which compare well to polyester and stronger than viscose. Lyocell can be bonded using a wide range of other techniques, which will not be discussed in detail here. It is being trialled and developed in nonwovens for a wide range of fend-uses including:

- surgical swabs, drapes and gowns
- floppy disc liners
- filtration applications
- semi-disposable workwear
- lining materials

5.3 Lyocell Papers /15/

The ability of lyocell in fibrillate means that is can be processed and made into a paper, like wood pulp. The main steps in paper making are:

- Beating and/or refining – these two processes take a dilute suspension of short fibre – and mechanically treat the fibre in order to fibrillate it.The forces exerted on he fibres cause the fibre to fibrillate and can also cut the fibre.
- Sheet formation, the refined stock is diluted further and then pumped to the paper machine where is diposited onto a porous metal belt or wire. The water is sucked through the belt, leaving the fibre on top as paper sheet. The paper is then passed through a series of drying cylinders and presses before being wound on a roll.

Lyocell can be processed into a strong paper. The properties depend upon the amount of fibrillation generated, increased fibrillation gives more paper strength, and also affects of properties. In general lyocell papers are strong, with good opacity and low air resistance owing to the circular nature of the fibres and fibrils. The end-uses being explored are therefore mainly filtration applications, and also as an additive to improve the properties of a standard paper made from wood pulp.

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Designing Textile Products for the Full Life Cycle with a Special Focus on Maintenance during Usage

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Abstract: It is a common idea about designing in light industry that only those product parameters are focused on which are realized at the moment of delivery to the user. We developed a new, innovative design method, which considers the full life cycle of the product. We extended the widely used QFD method into a complex set of customer demands about the product. For the contradictory demands we set into the design process a modern method that provides the optimal compromise level. Computer software supports the use of both methods in everyday practice.

Keywords: designing textile products, full life cycle, maintenance during usage, Quality Function Deployment, seeking compromise solutions, Harrington optimization method, desirability, compromise function

1 A Modern View of the Design Process

A complex design process should precede the production of a quality product that is to meet all the requirements of the modern consumer society. Designing is a complex problem-oriented process, which must fulfil all the demands and expectations concerning the product. The phases of the design process should be implemented according to a well-defined and fully controlled method. Designing for the full life cycle is a new and modern extension of the actual demands concerning the product, as well as fulfilling these demands.

Designing for the full life cycle is not an extensively used method at the moment. Many designers still have a conventional view of the design process. This conventional view restricts the demands concerning a product to those characteristics that are realized at the delivery of the product to the customer.

2 Phases of the Life Cycle

This conventional view, however, fails to admit that there are far more demands concerning a product than those realized at the delivery. The suitability of the product is obviously not constant. At the end of its life cycle the product much less meets the demands and functions, and finally it breaks down or gets outdated. The modern design process has to take into consideration all the demands and aspects concerning each and every phase of the life cycle.

Table 1
Design aspects according to the different phases of the life cycle

Phases of life cycle	*Design inputs*
Designing the product	- methodology is needed (documentation, sizing, composition, cost analysis etc.) - knowing the available materials (type, size, costs, performance parameters etc.) - knowing the available technology (production line, equipments, costs, human resource demand) - the risk types caused by the product - customer demands (function, performance, aesthetics etc.) - etc.
Implementation	- human resource capacity - knowing the available technology (production line, equipments, costs, human resource demand) - waste analysis, expected waste rates - condition and maintenance of equipment - etc.
Putting into use	- available commercial channels - product information for customers - etc.
Supporting maintenance during usage	- planned frequency of usage - expected lifetime of parts - maintenance possibilities, used equipment and material - changes in the characteristics expected during maintenance (functional, aesthetical) - etc.
Improvement	- users' experience (e.g. guarantees, customer complaints) - compatibility of the improved parts and units - etc.
Withdrawal from circulation	- knowing alternative products - expected lifetime - consequences of withdrawal - etc.
Recycling/destruction	- collection possibilities - recycling possibilities and neutralization characteristics - type and measure of pollution in different destruction methods - etc.

The delivered products will undergo regular maintenance procedures. During usage, different types of faults can occur resulting that the original function of the product can only be recovered with replacing parts. In case of textile products maintenance can mean cleaning (washing or chemical treatment), hot shaping (ironing, steaming), replacing some parts (changing decoration, fringes, etc.).

In the design process, all the demands of the different phases of the life cycle should be considered. The most important aspects are maintenance and cleaning, for which special demands can occur. Failing to regard these aspects can cause a product originally designed for a longer lifetime to be destroyed or lose its functional and aesthetic value after the first cleaning.

Most products lose from their quality and their parameters are changed during usage. In case of textile products this change can involve a worn-out and rugged surface, which is not only an aesthetical question, but also affects the mechanical parameters of the product. In case of knitted textiles, non-expected stretching can also be a problem. These changes of the quality can be eliminated with choosing the proper material and textile structure during the design process.

3 Designing Products for the Full Life Cycle

a) Quality Function Deployment for the Full Life Cycle

The basic condition for a product design based on customer needs is to get acquainted with the expectations of the customers and the society (everyone concerned), and to translate these demands to technological terms.

In order to regard all the demands concerning the design process, a complex methodology is needed. The basis of the design process can be the Quality Function Deployment (QFD) method. The main advantage of this method is that it can be used under very basic circumstances, but, on the other hand, in case of complex innovation projects, a more elaborated form of the method can be applied. The present study aims to extend in an innovative way a method wildly used in car designing.

The most important practical means of implementing the QFD method is the matrix technique. Customer demands give rows of the matrix, whereas those technological, quality and product parameters that are capable of fulfilling these demands give the columns. The matrix contains numbers that express the connection between the rows and the columns.

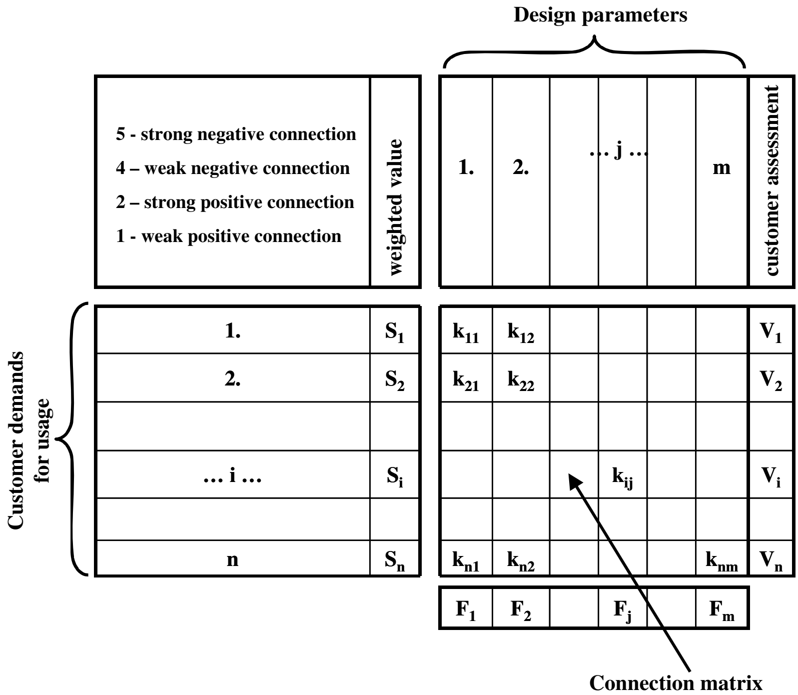

Figure 1
General QFD matrix

Entries of the connection matrix are numbers (k_{ij}) defined by team members, expressing the connection between every aspect of the customer demands and the designing parameters. In defining the values, we consider the direction and the strength of the connection:

- 1 – strong; 2 – weak negative connection (in case of negative connection increasing the value of the design parameter results in a reduction in the level of fulfilling customer demand).
- 5 – strong; 4 – weak positive connection (in case of positive connection increasing the value of the design parameter results in an increase in the level of fulfilling customer demand).
- 3 – there is no connection between the customer demand and the design parameter. In the matrix, we omitted number 3, in order to make the table clearer. So the meaning of an empty box is 3.

The numbers expressing the strength of the connections are based on subjective evaluation, but their value is in proportion with the correlation coefficient. The correlation connection close to +1 means the number 5, that close to –1 means the number 1, and that around 0 means the number 3.

As a result of the QFD method we get a list of the design parameters that have to be improved, in the order of priorities.

$$F_j = \sum_i S_i \cdot (k_{ij} - 3) \cdot (5 - V_i)$$

where S_i- is the weighted value of the customer demand,

k_{ij} – is the entry of the connection matrix,

V_i – is the product assessment by the customer.

b) Modifying QFD regarding the Full Life Cycle

Too many times, including the conventional application of the QFD method as well, the customer is interpreted simply as a user of the product, and the definition of the demands is restricted to those expectations realised during the usage of the product. According to the modern view of the designing process, the customer has to be identified in every phase, throughout the full life cycle, so that the demands that occur in the different phases can also be defined.

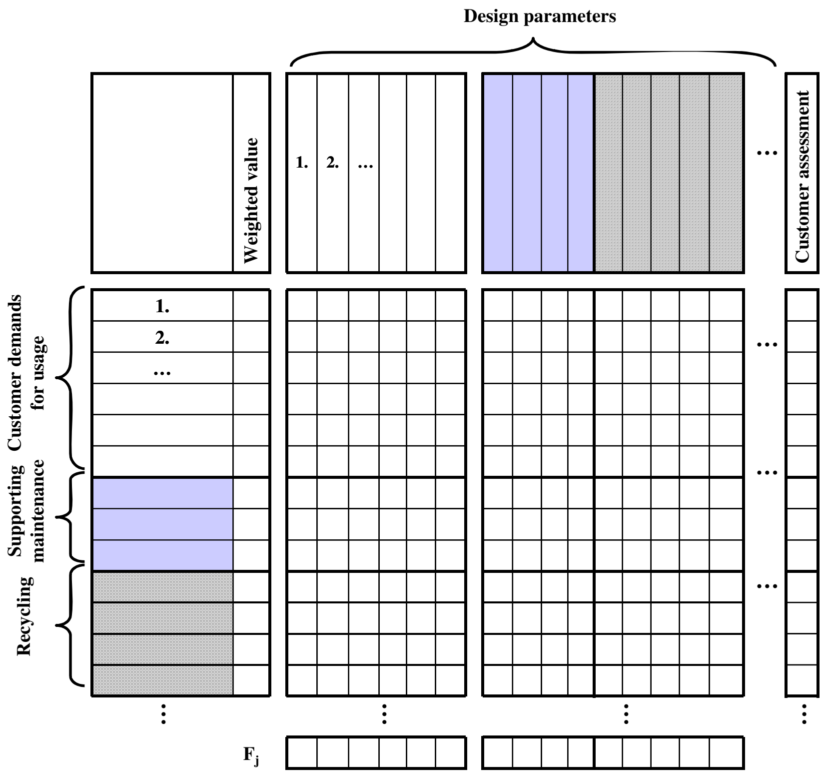

Figure 2
Extended QFD matrix

For a complex evaluation, the QFD matrix has to be extended: we must also consider those expectations realised outside the usage. This way the design process can include all the demands of the different phases of the life cycle.

4 Supporting Maintenance during Usage in the Design Process

A company produces and sells textiles, and also designs collections of curtains, linen, quilts, upholstery and furnishing for hotels and guesthouses. Matching the interior designer's ideas, the company designs products and provides instructions for the usage and maintenance. The company contacted our research group to help to reduce the risks of maintenance of their products. We developed an innovative method to solve their problem.

As the first step of the original procedure, the customer chooses the textiles matching his/her ideas. The interior designer provides designs about the different rooms, halls and dining-rooms. After discussion and approval production plans are made, and production starts. The company is also committed to provide instructions for the handling and maintenance of their products.

In the design process matching the type of the textile to the customer's ideas is not a relevant parameter, so neither the materials, nor their mechanical and chemical parameters are taken into consideration during the design process.

> This drawback of the design process results, for example, when confectioning two or three types of textiles for producing a quilt, each requires different cleaning circumstances, or, in more extreme cases, one of them is not cleanable at all. The same product can also have problems with keeping its size, because this important parameter has not either been regarded when choosing the materials.
>
> Products made of different types of textiles can also produce problems in keeping their colour during cleaning. Cleaning textiles of different colours and different colour retention parameters can easily result the light colours spoiled by the dark ones.
>
> After washing, most products require some ironing, but if a textile that must not be ironed even at a low temperature is involved, then obviously the final product must not be ironed either.
>
> As for curtains, the main problem usually comes from handling and cleaning the extra decorations, fringes and borders. These parts can hardly be washed without deterioration, whereas regular cleaning is indeed a relevant demand in case of curtains.

Faults of the design process can be eliminated if identifying customer demands also include handling and maintenance of the product. We developed a method extending QFD with further aspects, taking into consideration the demand for supporting maintenance in the different phases of the life cycle.

Table 2

QFD matrix developed for two phases of the life cycle for curtains

	DESIGN PARAMETERS													
CUSTOMER DEMANDS	***WEIGHTED VALUE***	Ambitious designer	Brightness	Range of colours and patterns	Textile shrinkage	Number of layers and components	Area density of layers	Accuracy of size at confectioning	Sensitivity to chemicals (textile, fringes)	Stretching and flexibility	Yarn floating inside the textile	Colour -fatness	Heat resistance of the raw material	***CUSTOMER ASSESSMENT***
Has a nice drape	***7***	4				4	2			4	4			***2***
Light resistant	***5***					4						5		***3***
Nice colour and texture, matching the surroundings	***10***	5	4	5							4			***5***
Should be accurate in size	***1***					2		5		2				***2***
Stain resistant	***5***						4							***4***
Should ensure darkness	***9***			4		5	5							***5***
Should be cheap	***10***	1		2		2	2							***4***
Should keep its size	***3***				5					1				***3***
Should have a nice shade in indoor lighting	***7***	4	4	4		4	2				5			***5***
Should be insolating	***1***					5	5							***4***
Should not be vulnerable (drawn fibre, wrinkling)	***7***		4	4		2	5				1			***2***
Cleaning should not destroy its colour, light	***10***		5						2			5		***5***
Cleaning should not cause surface destruction	***9***		4			2	5				1			***2***
Should not be deformed during cleaning	***7***				4		4			2				***5***
Can be cleaned without undoing	***3***					1			2					***4***
Simple cleaning process with few steps	***3***					2			2				5	***3***
Cleaning with standard machines and detergents	***5***					1			1		2	4		***2***
Should be creaseless after treatment	***9***												5	***3***
		1	**48**	**11**	**12**	**-70**	**72**	**6**	**-39**	**6**	**-90**	**35**	**48**	

5 Product Improvement Based on Priorities

A common problem in designing is that changing a design parameter that increases the level of fulfilling one customer demand, would reduce the level of fulfilling another. So setting priorities and finding a compromise solution is of utmost importance. One possible method for optimization is the Harrington's desirability function, which handles together the effects of the most important variable parameters.

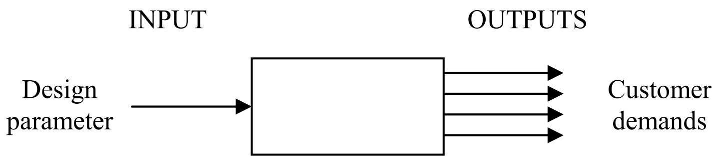

Figure 4
A theoretical model for seeking compromise solutions

Harrington's optimization method takes into consideration, in a weighted format, every parameter (customer demand) that is changed, and defines the optimal design parameters on the basis of that.

Focusing on one parameter of our case study, that is 'Yarn floating inside the textile', it can be seen that this parameter is in connection with many customer demands that require contradictory changes of this parameter. There are customer demand parameters that are limited from one side (below or above), and one parameter that is limited from both sides.

Table 3
Contradictory customer demands

Customer demands	k_{ij}	***Limit***	***Design parameter demands***
Has a nice fall	4	from below	Require increase of yarn floating inside the textile.
Nice colour and texture, matching the surroundings	4	from both sides	
Should have a nice shade in indoor lighting	5	from below	
Should not be vulnerable (drawn fibre, wrinkling)	1	from above	Require reduction of yarn floating inside the textile.
Cleaning should not cause surface destruction	1	from above	
Can be cleaned with standard machines and detergents	2	from above	

For the compromise-based improvement, first the connection between the input and the outputs has to be defined. Then a desirability function (d) has to be associated with this input. The function can take a value between 0 and 1. The values of these functions can be linked to the design parameters.

The $d_i(x)$ desirability function changes depending if the quality parameter is limited from one or both sides.

The optimal level of input can be defined by finding the maximum value of the harmonic average of the desirability function (compromise function).

$$D(x)=\sqrt[n]{d_1(x)\cdot d_2(x)\cdot d_3(x)\cdots d_n(x)},$$

where D(x) - is the function to be optimized, containing a compromise regarding *n* number of customer demands,

$d_i(x)$ - is the function expressing the fulfilment of different customer demands, according to the modified designer parameters.

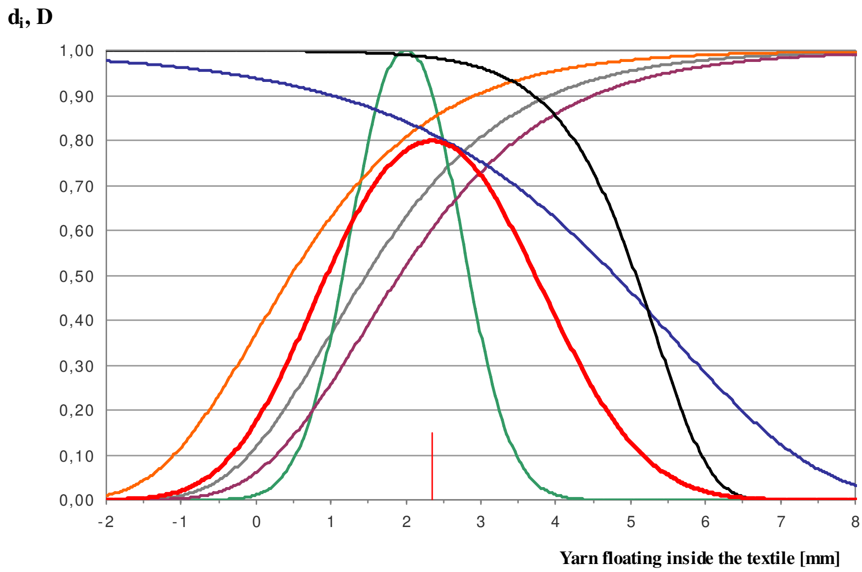

Figure 5

Compromise function calculated from d functions with the optimal value of the design parameter

From the D function calculated this way the optimal value of the design parameter can be defined, which regards contradictory customer demands.

Conclusion

While introducing the extended method, a wide-ranging innovation seems possible to implement. Giving a theoretical underpinning, the analysis of our case study has proved that the new design method is relevant and effective.

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Influence of Maintenance Strategies on Environmental Load

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1 Depleting Natural Material Resources

The global resources are monotonously decreasing with the evolution of civilised life forms, so despite of the spreading of material-sparing design, the running out of energy providing materials is an ever increasing concern for mankind.

People use more and more raw material and energy produced from these materials to sustain and – driven by their nature – to continually develop the quality of their lives. This means increased exploitation of natural resources. In addition to the fact that this level is really high in developed societies, it increases dynamically in developing countries, owing to the greater population.

Contrarily, the volume of the exploitable global raw materials is decreasing. According to the opinion of optimistic research workers, taking into consideration the present consumption statistics and the estimated rate of increase, the depletion period of our most important minerals can be characterised as comparable to the order of magnitude of the lifetime of a generation.

The following aspects determine the uncertainty of the above-mentioned estimation:

- the number of the quarries – even excluding the depleting quarries – is growing, furthermore the research intensity depends on the needs;
- the declaration of some specific data may be intentionally distorted due to their strategic significance *(e.g. data presented by China, some of the Arabic countries or the Former Soviet Union)*;
- the utilized quantity of some specific kind of minerals may decrease by changing or increasing the efficiency of the technology *(e.g. lead and some of the metals are being replaced by the wide range of polymers)*;
- in some technologies utilization will be more sparing owing to the growing rate of recycling;

- alternative resources are also applied for energy production at a rapidly increasing rate;
- in addition to their significant role in the energy production, petroleum and natural gas are – for the time being – the fundamental raw materials of organic polymer technology.

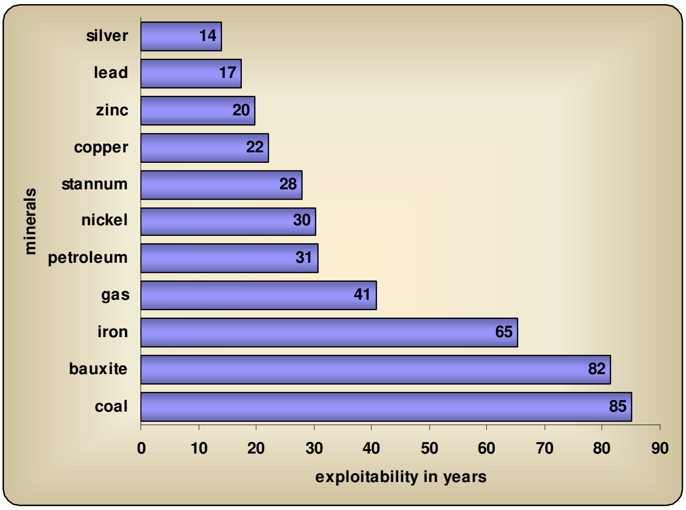

Figure 1
Estimated reserves of global mineral resources

However, it is generally admitted that the technological development demands bigger amount and more difficult machinery and electrical equipment, the production and annihilation of which also need raw materials. These are decreasing-depleting at various rates.

The manufactured consumer's goods are serving both our life and intellectual completion, so the subsistence of civilisation. The number of articles for use that we think „essential" is increasing and it generates the multiplication of the machinery and manufacturing systems producing them. Up-to-date „environment conscious" principles and technologies have been developed for the conditions to produce and annihilate them. Although the growth of environmental load due to the growth of volume is demonstrable, fortunately products of the modern age use energy more efficiently and require less valuable and recyclable raw materials. The aim of this lecture is to involve the audience and readers in our colloquy in the field of energy- and raw material consumption and environmental load.

2 Environment Consciousness regarding the Life Cycle of Products

The effect of the life cycle of the products on the environmental load is a point of interest in both the design, the fabrication, the operation and the waste treatment or reuse phase, and the applied solutions are considerably effective. Elaboration of the optimal variant regarding the environment begins already in the *design phase*, computerised virtual tests are utilised wherever possible. Processes of the *manufacturing technologies* are optimised for low need of resources and low exhaust of harmful substances; the highest possible percentage of wastes is recycled. During *operation,* when the product serves to meet our needs, the main target is the lowest possible energy need and material consumption, whether it is a washing machine, an industrial refrigerator or the turbines of an aircraft. It is a more and more widespread practice, that those products, which become useless at the end of their life cycles, should be made mostly of such kind of materials, which can be recycled or combusted in a waste incinerator, or at least will be rapidly degrade into harmless, low molecular weight substances in the dumping ground.

For the further discussion we have to distinguish between two functionally different segments of the operation phase, essentially two categories, i.e. the stages of productive and unproductive operation.

- Operation of the device during its useful life serves to meet the demands, this is the **stage of productive operation**. During this stage the hairdryer blows warm air, the printing machine prints newspapers, the car transports people and goods between two geographic points. All this is performed in a manner, designed in a more and more environment conscious way.
- Safe operation, however, renders maintenance of the devices necessary. This is defined as the **stage of unproductive operation** within the operation period of the life cycle. Risks of the consequences of spontaneous errors during this stage are assessed to an increasing degree (FMEA etc.). Main emphasis is laid not so much on the assessment of the burden or damages to the environment, as of the risk of accidents and operational safety. In the case of scheduled maintenance, on the other hand, the aim in the first place is the reduction to the minimum of the time needed to putting the device again into operation (mean time to recovery, MTTR) and of the involved costs.

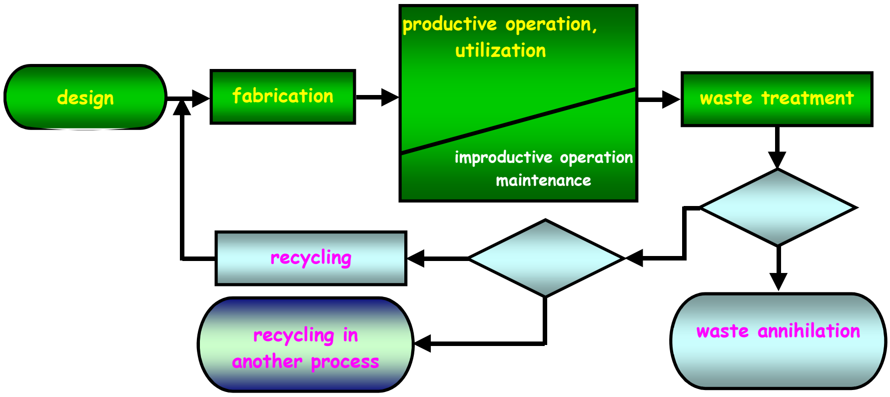

Figure 2
General life cycle of a product and stages of the „caretaking"

In the *unproductive operation stages* that we studied, however, no unanimous evidence could be observed of a positive development concerning the need of natural resources in the corrective and maintenance activities. A full assessment of the environmental impact is not considered to be of primary importance during the design/development of product and technology. The unproductive reservation executed according to the used maintenance strategies surely loads the environment in some form. The well-chosen strategy can fundamentally influence the level of this load (particularly in the case of equipments designed for longer life). The following should serve as thought-provoking examples regarding the strategies mentioned in the third chapter.

Considering the ***appearance of spontaneous failures*** from harmless breakdowns to havaries of catastrophic outcomes, we should think of the consequences and the effects to the environment. (Breakdown of an air conditioner in an office shall be deemed harmless, despite all the inconveniences observed, while a breakage of the shaft of the circulating pump in a chemical reactor or the breakdown of fuel supply in the engines of an airplane may have catastrophic consequences.) A simple failure itself, as well as the prevention of catastrophes or the handling of damages will consume resources and produce waste and pollution. Good examples are the effective protective packaging of spare parts or the diesel oil used up and combusted during polluted soil regeneration as well as accompanying environmental loads.

In some cases prevention may cause less load to the environment. In the case of processes and machinery having a slight environmental risk, replacement of the still operable component might be an economically better solution.

Nevertheless, from the environmental aspect it would be more advantageous to use it until the end of its life.

As part of ***preventive treatments*** machines are cleaned periodically, which can lead to production of harmful substances even in the case of simple mechanical cleaning (dusting, wiping), and the use of solvents can produce garbage even more harmful to the environment. The amount of replacement parts or lubricants, their packaging materials, pollution due to their transport, wastes during installation and putting into operation are all factors, which may determine the feasibility of the prevention strategy of a certain machine concerning aspects of environmental load.

*In the case of **fixed-cycle maintenance** the more punctual estimation of the point of failure is exceptionally important, so as to throw away less operational reserves, from the aspect of environmental load.*

In the case of the **condition-based maintenance** *the above-mentioned point of failure is more predictable in order to prevent effects, which are caused by the sudden failure and shutdown and are influencing the environment. At the same time, the production, operation, continual replacement (owing to their rapid development) and maintenance of the machinery, which has been created to diagnostic purposes, emerges as a new element among the factors causing environmental load.*

The more complicated the device itself is, the more resource-intensive are the maintenance processes and procedures, and the more environmental load they produce. As follows from the above, environmental load associated with the unproductive stage is a function of the state of the device, the maintenance needs and of the planned lifetime. When analysing environmental load during the utilization cycle of a product or facilities we should consider material and energy inputs and outputs both in the productive and in the unproductive categories.

Environmental aspects of the *productive area* are thoroughly investigated as a general practice when choosing among investment options. Generally they are closely linked with efficiency and standard requirements, in some cases directives apply for the allowable loads.

Economic aspects of the *unproductive activities* are also well known to decision makers, as the expenses of maintenance and upkeeping are essential points. Other aspects of environmental load are, however, not always of economic nature. They play, therefore a subdued role in decision making, although the neglected environmental effects cumulated during long lifetimes may cause considerable differences.

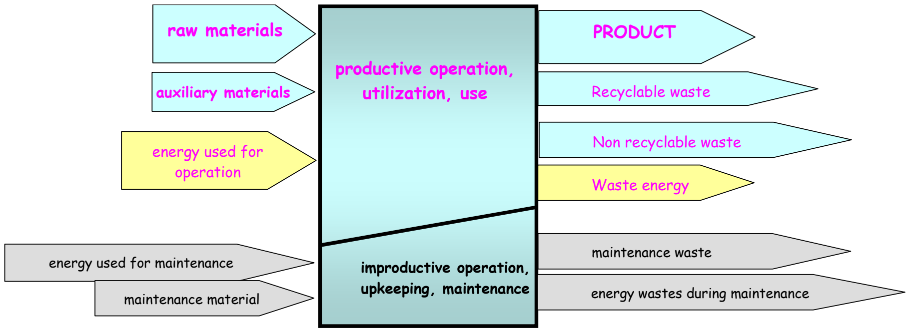

Figure 3
Simplified material and energy flow during utilization cycle of the product

3 Strategic Questions of Maintenance

Maintenance, which ensures proper operation and preserves value, forms part of the consumption phase regarding facilities and consumer durables.

In some decades' time maintenance was *problem-oriented* – eliminating problems was the basic target. Recently this has been replaced by the *process-oriented* maintenance strategy, depending on the field of application. Prevention has become the main objective. Using the human experience efficiently, today's technologies established the knowledge-based maintenance.

Event-based (repair in case of a defect, operative), *time-based* (inflexible periods) and *condition-based* (CBM) maintenance have been deeply analysed. Besides reliability and safety economic aspects should be taken into consideration while choosing the right approach.

Economical or safety risk, which has been undertaken consciously, may require machine replacement instead of service or maintenance in a specific case. This may be reasonable in case of especially rapid development.

The extreme rapid development can increasingly stress the environment all by itself: obsolescent machineries have to be annihilated or 'pushed' towards lower advanced appliers, where further exchanges would be generated. However, these replaced machineries were 'active'; their material and construction haven't reached the end of their duration of life.

Buying a new product is often induced by the deliberately high price of the components – it is generally known that a car would be much expensive if we bought it piece-by-piece.

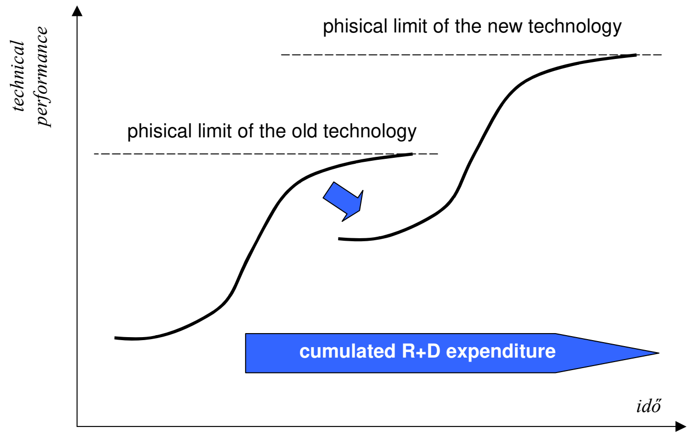

Figure 4
Model of changing technologies

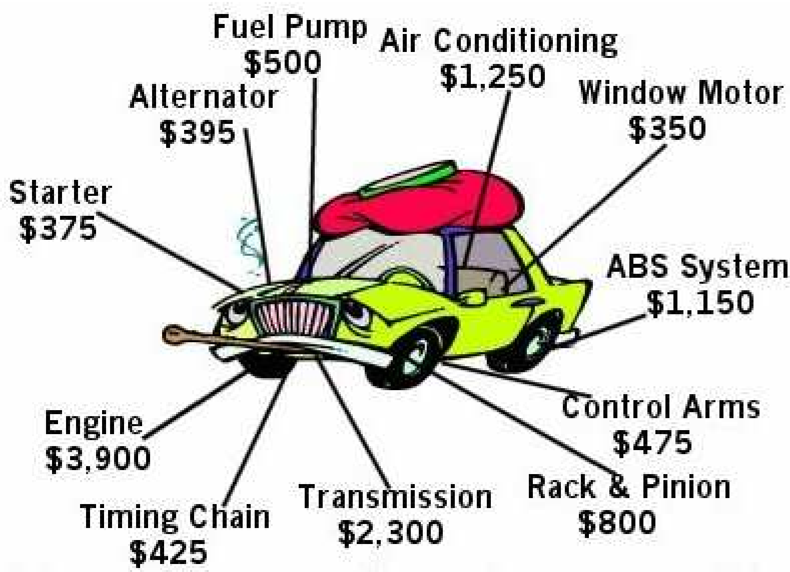

Figure 5
Disproportionate prices of the components

The development of diagnostic procedures has been generated primarily by condition-based maintenance. From the methods originating from the human therapy to the knowledge-based professional systems numerous procedure facilitated the trace-back and forward analysing techniques. The passively *reacting* maintenance has been replaced by the *active*, forecasting and the *proactive* maintenance, which uses real-time data.

In the case of consumer durables – e.g. cars –, the on-line supervision appeared besides the periodical status-check. Built-in sensors and indicators make more efficient the active and passive diagnostic procedures.

The *Total Production Maintenance* (TPM), known as a maintenance-organization method, is based also on the human factor.

In case of big-sized, primarily technological complex systems, initial strategies would have ensured the high level of availability and safety by quite high expenditure. In order to meet technical demands *reliability-centred* maintenance has been developed (RCM). By the analyses of the effect on the technological and social environment, their probability and severity, the next step was the *risk-based* maintenance (RBM).

The *Risk Based Inspection and Maintenance* (RBIM), which synthesizes the former maintenance elements, is spreading through Europe. Its RBI analysing element, which is based on diagnostic possibilities, filters out the factors of high risk by qualitative analysis, determines their risk, and generates a risk matrix and a hierarchy. Of course the final target is to choose the optimal maintenance strategy and to develop an inspection/maintenance program on this basis.

The above-mentioned strategies and philosophies can be applied just partially regarding consumer durables and facilities. The contradiction between the value-preservation demand and the new product promotions is typical of the consumers' society. In our age sometimes the life cycle of facilities of the traditionally long rate of return (e.g. buildings) become very short. However, despite the rapidly accelerating period of reproduction, the economy and environment-friendliness of the unproductive operational phase of the consumption period is determined by the applicable maintenance strategy and therefore basically by the product construction.

4 Responsibility of the Developers

The complex organization of design and development consist of engineers and marketing professionals. They have increased responsibility to develop environmental-conscious products to fulfil social needs and to generate environmental-conscious demands in the society, which is present in their entire life cycle.

After the detailed analysis of the consuming phase of life cycle and the discussion about the special aspects of the related maintenance strategies here you can find some thesis regarding consumer durables and facilities:

- The consumption and operational period of the complicated and expensive products and facilities may be quite long. As a result, the environmental load of the reservation and maintenance activities would also be remarkable. In other words, even more emphasis is put on environment-conscious operation in the case of equipments designed for longer life in productive as well as unproductive fields.

- The level of environmental consciousness depends also on the advancement of the given society. In a technologically developed country people think more "green", therefore a kind of environmental culture is able to develop that will be able to pay particular attention to the unproductive period regardless of money or time.
- Nations aiming to fall into line focus on design and manufacture in order to meet the strict requirements of the "big ones". They don't have the possibility to decrease the ecological effects of the unproductive maintenance activities.
- In general, the degree of the environmental load concerning the consumption period infiltrates into the product at the design phase. During the operation just a slight modification can be done to these eco-parameters.
- Our articles for use that ensure better quality of life are getting more and more complicated, those are embossed with safety, information and comfort elements. These are generated by the overdriven technological development of the leader manufacturers and by the "pumped up" customer needs.

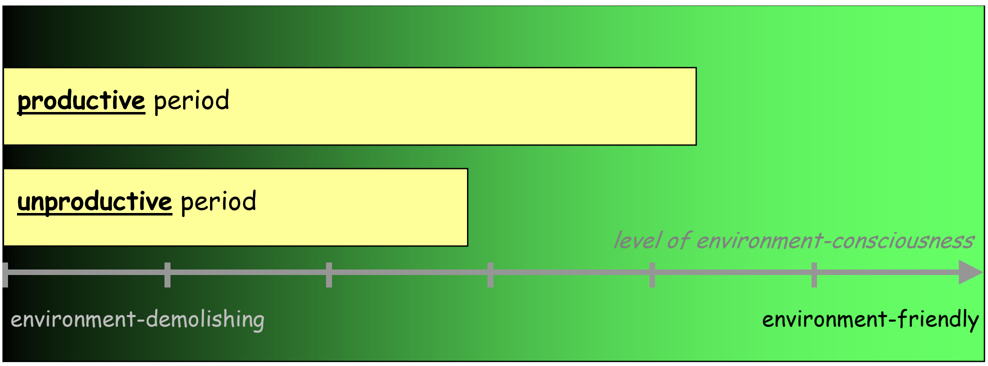

Figure 6
General advancement of the environmental consciousness in two periods of the operational phase of the life cycle

The main objective of this lecture is to drive the attention to the fact that although reservation and maintenance are small segments of the impacts causing global warming and resource depleting, the operation of our society is basically determined by the operation and reservation of our facilities and consumer durables. As a result, our creativity plays a significant role in our own and our grandchild's life. If taking care of the environmental load of unproductive operational periods means value for the society and the operators, this demand would reach the designers and spread towards the less conscious consumers.

Operating Maintenance Model for Modern Printing Machines

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Abstract: The authors outlined a model to examine the modern printing machines' unexpected breakdowns. They had been analysing the different downtimes for years. The results of the researches help to organize the pro-active maintenance at the graphic arts industry.

Keywords: printing machines, predictive and pro-active maintenance, breakdown

1 Introduction

The problems of maintenance have accompanied and 'threatened' the working people ever since the application of equipments. It was experienced from the beginning that equipments could go wrong and machines could break down. Humans have been and still are working on solutions to these problems, so it is not an exaggeration to say that maintenance is the same age as humanity and manufacturing activities. [1]

Maintenance techniques have changed over time from correction (breakdown) to prevention to prediction and pro-active continuous improvement. Effective maintenance is a series of progressive steps to improve operational effectiveness and the key step in this process is the transition of pro-active working. Companies that optimise their maintenance select and combine the techniques that match the needs of their equipment and operations.

Moving up the maintenance stairway requires a planned approach that brings together the right procedures, tools, training and the knowledge the feature and history of our machines' breakdowns. [2]

2 Maintenance Characteristics and Requirement of the Modern Printing Machines

The user of printing industry machines and any other operating systems, expects the machine or system to stand a heavy-duty use during a given period. This period is not constant. It depends on the construction, the nature of use, the mode of operation and the quality of maintenance as well. However the analysis of these technical systems, the profound knowledge of the characteristics of building elements and the operating indices are essential to establish an adequate operational and maintenance concept. [3]

Following this approach this chapter summarizes the technical, technological features, handling and maintenance characteristics of printing industry machines from the *maintenance point of view*.

3 Operating Maintanace Model for Printing Machines

Despite the possible big differences between printing machines we treat them with a united approach based on their fundamentally common characteristics. One of the major reasons for the synthesis is originates from maintenance practice. Generally, the printing offices perform the maintenance duties with staff small in number. Consequently, there is a little chance to gain special knowledge and subdivide the maintenance approach and practice. The machines, which are different in structure and technological tasks, have a lot of common characteristics from the operational and maintenance point of view in case of printing office applications, which makes the united approach acceptable.

Consequently, we developed a simple model (*Figure 1*) that reflects the general structure of printing machines (divisions and detailing are included), which is needed to analyse the features of maintenance and maintenance-management.

The technological elements of modern printing machines unite two equally important operations. The major operation, which performs informational types of formation on the product, is based on a highly accurate transmitting operation of the processing material (mostly paper). Therefore, the input and the output units are very important elements of printing machines. These elements ensure the assembly of machine systems. Moreover, if the bigger systems were divided into elements we would always get division three, in the model. The units of operation, management and supply set the same claims up for the technological units regarding their structural form, complexity and especially their maintenance requirements.

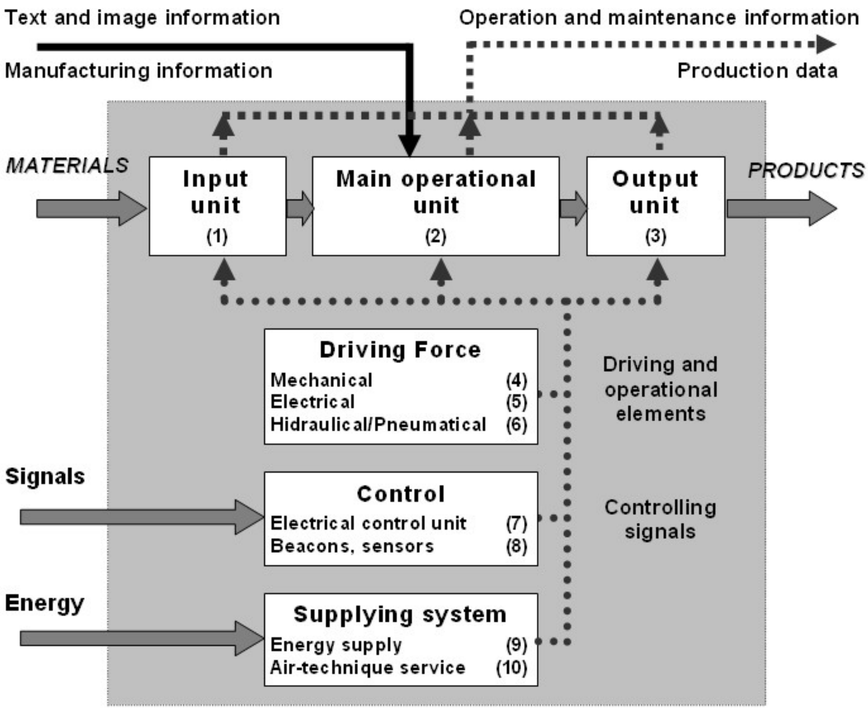

Figure 1
Operating maintenance model for the printing machines

3.1 Maintenance Features of Printing Machines

The similarities between the manufacturing processes, raw materials and products of printing machines result in similar defective, corrective and maintenance features, which should be considered during management and organizational tasks. Therefore I thoroughly analysed those sources of faults and damaging processes, with which we struggle during the operation of printing machines.

At present, according to the results of our survey – carried out among 25 leading Hungarian and 5 significant printing offices – the major cause (46%) of maintenance events is the unexpected breakdown. This big proportion also means that this is the most influential factor of designing and managing tasks. Therefore, the knowledge about unexpected breakdowns, as a phenomenon, is extremely important for the maintenance management. [4]

The authors could collect data on unexpected breakdowns of printing machines for a long period of time at Alföldi Printing Plant Plc., Hungary's largest book printing plant. A computer-assisted system could continuously record the basic data of the important processing machines. The historical datasets were set as the starting point for our analysis. The continuous data collection was carried out on the most important processing machines of Alföldi Printing Plant Plc. During the monitoring the machines were replaced from time to time following the technological development. We monitored 65 printing machines. These represent the previous, current and following generations. Their age varied between 1 and 27 years and 22 completely new machines were purchased during our monitoring. Every machine was operated at a specific site, the centre site of Alföldi Printing Plant.

We used the data of unexpected breakdowns from a wide period of time (data of 17 years of full operation between 1988 and 2004).

The extent of generalization based on the characteristics of printing machines might obviously raise a few questions from the reader. The printing machines and the relatively complex technology of Alföldi Printing Plant and their loading give an extensive cross-section of today's typical printing machines. It was a limiting factor that there were only a few similarly detailed and accessible historical databases even for a shorter period of time. However we could make a comparison with the data of similar Hungarian printing plants; Szikra Lapnyomda., Révai. and Petőfi Printing Plant. The data on downtime and reparation time showed similarities with the calculations from our database.

The calculated mean values	*Mean*	*Standard deviation*
Time of troubleshooting [working hours]	**1.80 hours**	0.47 hours
Reparation time of a breakdown	**2.24 hours**	0.54 hours
Characteristic data of printing machine		
Operational time in a year	**2 883 hours**	**617 hours**
The expected number of unexpected breakdowns during the operational period (rounded values)		
yearly	**87 occasions**	**24 occasions** *
monthly	**7 occasions**	**3 occasions** *
weakly	**2 occasions**	**1 occasions***

* Rounded values for the easier understanding

Figure 2

Most relevant data characterising the unexpected breakdowns of printing machines

(Examination period: 1 January 1988 – 31 December 2004)

Figure 2 shows the major conclusions and the calculated characteristics. The 65 printing machines ran nearly 1.7 million operating hours, while 58317 maintenance events originated from unexpected breakdowns were recorded. The reparation of the machines caused more than 105,000 operational hours of dropout in the production and more than 130,000 reparation hours.

The first and the most important conclusion of the calculated values is that the average value of the reparation times of unexpected breakdowns is low, in other words dropouts from production due to downtime are short. The average value is 1.80 hour.

According to the Alföldi Printing Plant's instructions the reparation time is the period between the report of breakdown and the short check of operation after the troubleshooting. The troubleshooting takes about 2.24 working hours on average. We only took those reparation times into consideration that didn't last more than 24 hours. On one hand the number of longer reparation times are negligible, on the other hand these breakdowns are not considered to be unexpected by the maintenance strategy applied at Alföldi Printing Plant.

The machine monitoring system identifies the operation hours of the machines with the 'on' position of the main switch. The identified annual average operating time is 2.883 working hours, which is equal to nearly 1.5-shift production. The inequality of technologies and capacities – even within Alföld Printing Plant – should be considered. There are continuously running basic machines and there are several other machines performing special technological steps working with identical speed as the server machines, but these are poorly utilized.

The development of maintenance efficiency obviously has a great impact on unexpected breakdowns. The change in average values during the past few years show a slightly decreasing tendency as shown on *Figure 3*, conforming that the maintenance efficiency has also improved at Alföldi Printing Office Plc. The slowly changing tendency of downtimes however proves that the fundamental maintenance characteristics are originated from structures and technological conditions. These are independent from the quality of maintenance. The number of machines used after 2000 didn't modify the average values of downtime and reparation times significantly.

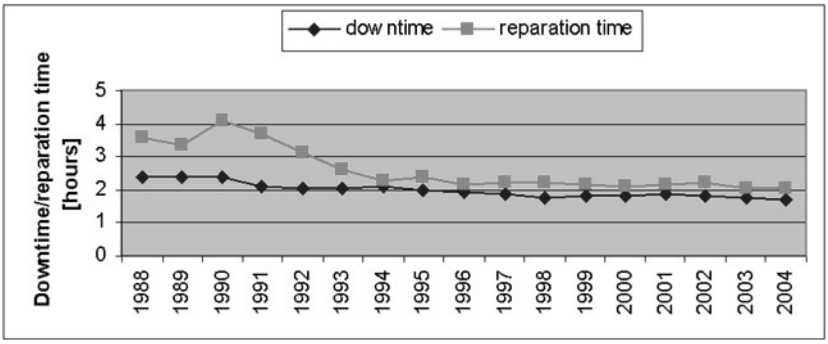

Figure 3
Time dependence of the average downtime and reparation time

The data also show that the maintenance characteristics of pressing and bounding machines didn't differ significantly. The values (shown at *Figure 4*) confirm the correctness of the principle; these should be treated together, like we didn't distinguish them in the maintenance model either.

Calculated mean values	**Pressing machines**	**Bounding machines**
Time of troubleshooting:	***1.84 hours***	***1.77 hours***
Reparation time of a breakdown:	***1.97 hours***	***2.38 hours***

Figure 4
Characteristics related to the troubleshooting of unexpected breakdowns for different types of printing machines

The unexpected breakdowns of printing machines are quickly reparable; these generally require small maintenance events. The downtime, which is not more than two hours, caused by operational failure is more than 80%, which generates more than 50% of this kind of troubleshooting. The originated reduction of losses requires concentration to details and predictive organisation. The relatively low average value might just well have a great influence on the future developmental concepts of maintenance systems. The relatively short reparation times typically contain several elements that are not actual professional work (reaction time, approaching the reparation scene, information transfer, etc.). The relative frequency of values characterising the reparation times of unexpected breakdowns is shown on a histogram of *Figure 5*. These data contain extremely important information for maintenance managers.

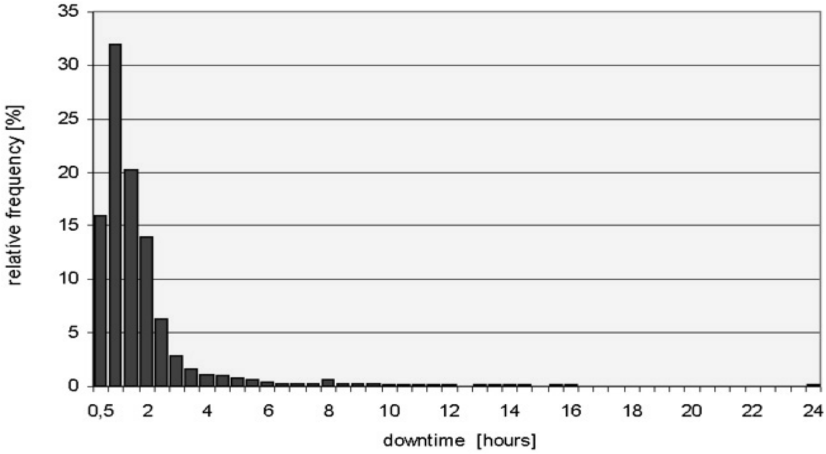

Figure 5
Histogram of the relative frequency of time needed to troubleshoot the unexpected breakdowns of printing machines

Values of *Figure 6* give information about the time expected to be needed for the reparation of the consequences of unexpected breakdowns for printing machines. Special attention should be paid to these data when designing because the relatively rare breakdowns require longer reparation time, which need considerable labour input as shown in the table of *Figure 6*. More than 8 hours of reparation time, which appears with less than 3% probability, is the 18% of the overall reparation expenditure. Whereas the 50% of the reparations resulting less than an hour of downtime is only 20% of expenditure.

Reparation within a given time period	Probability	Proportion of the reuired reparation time to the total reparation time
1 hour	47.75 %	21.05 %
2 hours	81.84 %	51.76 %
3 hours	90.84 %	64.39 %
4 hours	93.49 %	69.58 %
6. hours	96.04 %	76.43 %
8 hours	97.50 %	81.92 %

Figure 6
Probability values of time needed to troubleshoot the unexpected breakdowns (based on the histogram)

3.2 Typical Breakdowns of the Printing Machines

There is another important approach in this chain of thoughts. What breakdowns are typical for printing machines? The classification of breakdowns is carried out according to the 10 big structural groups characterising the printing machines mentioned in the maintenance event log system, based on the previously presented model.

Figure 7 shows the breakdown proportion of the distinguished parts. The input and output units – the units of the above-mentioned transmitting machines – give the 39% of all breakdowns.

There is a high occurrence of breakdowns due to failures of mechanical propulsion, sensors and beacons. Units performing technologically important operation have relatively smaller breakdown proportion compared to their importance in the machinery. The breakdown proportion of the electrical parts is 20% as shown on the diagram. The proportion of the electrical type of unexpected breakdowns is 29% including electrical faults of any part.

The knowledge of proportions is especially interesting when preparing for condition-assessment and modernisation.

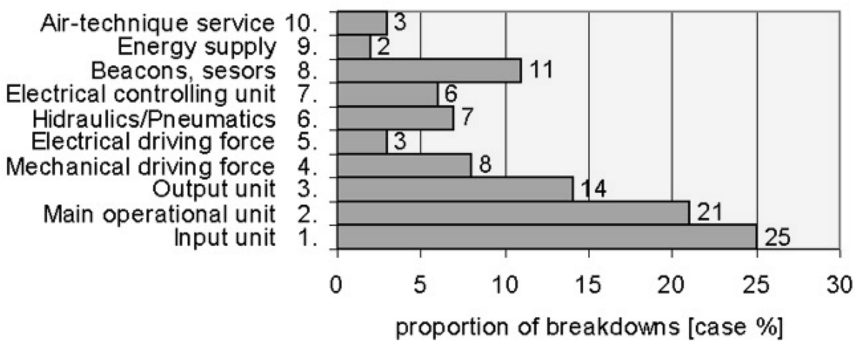

Figure 7

Distribution of unexpected breakdowns of printing machines between given main units

Conclusions related to unexpected breakdowns mainly refer to equipments of printing and further processing. It is also notable that the planned reparations and the proportion of troubleshooting at the maintenance of Alföldi Printing Plant correspond to the average in the industry. Characteristics related to prepress equipment corresponds to the characteristics of computer technology.

Conclusions

For the productivity maintenance of printing machines the detailed knowledge of relations of failures are crucial. Reparation of unexpected breakdowns generally requires management of short/reactive reparation. Knowledge about the typical failure rates of major parts of printing machines is the fundamental pillar to apply pro-active maintenance management.

Acknoledgement

The authors wish to thank Mrs. Katalin Kerekes, the technical director of Alföldi Printing Plant Plc. for her help and support.

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Study of Endocrine Disrupting Chemicals in Environment

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Abstract: Endocrine disrupting chemicals (EDC) cause more and more serious environmental pollutions. The EDCs show only ng-µg/l concentration level in the environment, therefore their determinations require multistep sample preparation processes and highly sophisticated instrumentation. This paper discuss the EDC effects, and show examples for determination of such compounds.

Keywords: endocrine disrupting chemicals, toxic effects, sample preparation, GC/MS

1 Introduction

The pollution effects of endocrine disrupting chemicals (EDC) gain more and more attention in worldwide [1-5]. An EDC is exogenous agent, which interferes with the synthesis, secretion, transport, binding action, or elimination of natural hormones in the body, which are responsible for the maintenance of homeostasis, reproduction, development, or behavior. They can cause difficulties in cell, organ, individual, and population levels.

For example, DDT was the reason of broken eggs of predatory birds, resulting in a sharp decrease in their number around the Great Lakes [6]. The symptoms, which had been observed in animal kingdom, are also recognized in mankind. Parents, working in certain pesticide factories, produced girls in significantly higher number, than boys [7].

Such shocking facts have triggered the research in this field. Recognizing the importance of research of EDCs, we have also launched research project in this topic [8, 9].

2 The Endocrine Distrubing Phenomena

2.1 Structure of Endocrine System

The actions of the hormones work along hormonal axis [10]. There are adrenal, thyroid, ovarian hormone axes. Their functions take place in cascade systems. The brain gives signals to hypothalamus through the nervous system. The hypothalamus passes the signal to pituitary with compounds called releasing hormones. The signal reaches the hormone producing organs with hormones. The hormone producing organs synthesize further hormones, which trigger action binding to hormone receptors. The receptor binding action can induce protein synthesis via mRNA in the cell's nucleus. The releasing hormones and hormones are transported by blood stream. The thyroid hormone axe consists of the following: hypothalamus –(thyrotropin, releasing hormone)→ pituitary gland–(Thyrotropin hormone) → thyroid gland –(thyroxine, triiodothyronine hormones)→ hormone receptors in cells. The major functions of thyroid hormones are the regulation of body temperature, regulation of metabolism, growth, and they have important role in reproductive developments.

The EDCs may disturb the hormone functions: occupying receptor sites, reactions with hormones, modifying the synthesis of hormones, inducing false protein syntheses. The EDC, binding to receptors, induced tumor, caused infertility, decreased immune strength in several occasions [11].

2.2 Establishing EDC Effects of Compounds and Monitoring Them

The recognition of harmful effects of EDCs is rather difficult. Several chemicals can cause EDC effect only for certain species. These materials have accelerated damaged in special life periods (embryo, newborn, pubertal and pregnant). Therefore the establishment of EDC risk needs several generations tests [12, 13]. Moreover several EDS are persistent, and show biomagnifications and bioaccumulations.

According to an EPA survey, 115 chemicals have serious EDC effects, but more than 87000 chemicals have to be tested for it in the near future [13].

The big number of potential EDCs suggest multistep test methods, namely only those compounds go to the more expensive second step, which were positive in the first screening step. Several representative species are involved into the test procedure, because the ECDs can act differently in various species of animals. The various tests target different endocrine cascades. The EPA worked out the following test system [13]:

First step

– *In vitro*

• ER binding / transcriptional activation assay

• AR binding / transcriptional activation assay

• Steroid genesis assay with minced testis

– *In vivo*

• Rodent 3-day uterotrophic assay (subcutaneous)

• Rodent 20-day pubertal female assay with thyroid

• Rodent 5-7 day Hershberger assay

• Frog metamorphosis assay

• Fish gonadal recrudescence assay

Second step

Mammalian tests

– Two generation reproductive toxicity

– An alternative less comprehensive test

Alternative mammalian reproductive

One-generation test

Non- mammalian multigenerational tests

– Avian reproduction

– Fish life cycle

– Mysid life cycle

– Amphibian development and reproduction

The EDCs can be divided groups according to their origins [7]:

- Natural and artificial hormones (e.g. fitoestrogens, 3-omega-fatty acids, contraceptive pills, and thyroid medicines),

- Drugs with hormonal side effects (e.g. naproxen, metoprolol and clofibrate),
- Chemicals of industry and household (e.g. phthalates, alkylphenol etoxilate detergents, 1,4-dichloro-benzene and PCBs),
- Pesticides (e.g. lindane, DDT, atrazine and tributyl -tin),
- Side product of industrial and household processes (e.g. PAH, dioxin, pentachloro benzene).

Monitoring the EDCs requires highly sophisticated analyses methods, because their concentration levels are very low (pg/l-µg/l) in the environment [2-4, 8, 9]. Such a low concentration levels need multistep sample cleaning and concentration pretreatments. The used analytical instrumentations are also dedicated (GC/MS, HPLC/MS, CE/MS). Some monitoring tests, based on immunoassay (e.g. Western blot) are also known for monitoring purposes [14]. The exact determination of EDCs requires sometimes even chiral selective analytical methods [15].

3 Determination of some EDCs

The authors present their analytical results for some EDCs from drinking water, natural water (Danube), waste water (Southern-Pest waste water plant).

3.1 Determination of Alkyl Phenols

The alkylphenols ethoxylate, non-ionic detergents have serious estrogenic EDC effects [3, 7, 9]. They are in the list of European Water Framework Directives [16], but theses compounds have not established, standard analytical method yet. We developed and validated analytical method for nonyl- and octyl- phenols, the persistent metabolites of etoxylated mother compounds.

3.1.1 Experimental Conditions for Determination Alkyl Phenols

The developed method has been summarized in Figure 1.

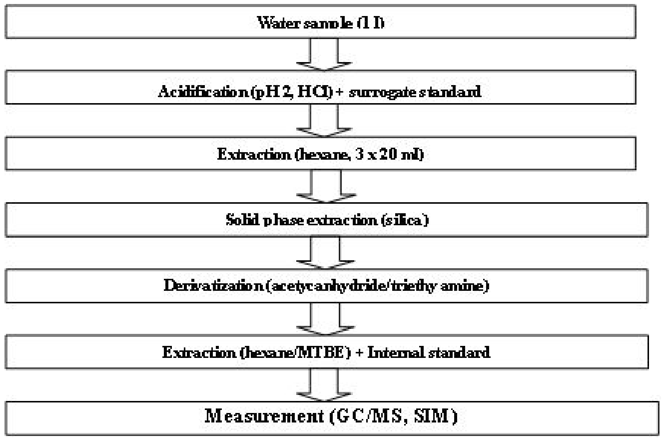

Figure 1

Flow chart of analytical procedure for determination of alkylphenols from water matrices

3.1.2 Results of Analyses of Alkyphenols

The acidification of water sample was necessary to achieve 40-50% recovery, bringing phenols in their undissociated forms. The hexane is advantageous because it has low toxicity, lighter than water and relatively cheap. 2,6-di-*terc*.-butyphenol was chosen for surrogate standard, because its chemical structure is similar to the compounds of interests, and it is a very rarely polluting material.

The silica gel solid phase extraction (SPE) cleaning step made the samples free from apolar triglyceride and hydrocarbons with hexane washing step. The dichloromethane elution gave good recovery, and lived the polar humic and protein dirts on adsorber.

Derivatization was necessary to reach 5 ng/l quantification limit. The underivatized phenols showed 20 times higher quantification limit than derivatized ones. The standard acetylating procedure [17] proved the best, using acetic anhydride with triethylamine catalyses. The yield of acetylation was above 95% after 1 hour reaction (60°C).

The unreacted components and side products destroy the filament of mass spectrometer, therefore the derivatized compounds were extracted from water diluted reaction mixture. Hexane: methyl-*terc*.-butyl ether (4:1) extraction medium was the best with > 90% yields. Terphenyl internal standard was added to solution before GC/MS measurements.

The GC/MS instrument was used in selected ion monitoring mode to improve the sensitivity. The retention times and mass fragments of sample were identical with the alkyl phenol standards. A representative analysis of raw waste water is in Figure 2.

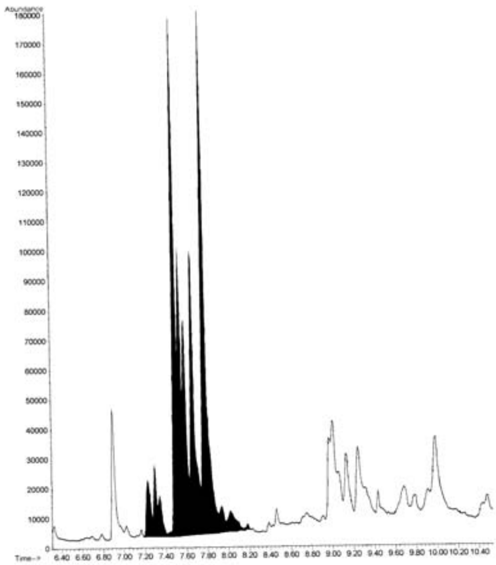

Figure 2
GC/MS analysis of alkylphenols content of raw waste water (Southern-Pest waste water plant)
Conditions: GC/MS Instrument, HP 5890/HP5790; column, 20 m x 0.18 FSOT, DB-5MS; injection, splitless (1 min);temperature program, 60°C → 300°C (20°C/min); carrier, He (45 kPa); ion source, 70 eV, SIM, 135 m/z.

The calibration curve was linear (r^2 0.995) in the 5- 5000 ng/l range.

Every tested water sample contained alkyl phenols (Table 1).

Table 1
Alkylphenol content of various water samples

Sample	Alkylphenol content (ng/l)
Drinking water	290
Danube water	320
Treated waste water	1000
Raw waste water	16500

3.2 Determination of Naproxen

Naproxen 2-(6-methoxynaphthalen-2-yl)propanoic acid is a widely used non–steroidal anti-inflammatory drug (NSAID). 6.8 tons of this substance were sold in Hungary (1998) in various formulation. The naproxen has EDC effect disturbing the synthesis of prostaglandins [2]. None of the pharmaceutical compounds had been analyzed in environment in Hungary, therefore we launched a project to start such research. We cave chosen naproxen as starting compound, because its consumption is rather high, their metabolism moderate, and having EDC effect [8].

3.2.1 Experimental Conditions for Determination of Naproxen

The developed analytical process is summarized in Figure 3.

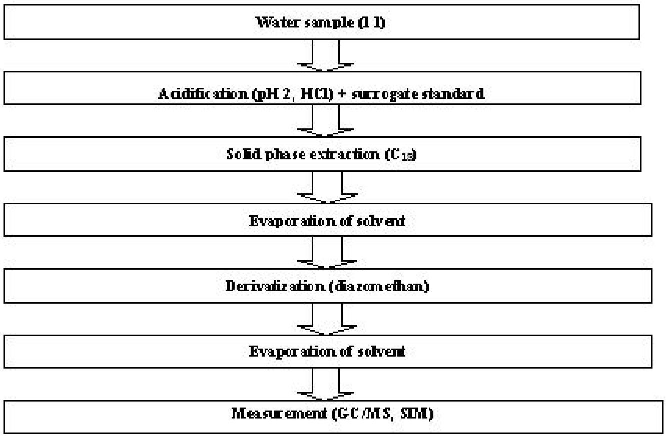

Figure 3

Flow char of analysis of naproxen from various environmental matrices

3.2.2 Results of Analyses of Naproxen

The β-naphtholic acid proved a good surrogate standard, because its chemical feature are rather similar to naproxen, and it is almost impossible to find it in environmental samples.

It was necessary to decrease of pH value of water to bring naproxen unhydrolyzed form. Namely, the anhydrolyzed form of acids (naproxen, β-naphtholic acid) can be trapped on apolar absorber (C_{18}).

The washing steps with water elute the polar (e.g. proteins, amines) matrix compounds from disc. The elution had 32±5% yield using methanol and aceton as elution solvents. Unfortunately, the selectivity of the C_{18} disk is moderate toward to acidic compounds. However, the majority of apolar matrix compounds remained (e.g. hydrocarbons, triglycerides) on disk. The disk form of absorber is better then column form, because, the columns can easily clogged by solid particles of waste water. Moreover the waste water sample hade to be prefiltered through 0.45 µm glass membrane.

The moderate selectivity of C_{18} absorber required 20 ml elution solvent, which were evaporated before the next step.

The underivatized acidic compounds are polar and have low volatility and strong adsorption characters. Theses feature do not suit well to gas chromatographic process, therefore the acids are derivatized before their GC analyses. Standard methylation with diazomethane [17] was chosen to produce methyl ester derivative of naproxen. The methyl ester derivative of naproxen proved idle for gas chromatography, and produced well recognizable fragments for mass spectrometric quantification.

Deuterated compound, D_{12}flouranthene was used as internal standard according to practice of our laboratory.

The gas chromatographic parameters were optimized, using HP 5890 II instrument, with 30 m x 0.25 mm FSOT columns, coated by DB-5ms stationary phase. To improve the sensitivity, splitless injections were (1 min) applied. Temperature program (50°C /2 min/→10°C/min →300°C), and he carrier gas (15 psi) was used to get sharp, well resolved peaks.

High resolution mass spectrometer (VG AutoSpec-S) was on-line connected to GC in electron impact mode (70 eV). The following m/z values were measured: 185.096 (naproxen), 186.068 (β-naphtholic acid), 244.11 (naproxen) and 214.142 (D_{12}flouranthene). The given m/z values are quantified at the time windows, determined by the retention times of observed compounds.

The calibration curve was linear (r^2:0.988) in 1-400 ng/l range. The naproxen content of various water samples are summarized in Table 2.

Table 2

The found naproxen concentration in various water media

Sample	Naproxen content (ng/l)
Drinking water	Non detectable
Danube water	2.4
Treated waste water*	87.5
Raw waste water*	250

*Southern-Pest waste water plant

We have found naproxen in Danube, waste waters, but not in drinking water.

Conclusions

Appropriate analytical methods has been work out for alkylphenol compounds, which are compounds to be monitored on the water framework directives. Every tested matrix contains alkylphenol well above 100 ng/l level. The efficiency of waste water cleaning is poor from point of view of alkylphenols.

Naproxen has found in Danube and waste water, but non in drinking water. The cleaning efficiency of observed waste water plants are moderate toward to naproxen.

Creating these analyses method prepared our laboratory for the analyses of endocrine disprupting chemicals and pharmaceuticals even at ng/l concentration level.

Acknowledgment

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Fashion and Innovation

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Abstract: The link between fashion and innovation is showed from the point of view of a fashion designer, who did research work on this theme in her doctoral thesis. The author demonstrates some of the results expressed in her practical work.

1 Introduction

In the theoretical research of my doctoral thesis, among others, I highlighted the basic definition of fashion as a whole and the driving force behind its development.

The design is continuously gaining importance in the development of the products so as to meet their various requirements, to produce high quality goods thus keeping and increasing our share in the market.

All these factors have become key elements of the development in the present economic and social situation.

The eternal demand for changing is the process that keeps fashion alive. The importance of fashion is well demonstrated by the large number of people involved in this branch of industry having historical roots.

Fashion senses the changes taking place in the world and response to them sensitively and immediately. These changes can be directly perceived in the way the individuals dress, giving unambiguous information about the wearers, their wealth, taste, age, national characteristics, etc.

The fashion shows the components of desire to belong to a certain group or to be different from it.

2 Effects Influencing Fashion

Prior to forming the concept of my masterwork it was essential to do research work on understanding the logic behind the operation of fashion.

Fashion is exposed to influences coming from all fields of life.

1. Social and economic situation
   - way of life, wealth, dressing habits, consumption, etc.
2. Protection of environment and health
   - climatic changes, protection of animals, environment friendly materials, sport, etc.
3. Political and legal environment
   - international agreements, etc.
4. Multicultural effects
   - historical and folk costumes, street-styles, etc.
5. Art
   - applied art, painting and sculpture, theatre, music, literature, etc.
6. Technological developments
   - new fabrics, intelligent textiles, new production and logistic procedures, etc.
7. Sexuality
   - blurred border between male and female dressing, etc.
8. Internet
   - presence of the global world.

The result of the above influences is the innovation itself expected by certain circles of fashion fans and when the late followers spread fashion widely, this process will regenerate the demand for new innovation.

The accelerating fashion multiplies the creation possibilities of the designers and they put aside their previous concepts and traditional design attitudes and directly combine characteristic costumes of historical ages and folk art with the street style as an expression of the global world.

It is not our goal any more to determine for the buyers what they should like or not, but to urge them to buy and to express their personality in this way.

Individuality and variability have key role in the design work which I experienced in my design work done for a garment manufacturing company.

Deep knowledge of the customers and their shopping motivations should be thoroughly known to realise the preparation of customised designs in small series in accordance with world trends.

The designers should always imagine their would be buyers, should know their latent demands as well, offering the buyers the possibility of creating their own image.

In the case of a ready to made collection a designer must have information of the international economic and fashion trends, the current position of the market, change of demand and supply, as well as that of the customer's habits and lifestyles.

In addition one have to be aware of requirements set by the company he or she works for, and technological background and possibilities of it.

As a designer having all the necessary information at hand, I make not only the designs of the collection, but I have to follow the whole technical production and until the final product is available in shops, as a competitive product.

As I really know the whole line I can interfere at any point of it, should any problem occur.

My work has been greatly supported by continuous innovation of technological facilities, such as newly developed fabrics, technological solutions and accessories, etc.

3 Freedom of Creativity

In spite of the fact that even a 3-D interactive garment designing system has been developed for gaining garments properly fit to the individual body, I followed a classical method of innovation as an experiment made in my doctoral masterwork.

My method allows the wearer to freely create perfectly customised series of garments, as well.

The starting point of my masterwork was a capsule collection which was awarded by Grand Prix of the Hungarian Products, in 2003.

The collection included experimental and expandable models, produced by the garment manufacturing company, I've been working for since 1995.

Some of these models gave me further inspiration to my masterwork, like:

- the special interference coming from the layers of the transparent, black and white optically patterned stripes,

- the second one was the softness of the muslin fabric which is vitally important from the point of view of shaping of the forms,
- the third inspiration was the lengthy striped straps which decorate and bring together the different parts of buttons and other conventional solutions of closure,
- the forth guiding principle was to create the delicate balance between symmetry and asymmetry,
- the fifth was the emphasising of the contrast of the black and white stripes by adding sheer black and white pieces.


The fabrics are of primary importance for me as they determine the form, style, colour and even the details applied.

In contrast to many years' designing work of commercial approach, with my masterwork, I didn't have to follow the business aspects of manufacture-sale-price limiting the designers' creativity. My only consideration was to make the best use of the possibilities offered by my experiments. Going back to the early ways of wrapping up the body and the modelling on a dummy, instead of drawing sketches first, brought me variety during my work.

4 Process of Construction

My experiments started with cutting out large size geometrical patterns and than the work of making mock-ups began. As I have been designing jackets for years the idea obviously presented itself to try different variations of them along with the other trials using cotton fabric.

The experimental work resulted in a surprisingly large number of variations that gave rich inspiration not only for my masterwork but for future projects, too.

In the case of half-pieces of different forms I intentionally avoided all cuts and separate sleeves, and I used only developed patterns. In spite of the asymmetric layouts of the garment pieces, they were eye-catching, well balanced and only the width and quantities put a limit on my imagination.



Most of the mock-ups have been prepared from the original fabrics, but they offered a lot more variations than presentable.

The overlapped pieces of different length resulted in peculiar visual effects, like the interference of the crosswise stripes, or when the white half jackets partially cover the striped ones, or the soft drapes produce wave-like effects.



5 Feedback

My experimental models were not intended to be manufactured for sale, but perhaps they will live on.

A large number of combinations were photographed some of them clearly showed the properties of the fabrics as garments of exclusive products and proved to be attractive for being manufactured. So I offered them to the fabric printing company (Maya Rt. I bought the fabric from), and they presented some of the photos in the form of enlarged posters at a joint trend blocks at the Texworld Fair in Paris, in 2005.

My doctoral exhibition made it possible to present this work to the public and the professionals, as well. They expressed the opinion that these models can be worn practically by all sorts of figures, due to their simple cuts, but sophisticated variability.

On the occasion of the 35 jubilee of Rejtő Sándor Faculty of Light Industry and Environmental Protection Engineering of Budapest Tech, some of my models were put on by the staff in a fashion show as a surprise for the guests invited, proving the wearability of my innovative collection.

Conclusions

As a designer I consider it extremely important to make continuous analysis of economic and social situation, the motivations and identity of the group targeted, and the new trends, as well as to keep abreast with the latest technological innovation for creating new competitive ideas.

As a tutor my primary aim is to provide our students with all these kind of widely applicable knowledge.

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Engineering Evaluation about the Role of Innovation in a Globalized Economy

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Abstract: New trends in production processes result in the important role of innovation in a globalized economy. In the different market segments, strong competition does not allow even the smallest loss of the traditional processes, so the whole value-add process has to be managed by a complex, globalized, IT-based system and standardized management methods. In order to provide adequate and effective solutions the critical process elements, a whole new set of innovative engineering methods has to be developed. This paper analyses the means related to the existing production systems of light industry, discussing in detail the LEAN logic that is to minimise stock levels; and on the other hand attempts to give an overview of the up-to-date methods in proportion to their actual role.

Keywords: globalization, LEAN, innovation, management system

1 New Trends in Production Processes

Different branches of light industry often express complaints about their inability to solve problems resulting from the flood of mass products made in the Far East. This phenomenon can be seen not simply as one's fate, but as part of a new trend, and the novel aspects of this trend are surely worth considering. Globalization and the abolition of customs frontiers allow us to involve in the production process other economies of different strengths (e. g. cheap and hard-working labour). If we mean to maintain the competitiveness of our region, we need to carry out conscious developments that are tailored to our own strengths. This requires major changes in economies, management, and also, to a great extent, in the attitudes of engineers.

The main condition of the transition is that economic borders have grown more permeable. Logistic developments have changed the world faster than ever, and the need for minimising production costs resulted in a high concentration of capital.

Container loaded carrier ships and endless rows of trucks out on the roads are everyday proof that products are worth transiting for thousands of kilometres if the production process is well-designed and plenty of extra value is accumulated at the starting point. We also have the chance to build our strengths in the value-add processes.

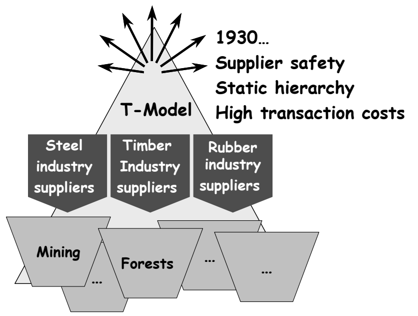
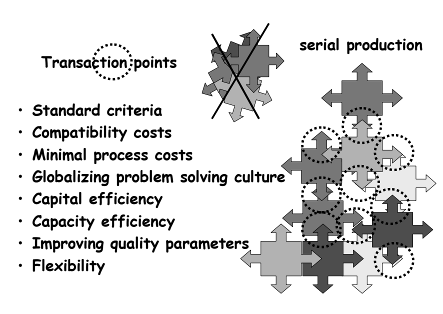
Strategy for production organization in the 1930's	Strategy for production organization in 2000
	

Figure 1

Production strategy adapted to the new conditions and aims in car industry

Besides the changes affecting the market strategy, the economy and the management, skills to be developed by engineering must also be considered. This includes minimising stock levels, reducing production changeovers time, developing flexible production systems, and reducing costs and time loss.

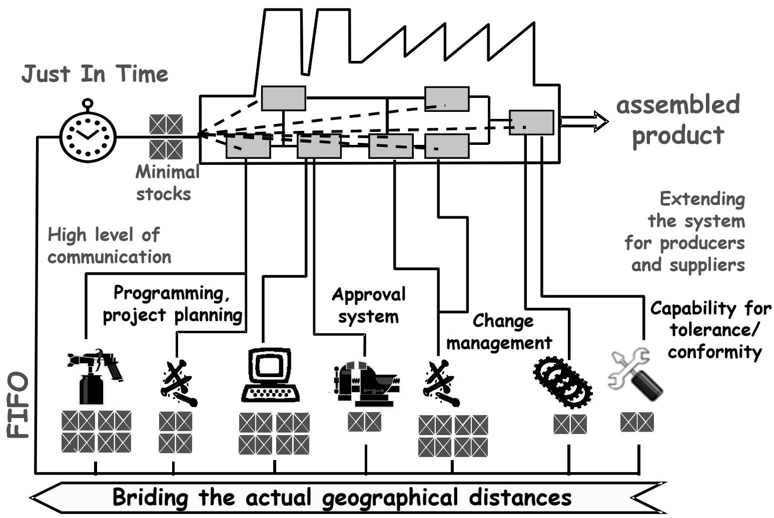


Figure 2

Production strategy adapted to the new conditions and aims

The demands from the development of the production system in the globalized economy include: marketable products; a wide range of products as a result of seller's market; order based production (or stock levels close to the order level) and the least costs. There are a growing number of methods to reach these aims: conscious and innovative management of product design [1]; network of suppliers (quality partners) through the necessary IT means; supporting quick processes and changeovers through flexible production equipment; general use of approval and logistics methods (e. g. Production Part Approval Process, Just in Time).

2 Value Loss in the Processes

An essential characteristic of the evolution of production and service processes is that different activities and operations are arranged in a hierarchical system. To implement this, the activity conditions are created according to the optimal capital concentration.

The targets of innovation were different technological and service steps at first, and harmonized processes later. These processes constitute the elements of the supplier chain, which usually constituted separate interests from the point of view of ownership and investment. The whole production/service cycle has to be constantly improved and optimised according to the investors' interests and owners' objectives (which is usually maximum long-term profit). This requires the reasonable and manageable modification of the economic, organizational and engineering means, for which methodological standards are commonly used (e. g. ISO 9001, SixSigma, TQM) on the basis of the best practice.

3 Commonly Used Methods of Value and Resource Analysis for the Whole Production Process. Value Stream Mapping (VSM)

The previous model, which seems to be ideal at first sight, reveals losses when analysed from the perspective of the whole production/service cycle. Optimising the supplier chain according to several particular interests is not optimal from the viewpoint of marketability and customer retention. Bridging particular interests was necessary where liberal market rules transform this into value. The implementation is only possible if activities can be supported by apt management and relevant information. Of course, at the end of the high-level innovation, the best practice will necessarily turn to standards (pull-production, LEAN).

While solving the problem, a demand emerges for a system that meets global requirements from the side of the full product/service cycle, and at the same time, is not in conflict with the elements of the production/service chain. This can logically start from the distributor's side. Coordination and approval of the activity chain is needed, parallel with constant communication. The most important supportive standard is the latest version of the ISO TS 16949 standard, which is constantly improved based on the best practice. This method is supported not only by standard regulations, but also by independent auditors, and the supervisory and problem-solving methods developed by the customers (process auditing methods, experimental design, risk analyses: FMEA, reaction standards, 8D, error elimination methods: SPC, Poka-Yoke, etc).

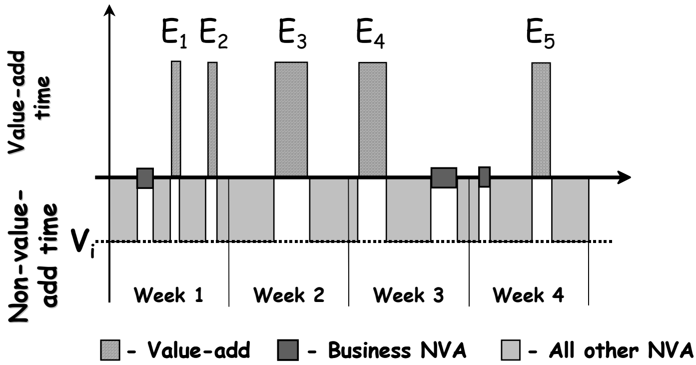


Figure 3
Time map for conventional production/service processes

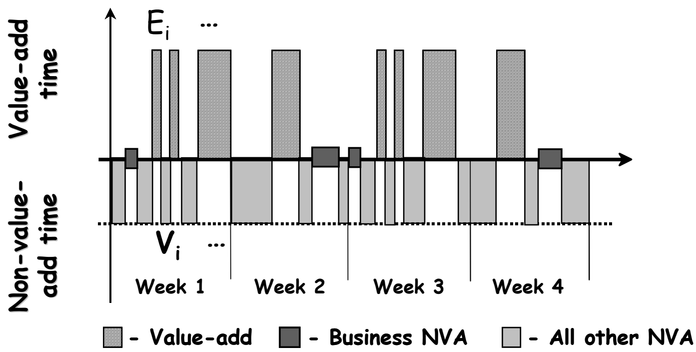


Figure 4
Time map for production/service processes after innovation

Reducing lead times requires conscious decisions, and sometimes the reorganization of production capacities is also inevitable. The main points and the evaluation of successfulness are defined by economic aspects, which also assign engineering activities. There is a need today for the innovation of value-add processes, which also involves, besides general improvement, building in one's own strengths. Out of the demanded innovations (demand pull [3]), some problems have major importance:

- developing balanced production/service production programs to support activities that are homogeneous and inhomogeneous in time
- optimising production changeovers and the time demand of production (methodology, optimising parameters)
- value-oriented minimisation of process times (Value Stream Mapping [4], JIT)
- harmonizing the maintenance system with the minimal costs of the value-add process (TPM)
- minimising deviation, a high level of achieving the objectives (SixSigma)

Throughout the whole value-add process, losses resulting from capital commitment can be eliminated by the adaptation of conventional activities on the basis of a new approach.

In the value-oriented analysis, activities related to changeovers, maintenance and process starting are necessary, however, they are not actually profitable from the point of view of the product (business processes). For these activities the main aim is to reduce time cycle and to implement the relating functions at the highest possible level.

$$PCE = \frac{E(1-\sum K_i)}{E+(\sum_{j=1}^{N} L_j + \sum_{i=1}^{N} n_i \cdot S_i + T)}$$

- PCE – process efficiency
- E – value-add time in the process
- K_i – losses related to process quality and the decrease of efficiency resulting from future waste recycling
- L_i – losses resulting from setting the operations, changeovers and maintenance
- S_i – average loss time of units queued up between the operations
- n_i – the amount of units queued up between the operations
- N – number of operations
- T – average loss time of raw material and products in the storage

The phases of innovation related to the process are:

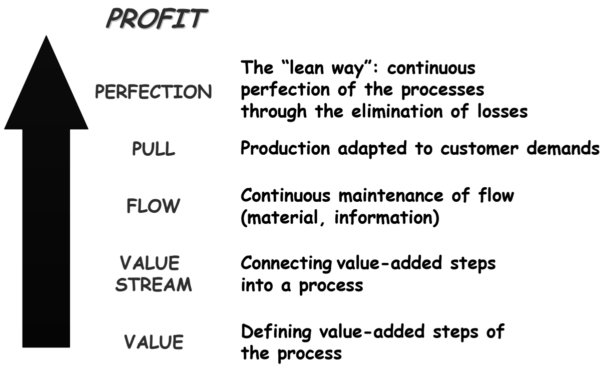


Figure 5
Innovation phases (starting from below)

Process phases that do not add value – for example, waiting, "must" processes and wastes – cause considerable increase in the costs, together with financial and commercial value losses. If these losses can be eliminated by organizational, process-planning and controlling methods, then we can remain competitive despite the relatively high salaries and their costs characteristic of this branch of industry.

Table 1
Phases of change management

Planned means of changes	*Aim, direction*	*Task, function*	*Method, standard*	*Result*
Analysis	Analysing organizational culture and the ability to change	Process structure, procurement strategy, losses, analysis of the inner/outer environment	Process definition (VSM), analysis, collecting inner experience	Process and organization analysis
Decision	Defining the modified process, the organization, establishing consensus	Target values, time plan, defining interests	Workshops, project definition, communication	Vision for the future, team, consensus, management support
Introduction, activity	Subtle design and implementation of the change	Planning, allocating resources, timing, coordination	DOE, GANTT, project follow-up, risk evaluation	Plan, risk analysis, expectable assets, consensus
Feedback	Systemising the results of the innovation	Managing change, risks and expectable assets	Documentation, team work, workshops, communication	Modified process, better performance, changed organizational culture

In practice, the projects aiming to achieve these objectives were implemented on the basis of a multiphase methodological system. The main scheme of that follows standards that support the implementation of radical changes (change management [2], BPR).

During the practical implementation, we used this methodology in several research projects. The novel approach has revealed an amazing amount of reserves. We have found that the efficiency of processes can considerably be increased (sometimes even by a few hundred per cent) not only in case of the traditional textile, leather and clothing industry, and the electronically assembling and production – which perfectly fits the traditional model of light industry –, but also in case of the economic and service processes, for example invoicing, administration and customer support.

4 Extending the Method; the Ideal Level of Total Social Costs

It is a common source of annoyance when a business activity is purely controlled by the interests of those directly involved, without taking into consideration the fact that many other participants also pronounce their demands. If we take the case of communal infrastructure maintenance works, for example, both the interests of the local authority for cost reduction and strict deadlines and the interest of the entrepreneur for maximal profit can be detected. The social consequences of the risks of pedestrians, the fuel costs of queued up cars and the extra adrenaline of both groups are aspects lying outside the business agreement. Highly organized economy support systems are capable of modelling the complexity of social values. This include environmental protection regulations (e. g. fines); legal possibilities with a social perspective (e. g. permission processes), and the like.

There is a trend in globalized processes that the optimisation is more complex: its modelling area does not simply involve the operations, but it is extended to the technological steps and processes, process systems and the design method applied to the different elements of the production chain. If the trend continues, our present knowledge can be integrated from the perspective of product life cycle and product dynamics. At the same, it is also useful to extend the process from the point of view of social interests, with those components that have relevance in the success of the business.

If we adapt this trend voluntarily to our business processes, it can bare practical economic advantages.

(„You should not be afraid ***of*** *the complex, but the confused”* [5].*)* The condition for success is that we should see everyone involved, together with the external effects, as weighted risk factors in the (long-term) innovation process.

The basis of the new approach is that previously not involved interests have to be represented. During that we must translate into numbers how much realisable and intensive the interests are, as well as the characteristics of the processes that are expected to influence our case. The direction of the innovation allows that the adapted processes can have advantages in the given context.

We initiated a research on the field of light industry to interpret the extra demands related to the production processes. The demanded “giant leaps” in developing the structure of the full implementation cycle can only be realized by taking into consideration the above mentioned aspects.

The important extra demands in light industry processes, which used to be interpreted in an instinctive way are:

- realizing the aspects of environmental protection in process definition,
- fashion making, and the issue of fashion dynamics,
- managing the effects of work conditions, and the degree of the involvement of key workers,
- planning for the special demands of usage [6, 7],
- process planning segmented from the point of view of capital processes.

The practical steps of the innovation process will be separated if they are to be adapted to the modification of an existing value-add process; or, in other cases, a new set of processes has to be developed. In case of light industry, the realization of the above mentioned objectives should not be expected solely from the individual market agents. Conscious innovation of such processes represents the interests of the whole national economy in a globalized world market. Major supporters of this practice in a globalized context are the benchmarking based evaluations and process innovations implemented in European Framework Programmes, in which Hungary is also involved [8].

Conclusion

Losses of the whole production/service cycle require organisational and technical analyses. This paper recommends methodologies, which are standardised, and provides optimisation of facilities according to determined aims.

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Characterisation of Fabric Drape Using Spectral Functions

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Absract: The article compares the measurement and calculation methods of the fabric drape coefficient used for computer modeling and describes a new parameter. This is the spectral function that is based on fabric drape and it describes the cloth's 3D plasticity, and ability to be fitted against forms. The new parameter can be used during design as well as during pre-production to for predicting tailorability in the garment industry.

Keywords: drape, material testing of cloth's

1 Introduction

The simulation of cloths using computers is an area that is researched long ago. Pre-production computer programs help in the garment industry to make models, series and to develop the garment. The modelling systems also utilize animation tools. The models designed using computers can be 'dressed' and they can be moved using preprogrammed human movements. The real behaviour of cloths can be simulated using the animated models to design a model for a given figure, although modelling is a complex task. The plasticity and behaviour of cloths is a complex mechanism, since the interaction of strings and threads result in special attributes. Textil cloths are different from other materials and they are characterised by their aniztropy and their ability to deform under small forces. These charachteristics are mainly due to drape, resistance to bending and shear strain. The behaviour of textile cloths differ from other materials (e.g. paper) due to the differences in there characteristics.

To model a textile with a computer simulation, to display a clothing model esthetically in 3D drape is used. Drape is such a deformation that is mainly due to gravitational force while only a part of the textile is fixed. The unfixed part can move around freely, this results in the deformed shape. In case of a skirt if the upper part is fixed then released, then the hanging part of the skirt will free falls, ie. drapes.

In this article we describe the test methods and attributes used for drape and also refer to their change due to structural and production technology parameter changes. Our goal is to search for such a new method which can also be used for computer simulation.

2 Methods Used to Calculate Drape Behavoir of Fabrics

2.1 Determining the Drape Coefficient by Measuring Mass

The drape test can be calculated from the projection of a rather large, freely sagging circle fabricsurface.

A fabric, is placed on the sample holder which has a larger diameter, then the sample holder, the edge of the fabric sags due to its own weight. The drape of a fabric that sags due to its own weight can result in different shapes (Figure 1). A fabric can be considered as fully stiff if a sample with a radius of R_2 is placed on a sample holder with a radius of R_1 and its projection is equal with circle that has the radius of R_2.

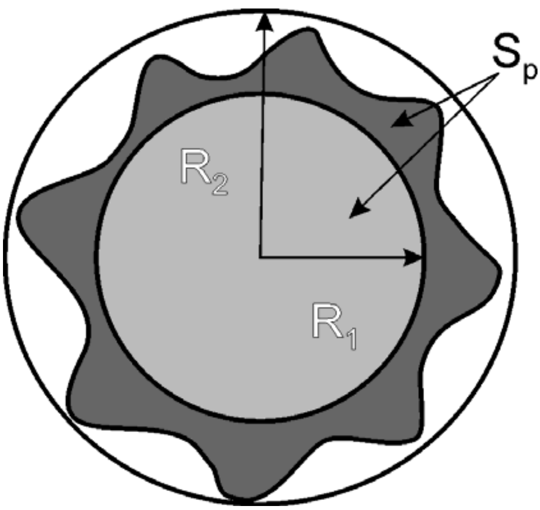


Figure 1
Projection of drape – paper ring with draped image

To calculate the drape coefficient from the values given on Figure 1 using image processing, the following formula can be used [Jevsnik, Gersak, 2004]:

$$CD = \frac{S_p - \pi R_1^{\ 2}}{\pi R_2^{\ 2} - \pi R_1^{\ 2}} * 100 \ (\%) \qquad (1)$$

where

CD drape coefficient [%]

Sp area of the draped sample, including the part on the sample holder [mm^2]

R_1 radius of sample holder [mm]

R_2 radius of the non deformed sample [mm]

The projection can be drawed on a paper ring that is placed on the upper glass plate using a local light source and a built in mirror. According the simplest mass measurement method first the mass of the initial paper ring (M_1) is measured, then the one that was cut out according to the projection (M_2). The drape coefficient in percentage can be determined as ration of M_2 and M_1

2.2 Computer-aided Drape Test

During a computer aided test the drape coefficient is determined using image processing. The Sylvie Cat system [Kuzmina, Tamás, Halász, 2005] measures drape using three dimensional body scanner. Four fixed cameras are located above the sampleholder and they make snapshots of the sample on different heights. The sampleholder is moved vertically to change the height (5 and 10 mm) of the sample. The three dimensional points of the sample's geometry are determined by the curves estimated at different heights. The data is processed by the software designed for the system [P. Tamás; J. Geršak; M. Halász, 2006]:, which can be used effectively for three dimensional simulation. The computer draws the shadow line on a ring and based on the images it creates a 3D image of the given fabric, which can be rotated in several directions. The program calculates the following data: drape coefficient, CD (%), number of waves (pc), minimal and maximal radius (mm). The minimal and maximal radius is used to describe drape, which is the distance from center of the circle to the smallest and largest crimp. (Figure 3).

The test were made on the Budapest Tech Polytechnical Institution using a Cusick Drapetester. The images of drape were captured using a digital camera that was fixed on the device and the drape coefficient was determined using Photoshop image processing software (Figure 2). The calculation of drape coefficient based on counting the number of pixels of inner and outer area of the draped image. The standard atmospherical conditions were not achiavable during the test, so such a sample was selected, where this influence on the measured data can be neglected.

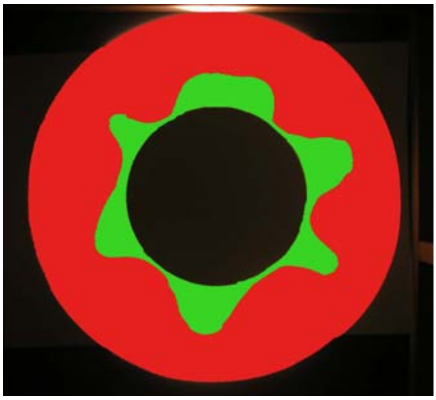


Figure 2
Drape test using image processing (a scanned drape in Adobe PhotoShop 6.0)

3 Interrelation of the Drape Parameters

Stiff fabrics have a high drape coefficient, these can be formed with difficulties. Fabrics with a lower drape coefficient can be formed easier, they fit easier to form and they also fit easier to the shape of the body. The shape and number of fold(nodes) are determined by the material and the production technologies, e.g. the firmness and stiffness of the fabric. A stiff fabric has larger and wider folds, while a fabric that is not as stiff has narrower folds. While finishing with softening largely influences the drape coefficient. [Kokas, Halász, 2005]

The professional literature considers the drape coefficient as a primary fabric characteristic, even though drape can not be always characterised only using the drape coefficient. There is a possibility, that two fabrics have the same drape coefficient, still the shape of folds differ from eachother [Halász, Kokas, 2006].

To create an image during simulation that is equivalent to the reality, the number of folds, their shape, amplitude and distribution is specified alongside the drape coefficient. In case of woven fabrics the position compared to the projection and warp line is also specified for these data (Figure 3).

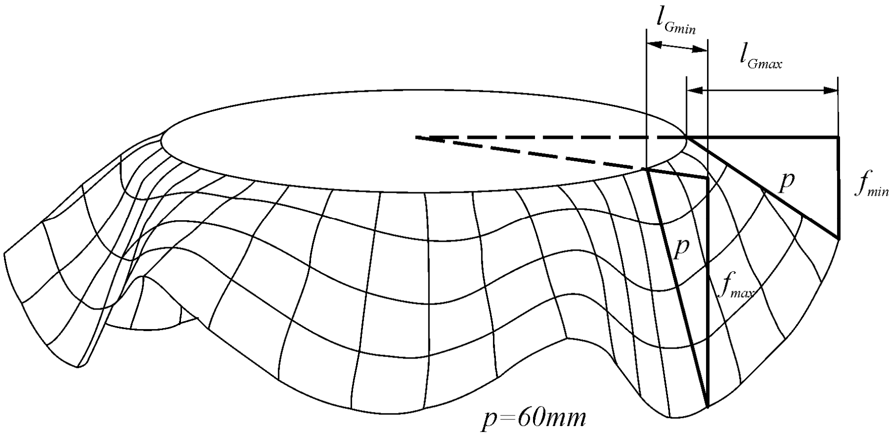


Figure 3
Maximal and minimal depth of folds

The distribution of folds can be calculated using the following formula [Jevsnik, Gersak, 2004]:

$$G_p = \frac{\sum\left[l_{G\max}(i) - \bar{l}_{G\max}\right]^2}{\bar{l}_{G\max}^{\ 2}} \tag{2}$$

$$\bar{l}_{G\max} = \frac{\sum l_{G\max}(i)}{n} \tag{3}$$

$$\bar{l}_{G\min} = \frac{\sum l_{G\min}(i)}{n} \tag{4}$$

where

G_p: distribution of folds

$\bar{l}_{G\max}$: average of the maximal depth of the folds [mm]

$\bar{l}_{G\min}$: average of the minimal depth of folds [mm]

l_{Gmax}: maximal depth of fold [mm]

l_{Gmin}: minimal depth of fold [mm]

n: number of folds

The number of data necessary to describe drape results in a difficult comparison of cloths in the garment indusrty. During our tests we were searching for such a new relation, with which the drape characteristics of different fabrics can be compared easily.

4 Determining the Spectral Function of Drape

During our research to improve the testing of drape we used the previousle partly proven assumption, that

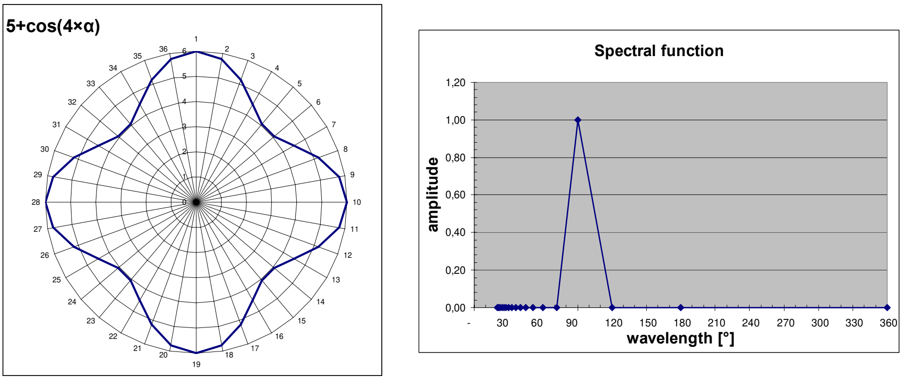
- fabrics with different flexibility can have the same projection ratio and
- the outlines of the projection can be generated using periodic functions superimposed on a circle.

To prove our assumptions

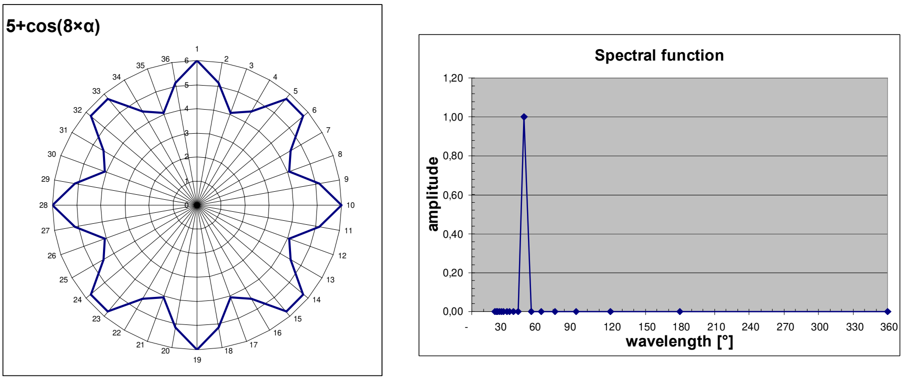
- we created a device that can easily capture the outlines of the sample digitally,
- we created a computer software that determines the radius of the circle that fits best to the digitized outline of the sample and those periodic functions whose sum can produce the original projection,
- we tested the spectral functions separately which examine the amplitudes of periodic functions in relation to angular deflection and
- we tested, whether the newly developed method can demonstrate the influence of different effects on the spectral functions by examining wheter there is any change in them.

The use of the method is demonstrated on idealized projections, then real samples and cloths that are made of the same compounds, but are exposed to different finishing effects.

On Figure 4 an idealized case can be seen: we show two different theoretical drapes that can occur at the same projection area. Next to the figures we represented the corresponding spectral functions on a graph, which plot the amplitude of folds in relation to the wavelength. For demonstration purposes we connected the discrete points aquired in relation to the angular deflection. It can be seen from the spectral function that the drape is symmetrical (the curve has only one apex), the angular deflection of the characteristic fold is 90 degrees in the first case, while 45 degrees in the second.



a) projection of a stiff fabric



b) projection of a soft fabric

Figure 4

Spectral function for two fabrics (a and b), which have the same drape coefficient

To compare different samples, first we examined that the same sample photographed different time instants what is the resulting drape. On Figure 5 we plotted the spectral function of a sample made of 100% viscose with 90 g/m^2 areal density, based on photographs at different time instants. For demonstration purposes we marked the angle for the amplitude apex. It can be seen, that this value is equal at both time instants, so this data is a characteristic of the tested fabric.

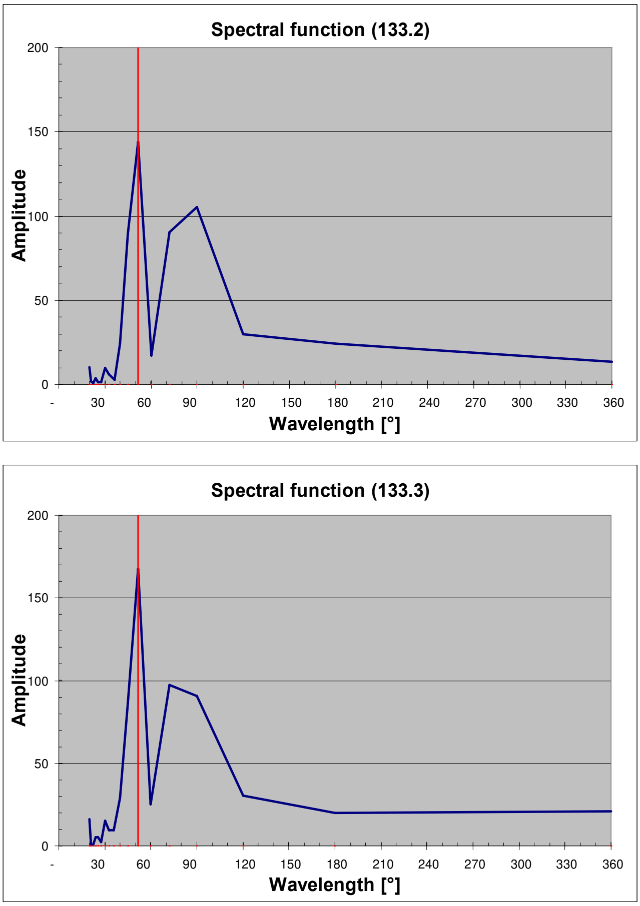
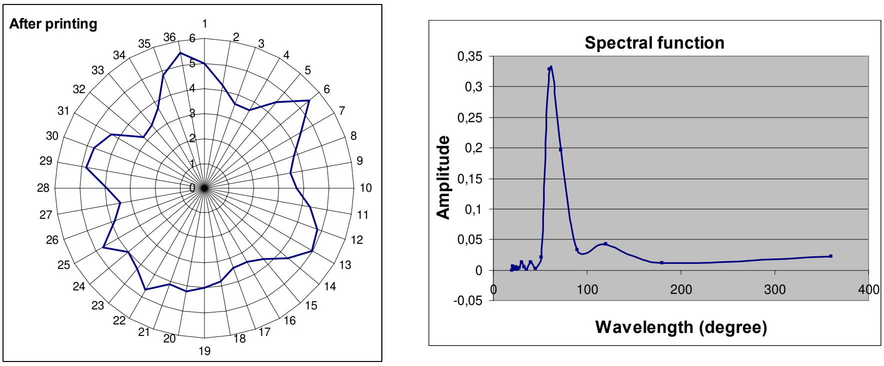


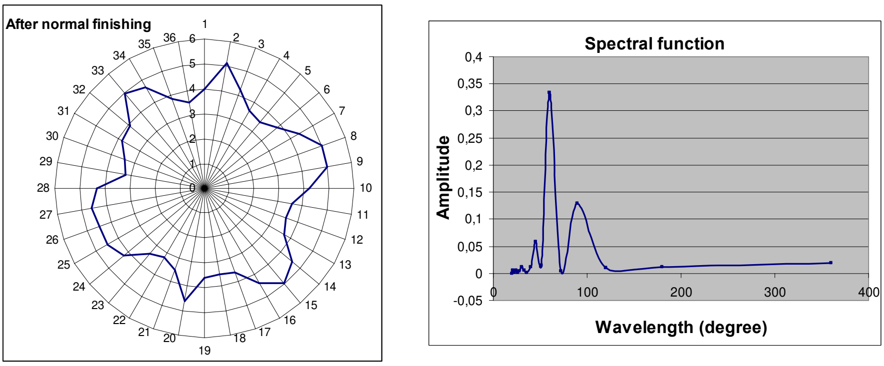
Figure 5

Spectral function on two identical fabrics, based on photographs made in different time instants (a and b)

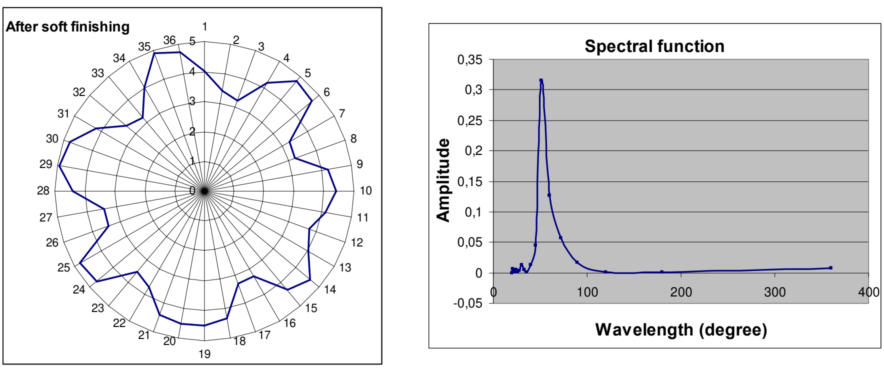
We examined this fabric in different finishing phases (Figure 6). The difference of the ratio of the area of the three samples during the test was minimal, but it could be stated, that using the soft finishing, the drape of the sample decreased.



a) after printing



b) after normal finishing



c) after soft finishing

Figure 6

Spectral function on a fabric with different finishing (a, b and c)

The spectral function which is the result of the Fourier transform of the drape data show the changes occurred during different finishing technologies.

The comparison shows, that with the use soft finishing the longer wavelength folds disappear and the wavelength of folds also decrease.

It can be seen, that the spectral function has only one apex, which means that using soft finishing the drape got smoother and the distribution of folds is almost symmetrical (Figure 6c).

Our tests presume that the spectral function is suitable to describe the ability to drape, to give the frequency of different wavelength folds, the distribution of folds, which enables the draw conclusions regarding symmetry. Further measurement will be made to prove this statistically.

Summary

The drape coefficient alone is not sufficient information about a fabric, so the number of folds, their wavelength, distribution and amplitude is specified as well. In case of cloths the position compared to the projection and warp line is also specified for these data. This is a large amount of data, so it is difficult to handle it, so our goal was to develope a method with which the drape capabilities of different fabrics can be compared easily and fast. Instead of the drape coefficient we gave a new characteristic: the spectral function of the drape. Further research is necessary to prove that the new method is capable of characterising different fabric types. The effect of different technological treatments on the spectral functions has to researched as well. The new method will be most likely a tool for the designers, in the garment industry pre-production process and in the garment technology.

Acknowledgement

This work has been supported by Hungarian Government by National Office for Research and Technology (SLO-8/05, TR-01/2006, SI-6/2007) and by Agency for Research Fund Management and Research Exploitation (K68438)."

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Determinations of the Colloidal Structure of Pulp Fibres by Adsorption in Liquid Medium. The Role of Pulping Process

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Abstract: We used the principles of theoretical colloid chemistry and our earlier results. We developed further the measuring of the specific surface by adsorption method. The aim of the study was the change of the usability of the method in showing out the structural differences of the pulping process. We found that the different pulping processes results in differences of the specific surface of the fibres measured with iron/III/hydroxide, TiO_2 and Methylene blue adsorption, and we also found that the specific surface data depend on the lignin content.

Keywords: spruce cellulose, beating, specific surface, adsorption, lignin content

1 Adaptability of Surface Measuring Cellulose Fibres in Liquid

The strenght, flexibility and permeability of pulp products is defined by the composition of the pulp, and the chemical and physical properties of fibres of different origin. It is necessary to scientifically check pulping and papermaking processes to characterize the fibrillation and the beating. (1)

It is practical to conduct the surface measuring in liquid medium, because drying degrades irreversibly the surface of the fibres.

If different particles are adsorbed on the surface of the cellulose fibres – and we know the diameter of the particles – we can calculate the size of the surface. So the calculated surface depends on the adsorptivum (Fig. 1). This measuring method is appropriate only if the adsorptive particles attach strongly to the surface and form monomolecular layer on it, and this is made possible by the potential difference of the cellulose and the adsorptivum. It is important to maintain the pH value 4 in the liquid medium all the time. (2, 3)

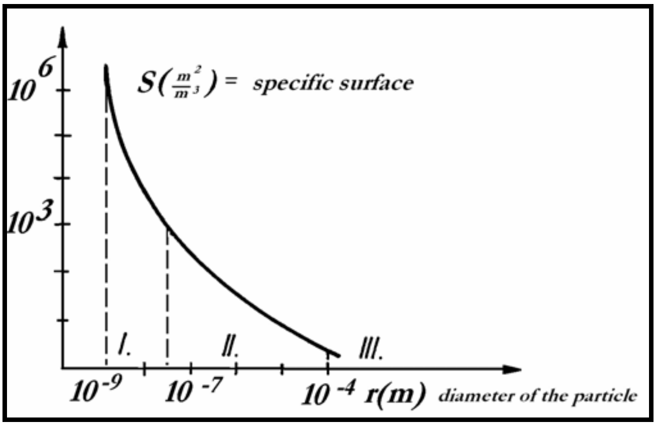

Figure 1
The specific surface vs. the diameter of the particle

1.1 The Counterfeiter Influential Factors of the Specific Surface

The cellulose fibres might have a structure that counterfeits the specific surface of different sizes and results in a seemingly large surface. For example: if the diameter of the micro fibre is smaller than the diameter of the adsorptivum, we measure larger surface.

2 The Materials and Methods of the Experiment

We used in the measuring spruce cooked with three different chemicals at different cooking temperatures (430-440 K) – and cooking times. The data of the pulping are summarized in Table 1.

There are differences in the chemical contents of the pulps. It is typical, that the cellulose content grows and the polios and lignin content diminishes by applying longer pulping time and by bleaching. In spite of the grate chemical difference it is still possible to compare the results of the adsorption, because in these cases the electrocinetical potential (Z-potential) is the most important parameter and its average value is 25.25 mV without significant deviation.

Table 1

The major data of the different pulp fibres after pulping

Type of the pulp	Chemical name	Chemical concentr. (g/dm^3)	Cooking time (min)	Cellulose content tart. w/w (%)	Polios content w/w (%)	Lignin content w/w (%)	Z-potential (mV)
Spruce chemical pulp CMP	Na_2SO_3	250	5	48.2	19.4	27.9	-26
Spruce half cellulose	Na_2SO_3	250	90	54.1	16.0	24.5	-23
Spruce cellulose	NaOH Na_2S	144 36	135	71.4	14.1	10.6	-27
Spruce bleached cellulose	NaOH Na_2S	144 36	135	85.8	9.0	1.8	-25

We have already published the concrete measurement methods of the experiments. The most important parameters of the measurement were the diameters of the particles. The diameter of Methylene blue is 0.77 nm, and we know that 1 mg Methylene blue means about 1 m^2 surface. The diameter of iron/III/hydroxide is 4 nm, so 10 mg iron/III/hydroxide means 1.2 m^2 surface. The average diameter of TiO_2 is 250 nm, 1000 mg TiO_2 it means 1.12 m^2 surface. Considering the molecular weight of the adsorptiums, we can calculate the surface of the cellulose. (3, 4)

$$m^{\sigma} = \frac{V \cdot (C_k - C_e)}{m} \qquad (Eq.\ 1)$$

Where:

V: volume of the suspesion [dm^3]

C_k: concentration of the solution before the adsorption [mol/dm^3]

C_e: concentration of the solution after the adsorption, [mol/dm^3]

m: weight of the cellulose [g]

m^{σ}: weight of the adsorptioned particles [mol/g]

$$S = m^{\sigma} \cdot N \cdot S_0 \qquad (Eq.\ 2)$$

Where:

m^{σ}: weight of the adsorptioned particles [mol/g]

N: Avogadro- Loschmidt number [$6 \cdot 10^{23}$ db particle/mol]

S_o: surface of one adsorptioned particle [m^2/1db particle]

S: specific surface [m^2/g]

(5, 6)

The chemical content measurement of the cellulose fibres were made according to the Hungarian standards.

Cellulose and incrusting substances content: MSZ.53.97 (1988), Lignin content: MSZ.8234. (1987) (7, 8, 9)

3 Results of the Experiments

Examining the spruce samples, we described the growing cooking degree with diminishing lignin content. The specific surface data depend on the lignin content as illustrated in Fig. 2.

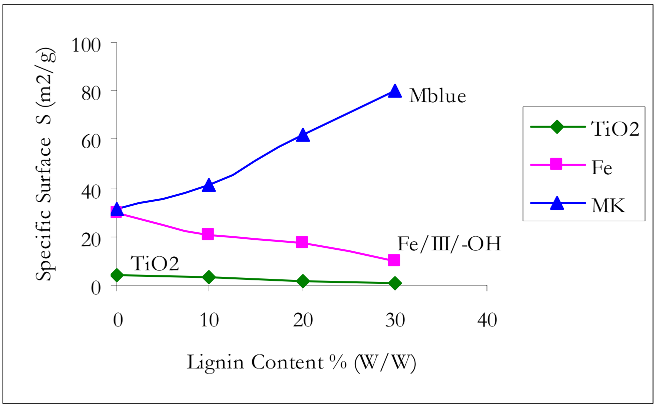

Figure 2

Methylene blue, iron/III./-hydroxide and TiO_2 specific surface of different pulps vs. lignin content

We can see in Fig. 1 that the Methylene blue specific surface diminishes with chemical pulping, but the iron-/III/-hydroxide- and Titan- dioxide specific surface grow.

We can assume that the different pores in the cellulose surface change with the changing of the cooking degree.

The Methylene blue surface value is an apparent value because the amorphous part of the fibres dissolves the pigments. The use of word ‘apparent’ is necessary in the case of Methylene blue according to our previous experiences. This is the explanation for the decreasing of specific surface when the content of incrusting substances and the lignin content diminishes.

During cooking and pulping there are opposing processes. While the amount of the incrusting substances diminishes, the dissolution of the pigments also reduces for new surfaces become accessible. The first process reduces the apparent surfaces, the second process enlarges it.

Comparing the results we can also calculate the surface of the different pores in the fibres (Table 2).

Table 2

Surfaces of the different pores of the spruce fibres

Name of the cellulose:		Spruce chemical pulp CMP	Spruce half cellulose	Spruce cellulose	Spruce bleached cellulose
lignin content % (W/W)		27.9	24.4	10.6	1.8
Specific Surface(m2/g)	molecular pore 0.4-0.8 nm	6	15	37	45
	subcolloidal pore 0.8-15 nm	60	66	24	0
	colloidal pore 15-420 nm	10	12	24	30

We can see in the above table that the specific surface of the molecular pores grows while the subcolloidal surfaces diminish by increasing the cooking degree.

Conclusion

In the course of the laboratory tests surfaces of different grades of spruce cellulose fibres beaten to different extent and cooked in different ways were determined using the molecular Methylene blue, iron/III/-hydroxide and TiO_2 adsorption method in liquid medium.

The Methylene blue specific surface diminishes with chemical pulping, but the iron-/III/-hydroxide- and Titan- dioxide specific surface grow. We can assume that the different pores in the cellulose surface change.

The specific surface of the molecular pores grows but the subcolloidal surfaces diminish as we increase the cooking degree.

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Ecological Design or Some Aspects to the Reconstruction of a Mediaeval Rotunda

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Abstract: The architecture of our ancestors (mediaeval architectural design, folk architecture) can serve as a model for recent ecological architecture (concern choice of material or construction). This work is dealing with a special kind of mediaeval building such as with rotunda. Here, we deal with the practicality of the mediaeval design and with constructional questions of the rotunda. There is shown, how a rotunda can be reconstructed from its recently exposed fundament.

Keywords: ecological construction, mediaeval structures

1 Introduction

Both high-tech and low-tech are applied in the ecological architecture [1]. That is besides the application of the novel developments (e.g. solar cells) it is to takes over from the design of our ancestors (earth wall) as well [1-3]. If you see historic buildings of centuries old, a question arises, what is the secret its monuments. They have resistivity against natural forces (against wind, against sunshine and sometimes against earthquakes). A few of these old buildings are in ruins. The reason of this ruined state can be searched in the history. They have been demolished during a war by a ravage. In this way, the monuments of our ancestors can be a model for ecological design. It is well known, that folk architecture has a fruitful influence on ecologically friendly construction. Their choice of material and their solutions for structures are parable for us [1, 3]. However, what can we learn from the mediaeval architecture? If we examine the modern buildings made from conrete, we have to state, that those are regularly renovated. These buildings have large mechanical strains inside their structure. These strains have temporal relaxation, which leads to the deterioration of the whole building. The mediaeval buildings are made in a way, that their structures have no bending and pulling forces. So here, the above mentioned relaxation does not apply. The walls and the bridging are constructed so, that only the compressive force is produced in the material, which can tolerate it. The rotunda presented here is a good model for demonstrating the above mentioned principle. In this work is shown, the reconstruction of a rotunda from the fundament. This reconstruction demonstrates the practicality of the mediaeval architectural culture.

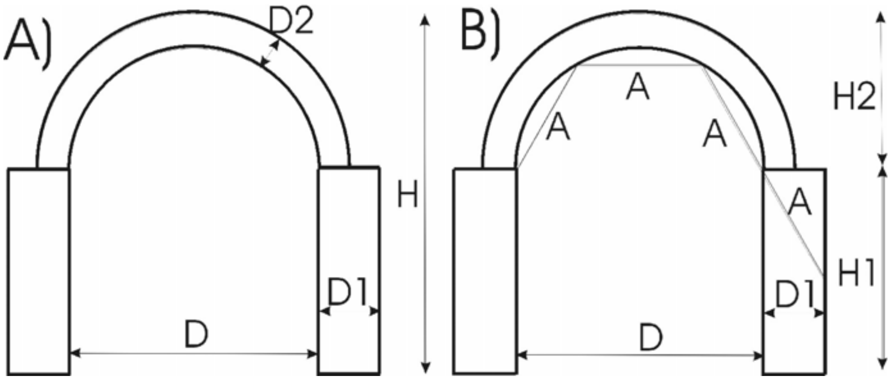

Figure 1
Illustration of the Alberti- (A) und Blondel-low (B)

2 Some Aspects to the Mediaeval Rotunds

The rotunda is a specular kind of our mediaeval sacred architecture. There are many rotunds in Carpatian basin. Some of them have not remained in their original form. Several ones were built in a larger church e.g. as a choir. Others were demolished and only its fundament remained. There are turn-symetrical churches in varous places in Europe. But according to the archeological excavations, we can declare that its denity is larger in Carpatian basin [4, 5]. These turn-symetrical rotunds possess frequently arched and rarely angled choirs. These rotunds in our territory differ from the West European ones not only in structure but in dimension as well [5, 6]. The internal diameter of our rotunds range between 5 and 7.5 m [4, 5]. Because of the frequent occurrence of our rotunds, their origins may not root in the West European or Byzantine model [5]. Instead of taking over, the origin of these rotunds have to be searched in the expedient constructional technology. The oldest rotunds in our territory are made from sticked-wicker-work, which is proved by excavations. Our ancestors have also rounded houses. Hence, we can declare that the frequency of these circular buildings originate in the technology and constructional experience of our ancestors.

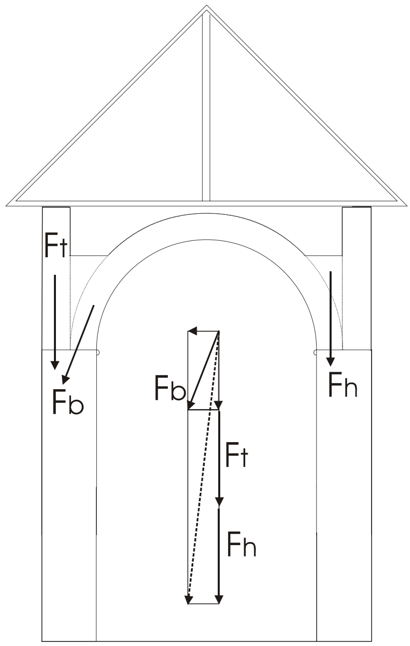

Figure 2
Demonstration of the role of kneewall and of the fill of vaultback

3 Mediaeval Engineering

For the reconstruction, we have to know the mediaeval mathematical and scientific culture [7]. We have few written documents from this mediaeval technical culture. The vaulted small churches and the large cathedrals serve as an essential fact to discover this knowledgement. The remained delineations in codices contain information about the execution of the cathedral [9-12]. In this work, we focus on the data which are connected with the rotunds. The architecture of our ancestors is always shoped by practicability [1-3]. This practicability or ecologicality help us find the proper construction. The bridging over the room determines fundamentally the dimension of the building. The bridging, that is the covering of the mediaeval rooms, can be either flat ceiling or vault. The square naves and choirs can be both kinds such as flat ceiling or vault. The arched choirs have always vault. In consequence of the construction, the vault is practical in the case of rotunds. The supporting forces of the vault (span) and their revetment wall (height and width) determine the enclose dimensions of the building. We have to be aware of the mediaeval planning methods and intact rotunds for the reconstruction of our building. It is to be noted that, the planning rules are the same for both the two and three dimensional (that is turn-symmetrical) vaults. Two dimensional vault is e.g. the triumphal arch of the choir and three dimensional one is e.g. the dome of the nave of the rotunda. The dome can be a real or a quasi cupola, which have theoretically different static functions. In practice, the real and the quasi cupola has not only formal similarity, but because of the friction between the large stones, their functions is partly also similar.

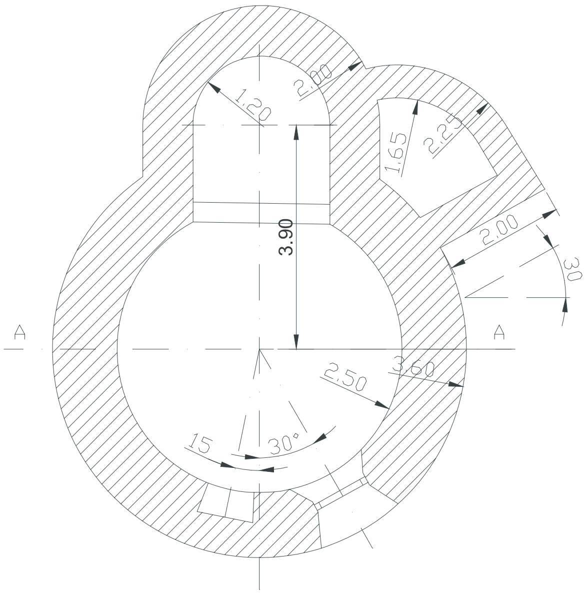

Figure 3
Groundplan of the reconstructed rotunda

There are documents from the Middle Ages and from the Renaissance about the ancient planning rules. One of them is written by L. B. Alberti. This rule gives the relation between span (D), high and width of the pillar (Fig. 1A). The width of pillar (d_1) has to be about quarter of the span ($d_1 \sim D/4$). When the hight of construction (H) increases, then the width of the pillar increases, too. Here, the relation is also the function of the quarter ($d_1 = H/4$). The thickness of the vault (d_2) has to be the tenth of the span ($d_2 \geq D/10$). Another rule was descibed by F. Blondel (Fig. 1B). This rule values when the hight is not larger than one and a half times of the span ($H_1 \leq 1.5 \times D$). The calculation of the pillar width can be followed in figure ($d_1 = (D\text{-}a)/2$). These rules describe well the dimension of the small diameter rotunds ($D \sim 5$ m). There are different planning rules for the larger diameter buildings [13-15]. It is important to avoid the stability loss of the cupola. Fig. 2 demonstrates the role of kneewall and that of the fill of vaultback [5].

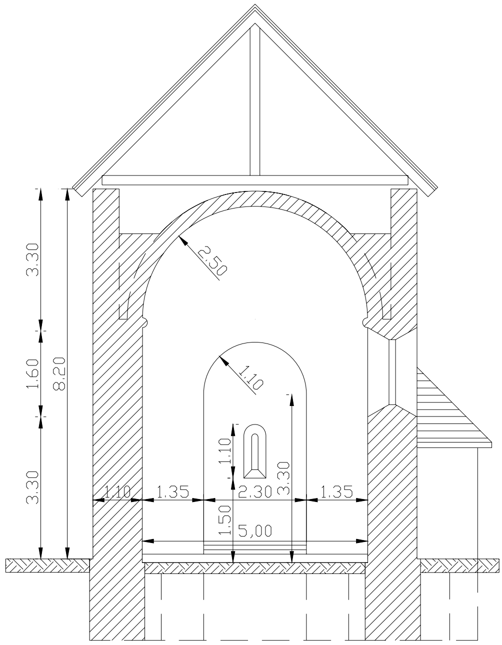

Figure 4
Cross section of the reconstructed rotunda

4 The Reconstruction of the Rotunda

Our knowledge about the rotunds is increasing because of the excavations which have beenmade recently, too. The excavated rotunda discovered recently serves as a base for this work [16]. Here, not only the fundaments of the rotunda but many graves and other things have been opened up. The data of the fundament are the following: the diameter of the nave (D_H = 5 m), the diameter of the choir (D_A = 2.4 m), the thickness of the walls (d_{1H} = 1.2 m, d_{1A} = 0.8 m). The ground-plan of the rotunda is derived from the meaurement of the fundament (Fig. 3). The hight of the nave wall and the choir wall can be determined with the help of the planning rules and with the proportions of intact rotunds. We can suppose the standardization in the measurement of the rotunda contruction because this building type was very often built in this region. (We can observe similar standardization in the case of folk arhitcture or in construction of family houses.) The ground-plan of the rotunda is derived from the measurement of the fundament (Fig. 3). The standardizatio often means oversized structures. The hight of the walls were detremined iteratively manner. The cross-section of the rotunda can be shown in Fig. 4. It is to be noted that some stones of the windows were founded, which could also help at determination of the vault position [5]. Some trimmed stones were discovered, they have a curved side. The curved side has two different radii which enable the dome of the nave to be quasi cupola (Fig. 5) [5].

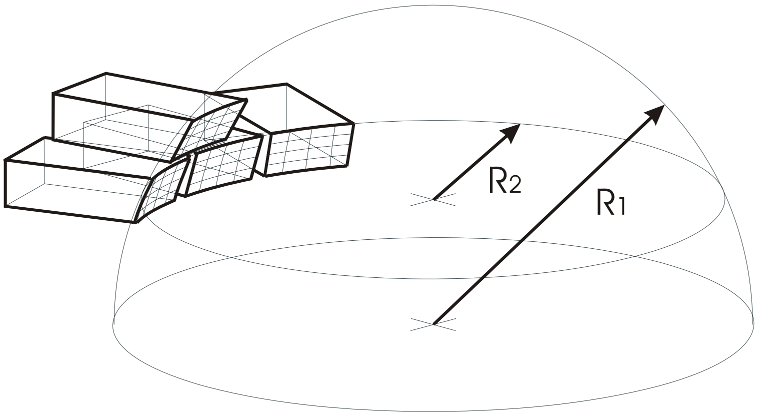

Figure 5
Stones in the quasi-vault

Acknowlegdements

First of all, the author would like to thank to his former and present students for the interest and enthusiasm in this topic. Without them, the experimental part of this project would not have been realized. The author is indebted to Sándor Petényi, that he has made the unpublished excavation protocol of the rotunda available.

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Biologically Qualified Environment, Ecologically Evaluated Conditions

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Abstract: The biological quality of an environment is defined as the condition reflecting the quantitative representation of living organisms in a given space and time. My lecture presents how to qualify the environment of a biocenosis synbiologically, in other words, on the supraindividual level. In this case, qualifying the environment in practice means that both the quantitative and qualitative composition of the biocenosis, and also the factors responsible for their distribution in space and time are considered and evaluated as characteristics. The ultimate goal of examining conditions is to evaluate, in other words, to determine relevancy and significance in a given biocenosis. We are facing the problem that in Hungary at present the biological survey methods are not standardized, and they are highly varied. An environmental information system however cannot function before appropriate methods of biological survey are created. The lack of such methods would result that one of the three major, organically complementary sources of information (i.e. the abiotic sphere, the biosphere, and human society) is completely missing. From a different aspect, ecological survey studies are different from the rest of environmental survey studies, inasmuch as they study living organisms and their communities, thus inevitably utilizing the results of other environmental survey studies that evaluate different components. This indicates that the ecological section of all environmental survey studies is vitally important due to its complexity, and should be considered primarily decisive.

Keywords: The quality of an environment, biologically qualified environment, ecologically evaluated conditions

1 How to Determine the Quality of an Environment

Basically, there are two approaches. One makes the classifications based on certain indicators relevant to the method of utilization (e.g. the parameters of drinking water, industrial waste water, irrigation water, sewage water), and the data is interpreted according to the appropriate range of standards. This approach is oversimplified, and consequently not quite operative. It is evident that a component of the environment does possess a "quality" even if it is not utilized for any purpose. The concept of quality is not the same as the concept of expediency, (bonitas) or appropriateness.

The second approach evaluates the quality of an environment as the sum of all characteristics. This means the quality is not determined based on a single method selected, favoring one particular angle (such as temperature, light conditions, the level of phosphorus, etc.) If one wants to determine the actual quality of any given component of an environment, one cannot be limited to measuring such individual factors separately.

The quality junctions of a material system cannot be solely or even primarily characterized by the number and level of these elements, but rather by their specific structure, i.e. the particular interrelations of the components within the domain of the entire system. As opposed to the individual characteristics of a particular component, it is essentially more complex and complicated to interpret and analyze the totality of the specific characteristics created by their interrelations.

Consequently, the quality of an environment can be defined as the condition determined by actual values measured in all of the characteristics of the given environment in a given time.

The characteristics-complex that determines the quality of an environment has three basic components as follows:

- the abiotic sphere (the lithosphere, hydrosphere, and atmosphere comprising the glosphere),
- the biosphere (living organisms),
- the human society (noosphere).

2 Biologicallyqualified Environment

The biological quality of an environment is defined as the condition reflecting the quantitative representation of living organisms in a given space and time. The object of our examination can be a living being, a single individual, or a single part of an individual (e.g. an organ, a cell, a gene), or a single characteristic of the individual (e.g. its metabolism, its perception.) In the latter case, the biological environment qualification deals with the infraindividual, or "below" the individual level.

The object selected can be a population of a single species, or a group of populations. A population is an isolated group of individuals of the same species, existing together in space and time, thus creating an actual reproductive community. A group of different populations existing together in space and time is called a biocenosis.

My lecture presents environment qualification in a biocenosis synbiologically, i.e. on the supraindividual or "above" the individual level.

3 Characteristics of Ecologically Evaluated Conditions

The research survey examines both the quantitative and qualitative composition of the biocenosis, and also the factors responsible for their distribution in space and time as characteristics: basic data, condition characteristics, and qualitative indicators are registered and analyzed.

Basic data: A list of species is compiled, summarizing the specific species involved in the given biocenosis. The quantitative characteristics are determined, such as the values of abundance, i.e. the number of individuals, and the values of dominance, i.e. the frequency and the size of the area covered.

Condition characteristics: The symbiotic relations, the number of species representing different levels of frequency, and the number of individuals are determined, the dominant and characteristic species are distinguished.

Condition characteristics are registered and analyzed

The status of designated nature conservation area, and diversity can be considered as qualitative indicators. Diversity is increased by the variety of environmental factors, and the relative stability of living conditions. The main advantage of diversity is to provide genetical variety. The more genetically different the living organisms are in a given area, the more increased the probability is that several species will be able to adapt to any potential environmental changes, thus avoiding the extinction of the flora (plants) and fauna (animals) of the given area.

The survey of ecological effects can be divided into three successive phases.

> In the first phase, the ecological quality and condition of the given area is evaluated. My lecture focuses primarily on this phase, applying the results of field exercises performed by our environmental engineer students.

In the second phase, the potential environmental changes that might be created by a given land development project must be analyzed as relevant to the biosphere.

In the third phase, the operations of the completed project must be monitored, and the results of observations and measurements taken must be continuously evaluated and analyzed.

Qualitative indicator is diversity

Conclusions

Ecological survey studies are different from the rest of environmental survey studies, inasmuch as they study living organisms and their communities, thus inevitably utilizing the results of other environmental survey studies that evaluate different components. This indicates that the ecological section of all environmental survey studies is vitally important due to its complexity, and should be considered primarily decisive.

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Risk Management and Loss Optimization at Design Process of Products

Dr. Katalin Németh-Erdődi

Abstract: We'd like to introduce a flexible system of design process elements to support the formation and tool selection of an efficient, „lean" product design process. To do this we identify numerical risk factors and introduce a calculating method for optimising taking into consideration

- the effect of design steps on usage characteristics,

- the time needed by the design elements and the resultant losses,

- the effect of design on the success of the implementation process.

A generic model was developed for harmonising and sequencing of market and technical activities with built-in acceptance phase. The steps of the model can be selected flexibly depending on design goals. The model regards the concurrent character of market, technical and organising activities, the critical speed of information flow between them and the control, decision and confirmation points.

Keywords: Risk analysis, planning of planning, project management, product design, optimisation

1 Introduction

The objective of this paper is to introduce an innovation of traditional product designing process. We think that a company's success is based – not at last – on the systematic, conscious product designing method which meets the market requirements and takes risks as well as resources into consideration.

Product innovation is not only technical subject but also a series of well coordinated activities in which market, professional and strategic aspects should come across. At the end of the innovation process every company wants to achieve an optimum concerning time, costs and the customers' reaction.

2 Aspects of Creating the Methodology of Design Work

It is pivotal question in both cases how quick the company can react to the customers' reactions and to what extent the value of novelty can be realized.

It is a fundamental truth in marketing that the market pays for the novelty and not the perfection of a new product. For this reason it should be considered whether it is really important to develop a "perfect" product which would require a lot of time and money or to create a not completely ideal product but to be the first entering the market by which the company can reap an extra profit.

The surplus of this new approach is that the product designing process will be optimized not only on basis of the quality level but on planning of extreme values based on the expectable maximum profit calculated from the costs of quality/lack of quality, the extra income of being first on the market if possible as well as on the costs of innovation process.

The obtainable final outcome of the company has been analyzed for three strategies and methodologies:

"A" – Fully Planned Product Designing

The goal at developing of the product to be innovated here is maximum fulfilment of the required parameters. Therefore such methods are used in the designing process which ensure the safe accomplishment and thoroughness. This leads to better quality, to the reduction of costs of inside and outside errors, but because of later appearing on the market, only lower price can be realized.

"B" – In Time Reduced Good Designing

This strategy is based on giving up the finding of the optimum for some elements of designing. The goal is only to effectuate the minimum functionality, but the designing period should be as short as possible, without significant reduction of the resources being at disposal. Some designing methods will be eliminated, some others will be used in reduced way.

"C" – Over Reduced Designing

The market requites rapidity with higher turnover but the designing process is done too superficially. This may lead first to higher income but can cause later the withdraw of the market's confidence from the product, the profit will be going down and can turn finally to loss.

The market requites "the first" or those who belong to "the firsts" with higher prices and with larger quantities of sold products. Figure 1 shows the function of number of sold pieces vs time.

Because of fastness of entering the market profits vary in time: they are high at the beginning but at the end they are the same as profits of products not innovated (taken over from others) (Fig. 2).

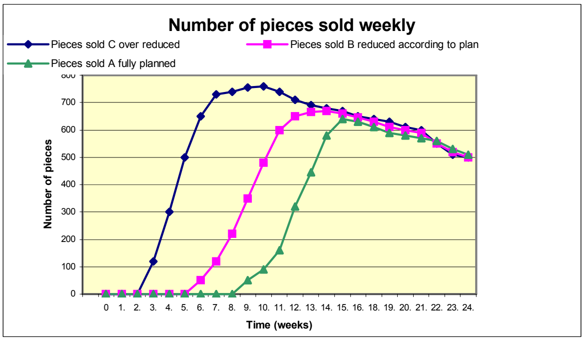


Figure 1

Example for number of sold pieces vs time for various designing strategies. (Data can be collected with suitable marketing appraisal.)

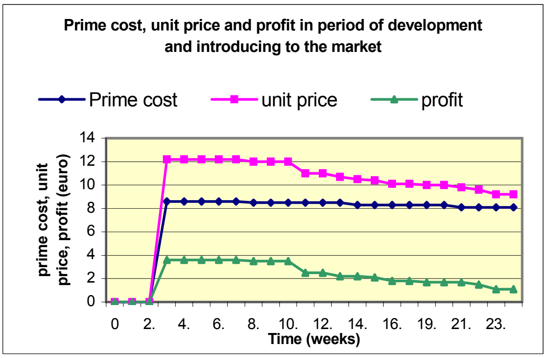


Figure 2

Expectable profit

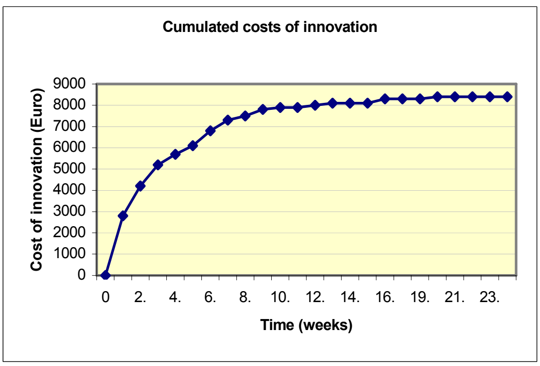


Figure 3

Accumulated costs of innovation in the period of observation

In case of over reduced (accelerated) designing the unit innovation capacity has to be utilized better, effectiveness of designing assures higher profit on the market. With modifications of inside sequence and structure of elements of the innovation process an acceptable but not perfect product can be created. However, innovation can go on later, when the product is already on the market and further resources can be mobilized to improve it.

Costs of errors can be estimated as Fig. 4 shows. Because of early entering the market specific costs of errors are relatively high. These costs of errors referring to the numbers of pieces can be seen on the diagram since they are probably in close connection with the level of innovation.

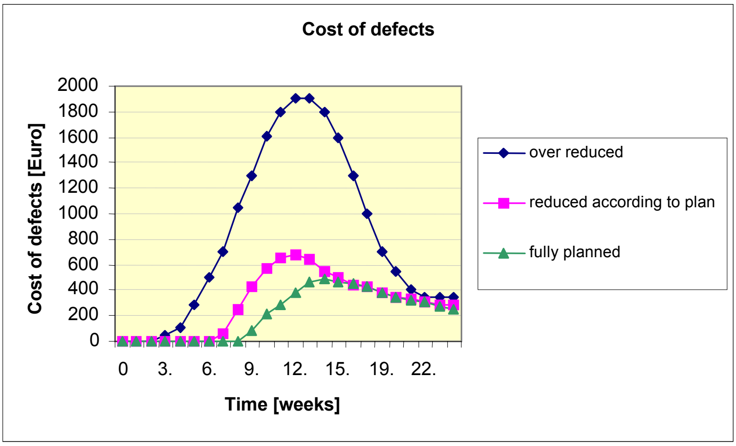


Figure 4
Costs of errors for various designing methods vs time

The final profit or loss can be calculated from the cumulated income (which is given by multiplication of the total number of pieces sold on the market and the profit per piece) minus sum of the cumulated costs of the innovation and those of the errors.

Figure 5 proves that the choice of designing strategy can have essential effect on the economic state of the company. If the development comes late, the result at the beginning is only loss, which, however, later can be reduced by strong but expensive marketing actions. With conscious concentration on the inner sequence of elements of innovation and using effective tools an acceptable however not perfect product can be developed by which extra profit can be booked.

The surplus of the new approach is that requirements for functions of the product have to be confined not only from the bottom but from above too, since they require usually extra costs. Requirements formulated for the designing process have to include the minimum and maximum values of product parameters and the resources connecting with them.

$$\int M(t) * P(t)dt - \int F(t)dt - I(t) \quad (1)$$

where: M(t)- number of pieces sold

P(t)- profit/pieces

F(t) – cost of defects

I(t) – cumulated costs of innovation

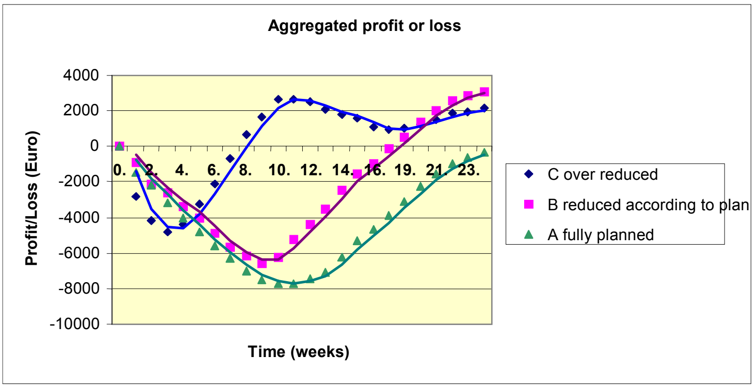


Figure 5

Aggregated profit or loss given by products developed according to the various designing strategies

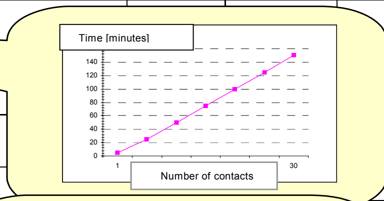
3 Ideal Designing Process

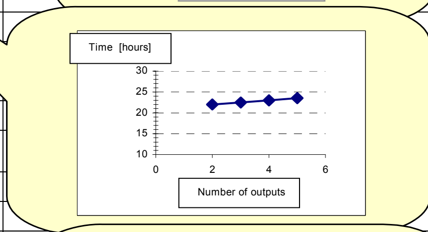
Successful and effective product design project requires precise coordination of marketing, planning, technical, technological and controlling tasks.

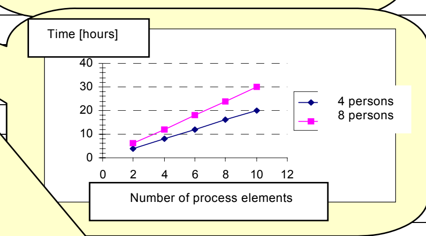
From the complete process which contains each possible step the ones can be chosen consciously that meet the company's aims on the market and its economic interests, and which are optimal for product development process, as well as the resources which can pertain to the process, in order to reach the required result.

In a systematic, well controlled "ideal" designing process there are all those steps which contain the determination of the customers' requirements, the controlling and approving functions as well as the necessary test methods and forms of documentation (Chart 1).

Step No.	Tool	Parameter-No.	Time	Cost
1.	**QFD**			
	Interview			
	Questionnaire			
2.	**Calculation of compromise** (Harrington method)			
3.				
4.	Project planning software			
	Time and resource plan			
5.	Aesthetical design			
	Technical calculations			
	Design of the construction			
	FMEA			
6.	**Design of experim**			
	Trials			
	Lifetime planning			
7.				
8.	Analysis of product parameter			
	Filtering ability to electrosmo			
	Breaking strength			
	.Change of dimensions			
	Trend to pilling			
	Stain repellence			
	Wearing comfort			
	Colour fastness			
9.				
10.	Flow chart			
	Ability tests			
11.	FMEA			
12.				
13.				







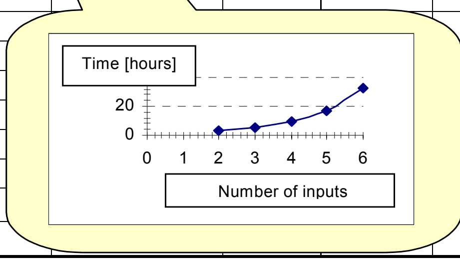


Chart 1
Steps and tools of design

1 - mar ket research, 2 - formulation of the conception, 3 - approval of the conception, 4 - Making a plan for the designing work, 5 - preliminary plan, 6 - elaboration of technology, 7 - model/muster production, 8 - test, experiments, 9 - Verification of the sample, 10 - Process planning, 11 - Production trial, 12 - Approval of the product and the manufacturing process, 13 - Production

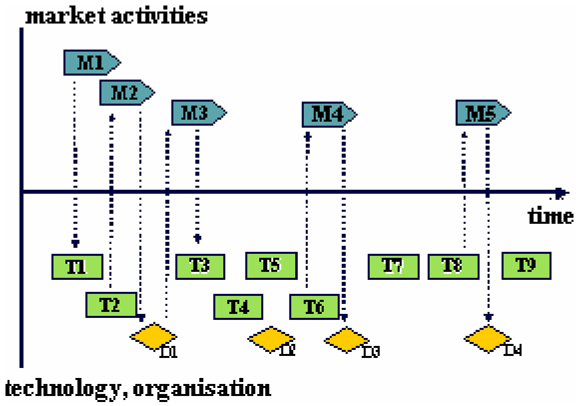


Figure 6
Steps of the ideal designing process

The elements of the complete activity plan for the product design, Fig. 6.

M1 - Market surveys; **T1** - Survey of internal innovative potential; **T2** - Formation of product ideas; **M2** - Market risk analysis of product ideas; **D1**- Acceptance of product idea, decision; **M3** - Survey of concrete consumer demands QFD, interview, questionnaire, product presentation…); **T3** - Determination of design, formation of compromises; **T4 -** Risk analysis, product design, Risk analysis of production process**; D2** - Decision on design model, based on risk analysis

T5 - Process of product design; **T6** - (muster/model) production; **M4** - Prototype demonstration to the consumer; **D3** - Acceptance of muster, decision on prototype acceptance; **T7** - Process design; **T8** - Trial production; **M5** - Customer judgement; **D4** - Acceptance of product and process; **T9** - Evaluation of remarks, Feedback.

4 Possible Risks of the Design Process. Method of Risk Calculation

Every project of innovation means risk. Before starting an innovation project worth to assess the market risk and the risk of product realisation and to decide on the way and cost of product development taking into consideration the acceptable risk.

The risk of product realisation appears as a question at the key elements of design:

- At formulating the design concept,
- At developing the product,
- At developing the process.

The risk assessment is done by the following expression in case of arbitrary Ai event:

$$Ki = P(Ai) \times G(Ai) \quad (2)$$

where: K – risk rate of Ai elementary event, measurement units as of G

P – probability of Ai event

G – financial or other resource with sign (loss of gain) connecting to the realisation of Ai event

i – ordinal of every element (aspect) of the (I) product development (innovative) process, not neglectable respecting the model.

The risk calculation can be made by assessing the real value of the probabilities, losses and the resource need, or just to inform on preliminary comparing, when we don't need numerically each factor, only the comparative importance of these.

In this case we can use artificially made risk numbers to evaluate the risks. We assess the "i" probability and the possible loss or gain connecting to the individual events comparing to each other on a scale. The risk numbers composing a product compared to each other are capable for doing decisions on the design process.

5 Process and Methodology of Design a Special Technical Textile (Protective Garment against Electrosmog)

The goal is to develop a knitted shirt which protects the human organism from influx of electromagnetic waves of range of 1000 to 30 000 Hz. This should be a knitted fabric in which metal fibres create a so-called Faraday-cage. Because of wearing comfort these metal fibres must be embedded in a cotton yarn.

Technical requirements to be achieved are as follows:

- good shielding effect,
- fabric parameters (area density, elongation, change of dimensions, air permeability, moisture absorption) which makes the product suitable for making T-shirt. Target values have been established for all of these parameters.

Strategically it is important to come to the market as soon as possible which means that the development work should be completed in one month. The product must be not very expensive, middle-class people who want to take care of health must be able to pay for it.

5.1 Planning of the Development Work, Choice of Convenient Methods

There are steps in the development work that require more or less constant time, like making project plan, approval, etc. In addition, there are other creative activities that are necessary to reach the final product – their time spans and costs have been estimated.

Setting up of parameterized toolbar needs the most extensive knowledge of technology and the technology is at disposal for every pre-designing process and using it, processes with required number of parameters can be designed quickly and precisely.

Chart 1 contains the steps of designing process and the possible individual tools. From this toolbar the proper methods can be chosen, with respect to time optimization.

Planning of time and costs is supported by pre-determined time and cost functions. Setting the time and cost, limits can be decided whether the goal is a quickly or a fully elaborated product and what methods should be used in the development work.

We can introduce the scheme of creating a toolbar by using the so-called 2^p design of experiment.

Now it can be arranged in an expert's surface to which tools of problem identification and analysis can be fitted to create one system. Using this, it is relatively simple to chose a solution for the problem in question, for the specific possible tools and experts being at disposal, with subjective evaluation (e.g. on a scale from 6 to 10) or within the frame of correct data identification. Elements of the functions can be determined individually, their connection with the parameters can be estimated or calculated precisely, thus the function gives discrete result to the specific task.

5.1.1 Method of Design of Experiment

Optimization of parameters offering maximal protecting effect can be made using design of experiment.

It is often required that the product be the cheapest, the strongest, give the highest performance, etc. Optimizations is determination of extreme values. If the effects, exerting influence on a certain parameter, and the contact of these effects with the parameter to be optimized are known, the values can be calculated that give the optimum. In the practice, one single parameter is influenced by more than one effect (factor) from which usually only the most important ones can be watched closely. The name "2p" refers to the fact that the number of parameters to be examined is p and the number of levels on which each parameter is examined is 2.

Thus, the total number of variations, in which input factors can be examined without repetitions is 2p. This is the total number of the experiments to be tried.

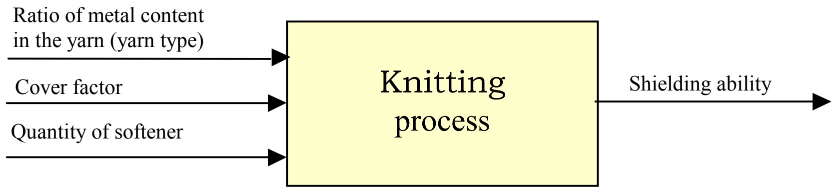


Figure 7
Modell of design of experiments

5.1.2 Cost Function of Design of Experiment (Example)

Cost function is this:

$$K= 2^p K_a+2^p(t_1+t_2+t_3+t_4)k_m \quad (3)$$

where Ka– cost of materials

t_1 – preparation time, making of design of experiment

t_2 – time required for a specific experiment (making sample)

t_3 – time for tests (tests of samples, measurements)

t_4 – time for evaluation (analysing of test results)

k_m – gross salary

With cost and time functions we can advocate making a plan for the designing work.

Conclusions

With conscious concentration on the inner sequence of elements of innovation and using effective tools an acceptable however not perfect product can be developed by which extra profit can be booked. From the complete process which contains each possible step the ones can be chosen consciously that meet the company's aims on the market and its economic interests, and which are optimal for product development process, as well as the resources which can pertain to the process, in order to reach the required result.

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The Environmental Significance of Bioindicators in Sewage Treatment

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Abstract: The presentation is about the significance of the bioindicators concerning environmental protection within the process of cleaning sewage. The existence of one or multi-celled organisms indicates the presence, condition or absence of certain parts of the water cleaning process. This way the optimal operation of the purifying appliances can be checked continuously and controlled in an environment friendly way.

Keywords: The quality of an environment, sewage treatment, bioindicators, polisaprobic sewage water, mesosaprobic sewage water,oligosaprobic sewage water

1 The Total Water Supply of the Earth

Life is dependent on water: an indispensable compound for all living organisms. It provides the medium, the dissolvent substance, and reaction agent for intracellular biochemical processes. It is one of the vital temperature controllers of the biosphere.

The total water supply of the Earth is approximately 1340 million cubic km but less than 3% of that (36.8 million cubic km) is fresh water, and the ratio of surface waters, lakes, streams, rivers, and groundwater is even less, only .64%, or 8.3 million cubic km.

The population of the Earth is presently 6.1 billion (US), (or 6.1 milliard GB). Based on current tendencies, this number is growing by 70-90 million per year. One of the most pressing global environmental challenges, due to the intensive population growth, is the lack of sufficient fresh water. Overpopulation, however, is not merely a consumption issue (5500 cubic km annually). The amount of wastewater or sewage water produced by the population is also increasing in direct proportion to population growth. Consequently, the pollution of water supplies, previously assumed to be of infinite capacity, has been significantly increased in the last three decades, thus sewage treatment has become a most pressing and immediate issue presently.

There are two options for the final disposal of sewage water. It can either be entered in natural waters, or in the ground, thus returning to the natural cycle. The self-purification capacities of the natural waters and the ground, however, are no longer able to handle the constantly increasing amounts of organic matter, and they have absolutely no resistance to toxins.

Following the example of self-purification in natural waters, biotechnological procedures have been used in sewage treatment more and more extensively, both in water clarification procedures, and in the related issue of water quality qualification.

2 The Quality of an Environment

Basically, there are two approaches to examine and determine water quality, and in a broader sense, environmental quality.

One approach makes the qualifications based on the indicators of end use (e.g. the parameters of drinking, industrial, irrigation, and sewage water), and interprets the data according to the appropriate standards. This approach is not quite operative because of its oversimplification. Obviously, any entity in the environment has a "quality" not only if it is used for some purpose. This is to confuse quality with the concepts of practicability, adequacy or utility.

The other approach determines environmental quality as the totality of attributes. This means that environmental quality is not determined based on a single characteristic, and it does not single out one variable, e.g. the temperature, the light conditions, the phosphorus content, etc.

Water as an environmental element can be defined as the sum of hydrological, physical, chemical, and biological characteristics. Some factors to be considered are: the properties of currents, the temperature and translucency of water, its free oxygen content, its ionic composition, its richness in different organic matter and living organisms, and various other factors.

If one wants to determine the actual quality of an environmental element, one cannot be limited to the examination of the relevant properties of the components separately. The qualitative "junctions" of any material system are not only, and moreover not primarily, characterized by the number of and the values of the components, but rather by their specific structure, i.e. the particular system of interconnections of the components within the domains of the given system. To analyze and interpret the complexity of the specific particularities created by the interactions of the individual constituents is significantly more complicated and more intricate than to study the idiosyncrasies of the individual components.

The accumulation of organic matter in natural waters, i.e. a positive change in the trophic state, is called eutrophication. The trophic state is defined by the organic matter content of a particular body of water. This state is induced by specific attributes as variables, e.g. the available amounts of phosphorus and/or nitrogen, the chlorophyll content, the algae biomass. It would be erroneous to reduce the cause of eutrophication to a single attribute or property. The interactions of various factors are required to produce the state of increased organic matter content, such as an energy source, several micro and macro elements, living organisms.

In the waters of Hungary, the trophic state is limited and determined primarily by the phosphorus content, sometimes by nitrogen, but it can also be the level of light available. Consequently, the subsequent phases of sewage treatment (i.e. the aerobic, the anoxic, and the anaerobic) must accomplish the decomposition of organic matter, the transformation of ammonia, nitrite, and nitrate, and must remove the excess amounts of phosphorus in order to produce water that is suitable to be absorbed by natural waters without triggering eutrophication, and can be returned to the natural cycle.

3 The Bioindicators in Sewage Treatment

The purity level of water, the current relevant properties of water quality can be determined in a fast, efficient, and cost effective way using bioindicators

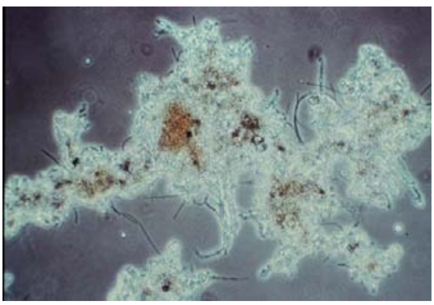

Figure 1
Cluster formed by bacteria (magnified 100 times)

Figure 2
Ciliata (magnified 400 times)

Many different living beings live in sewage water. Bacteria represent the most populous group. Some bacteria form conglomerates or clusters (See Fig. 1), others float as individual cells or threads in the interconglomeratic fluid. Bacteria clusters include every group of protozoa (Protozoa): flagellates (Zooflagellata), rhizopods (Rhizopoda), heliozoans (Heliozoa), ciliates (See Fig. 2), sectarians (Suctoria). Metazoans are represented mostly by worms: nematodes (Nematoidea), rotifers (Rotatoria), and oligochaetes (Oligochaeta). Plantlike protocysts are represented by a few Cyanophyta, Euglenophyta, Bacillariophyceae, and some fungoids (Protofungi). These living organisms stimulate bacterial activities in the process of water clarification. They regenerate the surface of the bacteria clusters, they support the formation of clusters, and have a positive effect on the adsorption of dissolved and delicately suspended substances. A significant increase in the number of these organisms, however, can also be detrimental (e.g. they can make the clusters loosen and collapse), and it serves as an immediate alert of changes in the operations of the system. The presence or absence of these organisms can determine and predict the causes producing the effect.

3.1 The Bioindicators in Polisaprobic Sewage Water

An increased number of several different bacteria, the presence of Cyanophyta, Zooflagellata, and Ciliata, is an indication of water overloaded with organic matter, i.e. an indication of polysaprobic processes and oxygen deficiency. Our observations can determine if the nutrient content of the sewage water was insufficient, or toxic substances entered the system. Water like that has a high concentration of organic matter, the nutrient to microorganism load ratio is between .4 and 1.5. The load per volume is excessive, thus aeration is inefficient with very little oxygen present. The sludge forming time is between .5 and 2 days, resulting in poor sewage treatment efficiency. As a consequence of the overload, only small clusters of sludge are forming, and they are settling slowly, with lots of bacteria floating freely in the water.

Microorganism indicators are considered excellent water qualifiers because although they all call attention to a system overload, they indicate the cause and gravity of the situation in their own specific way.

The presence of nematode bacterium Thiotrix nivea (See Figs. 3 and 4) is an indication of the final stage, the ultimate putrefaction of water: hydrogen sulphide indicator. In this case it is necessary to empty and clean the aeration tank. This stage can be avoided if the other indicators are paid attention to in a timely manner.

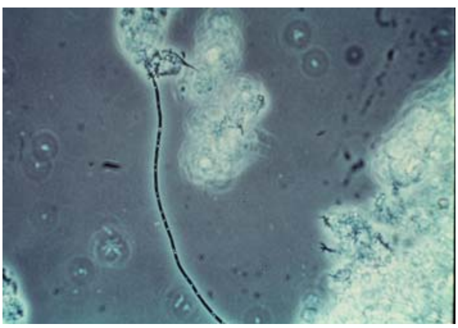

Figure 3
Thiotrix nivea (magnified 400 times)

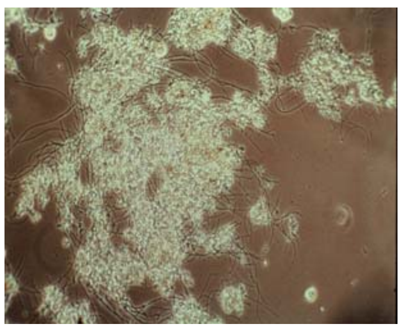

Figure 4
Thiotrix cluster (magnified 100 times)

The presence of Spirillum and Spirochaeta species (See Fig. 5) signals the first stage of oxygen deficiency and an increase in the load. The Sarcina and Streptococcus phyla indicate a shift toward overload, alert of anaerobic processes, and the creation of stagnant “dead zones.”

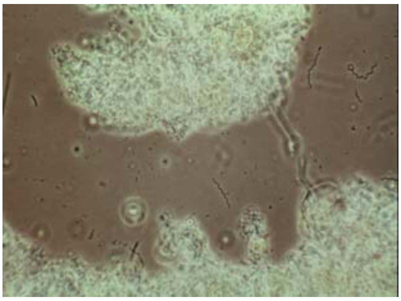

Figure 5
Spirochaeta (magnified 250 times)

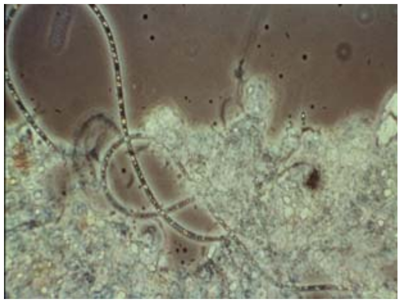

Figure 6
Beggiatoa thread (magnified 400 times)

Sulphur bacteria, Thiocystis, Chromatium, and Beggiatoa species (See Fig. 6) point to insufficient clarification level, the formation of hydrogen sulphide, and the stage of putrefaction due to oxygen deficiency. A significant increase in the number of these bacteria results in a white, “furlike” coating.

The swelling and movement of the sludge, usually caused by the decomposition of nitrogen compounds, are indicated by the presence of Nocardia (See Fig. 7), Zooglea (See Fig. 8), and Cyanophytes. Cyanophytes are autotrophic feeders, and a large increase in their number is not primarily a result of the concentration of organic matter, but that of a sudden and extreme change in some environmental factors, such as a change in the composition of sewage water, a rise in temperature, or an increase of the salt content.

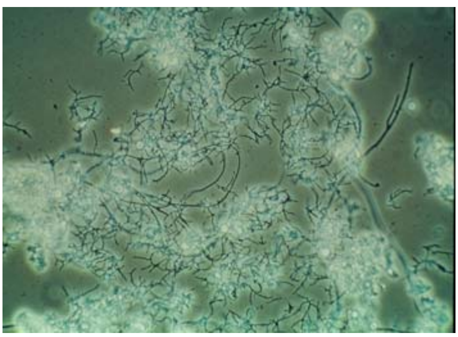

Figure 7
Nocardia (magnified 250) times)

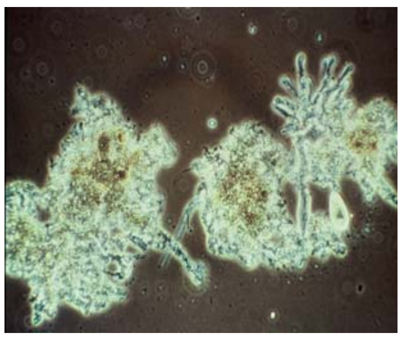

Figure 8
Zooglea (magnified 400 times)

The flagellate protozoa indicator organisms (Oikomonas, Trigonomonas, Trepomonas, and Bodo species, (See Fig. 9) found in heavily loaded water rich in organic matter, show characteristics of both fauna and flora. They are mobile and heterotrophic bacteriophage, but they can also behave in autotrophic manner metabolizing nutrients dissolved in the water. At the beginning of the sewage treatment process, these organisms are always present in large numbers (maximum 50,000 entities per ml) but later on their number is decreasing. A large increase in their number (i.e. several million entities per ml) during the treatment operations indicates the start of an advanced stage of the putrefaction processes.

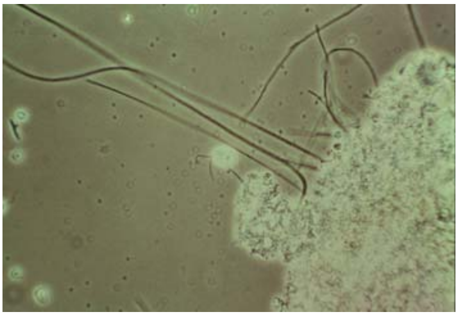

Figure 9
Zooflagellata (magnified 250 times)

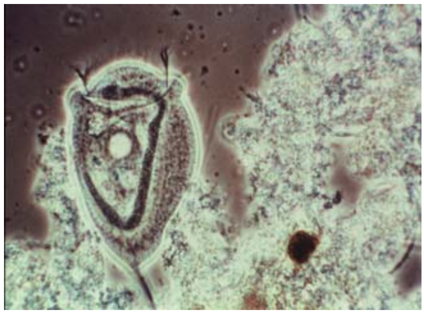

Figure 10
Vorticella (magnified 400 times

Besides bacteria and flagellate protozoa, the most significant indicator organisms are ciliate protozoa. Most of them have a cytostome, two nuclei, and one or two contractile vacuoles, all of which are important distinguishing characters. Trophologically most of them are bacteriophage but some are predatory. The absence of these organisms indicates the presence of toxic substances, such as phenols, cyanids, and heavy metals. The presence of these organisms indicates oxygen deficiency, system overload, and putrefaction. Ciliates most common in polysaprobic water are the Paramecium and Vorticella species (See Fig. 10).

3.2 The Bioindicators in Mezosaprobic Sewage Water

In mezosaprobic sewage water the organic matter load is medium, the nutrient to microorganism ratio is 50% less than in polysaprobic water where the organic matter content is high. Sewage sludge is formed in 3.5 to 7 days, big clusters are formed that settle easily, and the freely floating bacteria are few. The free oxygen content is 4 to 6 mg per liter, which means sufficient aeration. Optimal conditions are indicated by the presence of certain ciliate protozoan: Chilodonella (See Fig. 11), Litonotus (Fig. 12), and Aspidisca species. They signal the process of nitrification, decreased ammonia level, and favorable aerobic (i.e. pertaining to the amount of oxygen) conditions.

Figure 11
Chilodonella (magnified 400 times)

Figure 12
Litonotus sp. (magnified 250 times)

3.3 The Bioindicators in Oligosaprobic Sewage Water

Oligosaprobic water is poor in nutrition, and the decomposition of organic matter is at a low level. It may be characterized by excessive aeration, and the clusters floating in the water are small and loosely structured. This condition is indicated primarily by the thread bacterium Microthrix parvicella (See Fig. 13). This bacterium occurs frequently in the winter months, and can become a dominating organism. Epistilis ciliate protozoa (See Fig. 14) are present in large numbers when the efficiency of sewage treatment is above 65%.

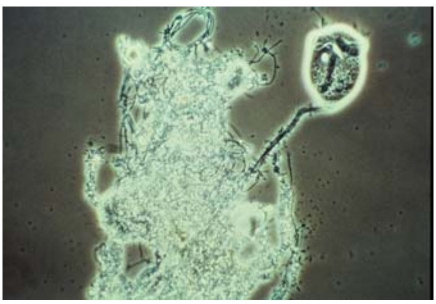

Figure 13
Microthrix thread and Vorticella sp (magnified 150 times)

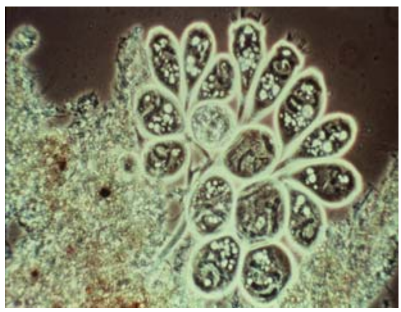

Figure 14
Epistilis sp. (magnified 100 times)

3.4 The Bioindicators in Stabilized Sewage Sludge

Stabilized (aged) sewage sludge is indicated by the presence of metazoan organisms since they need more time to reproduce than the protozoic protocysts and bacteria. The most characteristic indicators are Tubifex tubifex of the nematodes (See Fig. 15), and the rotifer group (Rotatoria) (See Fig. 16). Due to their filtering feeding method they reduce the number of bacteria outside the clusters, they loosen the structure of the clusters thus the bacteria inside the clusters have access to more oxygen.

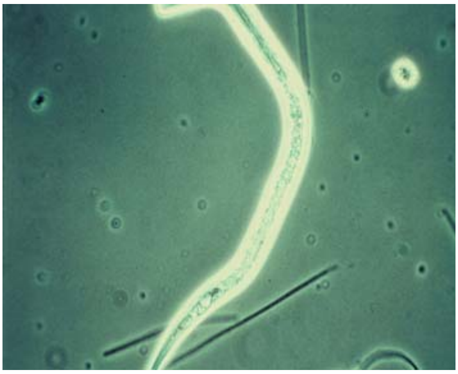

Figure 15
Nematoda sp. (magnified 250 times)

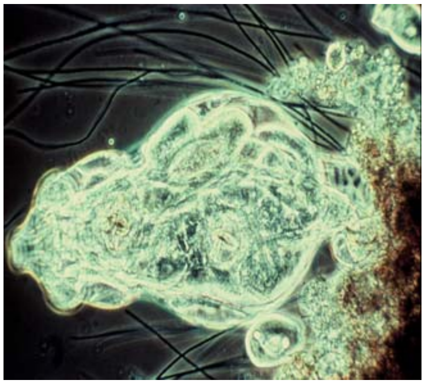

Figure 16
Rotatoria (magnified 150 times)

Conclusions

Bioindicators indicate the presence and condition of the different stages of sewage treatment, also indicating the absence or excessive level of an entity. Observing the bioindicators, the quality of water, and the condition and operations of the treatment equipment can be continuously checked and controlled in a cost effective way. Thus the study of bioindicators is absolutely justifiable.

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Effect of the Digital Technology to the Print Production Processes

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Abstract: Workflow systems are becoming applied in a wide range to improve productivity and quality control. Digital workflow systems developed by market leading companies meet this novel demand. These systems integrate jobs and forward them to the units addressed. Implementing these systems improve the market status of printing companies. Many routine and calculation tasks can be automated, administrative work can be simplified. In addition information flow becomes faster between units, workflow systems also enhance customer loyalty. All these advantages and opportunities make these systems an actuality to discuss. The objective of the research work is to draw attention to the process design solutions applied in Hungarian print industry, to introduce and analyze digital workflow systems and to provide information on relevant standards and operational background.

Keywords: workflow, CIM, process integration

1 Introduction

Computer aided design and production is integrated to Computer Integrated Manufacturing (CIM). The final objective of CIM is a totally automated unit of a whole factory without human labour force. In theory this objective is conceivable, but maybe in the far future, according to experiments. Nowadays highly automated production development with restricted human interaction seems to be cost effective.

The production of printed products has increasingly changed from a craftsmen's trade into industrial production. As in other industrial sectors, *computer-integrated manufacturing (CIM)* is becoming important. CIM became important during the development of prepress processes, but were soon replaced by the expression: workflow. In the past decades press manufacturer companies developed control software systems that can cooperate with management information systems (MIS) beyond controlling printing presses. The disadvantage of these systems is the lack of flexibility, for the MIS have to now all individual workflow solutions, which may introduce compatibility errors.

The CIP3 (Cooperation for Integration of Prepress, Press, and Postpress), and from the year 2000 the CIP4 (Cooperation for Integration of Processes in Prepress, Press, and Postpress) nonprofit organisation and the wide spread of the platform independent PDF format created a basis for development trends for all stages of production not only for printing but also for finishing. This way led to optimized, JDF (Job Definition Format) based CIM, which is widely integrated into company control infrastructure [1].

2 Research Methohology

In order to exact data regarding the specification of the printing processes and the using of digital data and workflow systems, an extended survey among print media companies has developed and implemented. The survey took place in Hungary and included interviews and answers to a questions.

The groups of questions are.

- Job preparation.
- How files and originals arrive?
- Digitális workflow system.
- Color management.
- Preflighting.
- Proofs.
- Platemaking/Computer-to-plate.
- After the job is completed.
- Computer integrated production process.
- Digital printing.
- Digital asset management and servers [2, 3].

The survey started in September of 2006 and ended in May of 2007. The questions has been distributed to 72 printing companies data have been obtained by 65 companies. The outcomes and results from the survey are presented in the chapter „Results" of this paper.

3 Integration of Print Production Workflows

3.1 Digital Workflow

There are more solutions to control production processes, one of these is the workflow. The workflow is a sequence of tasks assembled to accomplish a certain objective. Production processes implemented through a workflow need the support of the information system to ensure that the instruction or message is delivered to the addressed party immediately.

Networking can be implemented through external or internet as well. The progress of the process can be traced by control staff. This feedback enables schedule correction on the fly.

Advantages of using workflow systems:

- rapid or automated ignition of repetitive tasks,
- administrative tasks are partly automated and faster,
- verification of the job is fast and accurate through visual and textual report,
- long distances between locations are no problem, connection is easy,
- distant jobs can be integrated into groups,
- costumers and partners may also trace the flow,
- standardized communication channels are used [4].

3.2 Print Production Workflow

Printing houses as production units have a complex structure, control of the workflow is quite a challenge for experts, even though is can be divided to three areas. Prepress, press and postpress tasks are to be fulfilled in harmony. The achievement of this harmony can be supported by an effective workflow system. Process control in print industry includes the complete control of the production process from the idea through printing to the end-product (*Figure 1*).

3.3 Development of the Digital Workflow in the Print Production Process

Digital workflow in the print industry was based exclusively on analog data until the 1970s. The digitalization of the offset workflow has consisted of five stages.

At first, color scanners and phototypesetting systems were used to digitize. Drum scanners read the originals electronically, carry out the color corrections and color separations in the processing unit, and record the result on film. The text, image, and graphics were thus available in a digital form.

The second stage in the diditalization of data in the 1980s, with the introduction of Desktop Publishing (DTP). This technology is based on powerful informatics principle. DTP permits the compliling of text, image, and graphics elements digitally into complete pages using layout programs and the outputting of these by laser imaging units on film.

Already shortly after the introdusing DTP is becoming available a new method and softwer: the digital sheet assembly. These softwer utilities permitted the imposition of pages, the assembly of print sheets and their exposition on print format-size films. It was called Computer to Film (CtF).

The digitalisation of prepress ends with Computer to Plate (CtP). The information is directly transferred to the printing plate from the digital sheet assembly without generatiing any film. One of its technology is when by laser imaging unit are made the printing elements directly on the printing plate in a special plate imagesetter. Another use of CtP is that platemaking is directly integrated in the printing press (computer to press/direct imaging).

The last stage is a Computer Integrated Manufacturing (CIM). The transfer of production-relevant data from prepress, and the work preparation for makeready and control of printing and finishing sístems and shipping processing play a vital role in introducing CIM in the printing industry. The purpose of this development is to achive a networked printinghouse [1, 3].

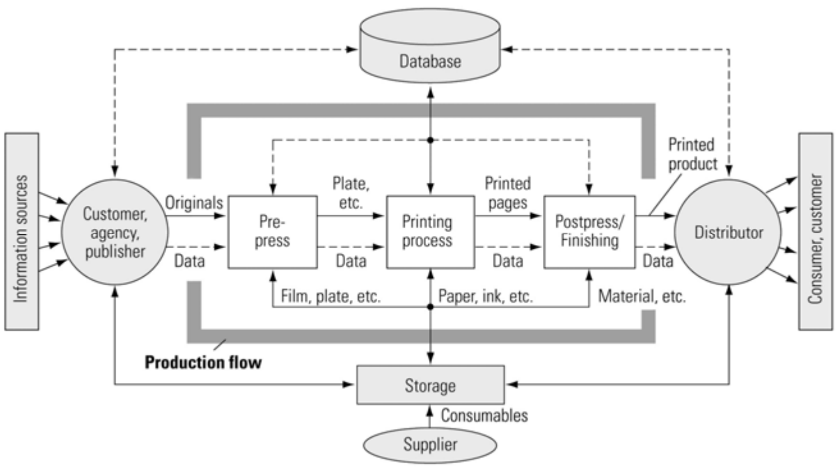

Figure 1

Print production process

4 Results

4.1 General Data

Details by the type of printing organisation are in the *Table 1*. The breakdown by size of company was quite typical of the overall printing industry (*Table 2*).

Table 1

Respondents by Type of Printing Organization (as a persent of all respondens)

Type of Printing Organization	Number of Respondents	%, Respondents
General Commersial Printer	54	75,0
Prepress Service Bureau	3	4,2
Book Printer	3	4,2
Magazine Printer	3	4,2
Package Printer	2	2,7
Miscellaneous/no reply	7	9,7
	72	100

Table 2

Respondents by Employees Size of Printing Organization (as a percent of all respondents)

Size of Printing Organization	Number of Respondents	%, Respondents
1 to 9 emploees	23	31,9
10 to 19 emploees	14	19,4
20 to 49 emploees	10	13,9
50 to 99 emploees	11	15,4
100 to 249 emploees	8	11,1
249 to 499 emploees	5	6,9
> 500 emploees	1	1,4
	72	100

4.2 Results – Answers per Question Groups

4.2.1 Job Preparation

All printers received images in all formats from their cutomers. The greater percent, 33,9%, received of their images embedded into PDF (*Table 3*). Of the respondents 20% received conventional originals (film, photographic printsor slides).

Most of all the files a printer receives come directly from the customers. All printers receive files from multiple source, and close to half of all jobs, 45,3%, require revisions.

Table 3
Format of Images Recived from Clients (as a percent of all images received)

Format Images Received from Client	% Received
Embedded in PDF	33,9
Digital file	32,3
Film	15,8
Part of composite file	7,0
Photographic prints or slides	6,1
Other	4,9

4.2.2 How Files or Originals Arrive

Jobs are sent to printers in a wide range of formats, the most popular being PDF (*Figure* 2).

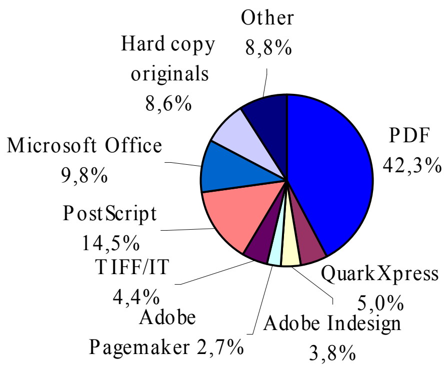

Figure 2
Types of Files Formats Receives by Printers

With the files arriving at the printer's location digitally, the question arises – did the costumer send a hard copy proof with digital file?

Close to three-querters of the respondents did receive a hard copy proof of some type with digital file.

Interesting is the wide range of hard copy outputs they received as demonstrated in *Figure 3*.

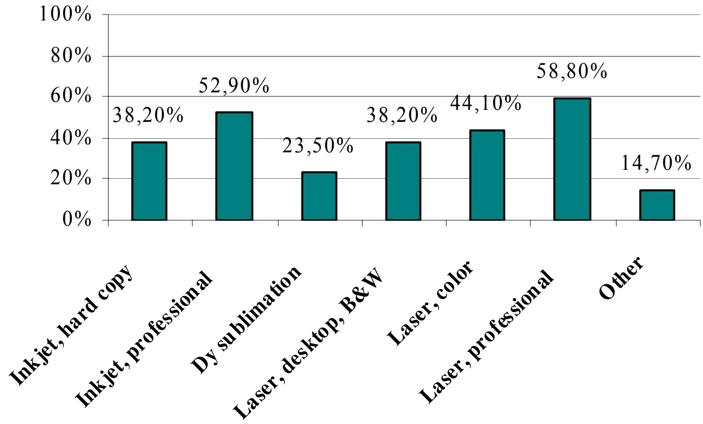

Figure 3

Types of Hard Copy Proofs Received by Printers (multiple respondes)

4.2.3 Prepress Workfow System

About half of the respondents used prepress workflows, PDF and PostScript are the most popular and Apogee (Agfa) is very much used (*Table 4*). We asked the respondents what system they were using in 2006 vs. what they were using in 2012. Primary PostScript was used by 15,6% of the respondents in 2006 vs. 7,4% of the respondents in 2012.

Table 4

Prepress workflows

Primary Prepress Workflow	% of All Respondents	
	2007	2012
Apogee (Agfa)	12,3	16,7
Barco	0	0
Brisque (Scitex)	2,8	1,9
Delta (Heidelberg)	2,2	1
Harlequin	1,3	0
PDF	19	18,5
PostScript	15,6	7,4
Prinergy (Heidelberg)	1,2	1,8
Prinergy (Creoscitex)	4,6	4,6
Other	10,7	5

4.2.4 Platemaking

Of the respondents 35% used computer-to-plate in their operations. The type of the used plates are: Agfa (35%), Fujifilm (25%), Kodak (15%), hagyományos nyomóforma (25%).

The better quality of the printing forms and prints and less platemaking time are the most important advantages of CTP for the printers as presented in *Figure 4*.

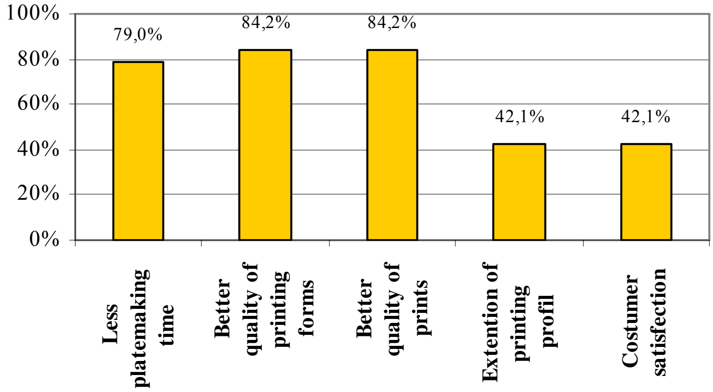

Figure 4
Advantages of CTPlate

4.2.5 Computer Integrated Production Process

Nearly half of the respondents had management information systems. We can stress the importante of the storage and the production scheduling from these system included.

We asked the respondents what setting and controlling operations were performing automatically. Of the printers 76,6%, chose the less waste for advantage of automatization, 66,7% the better product quality and 61,9%, the less human error. The presses of the printers make first ink fed setting possible automatically, as is apparent in the Figure 5.

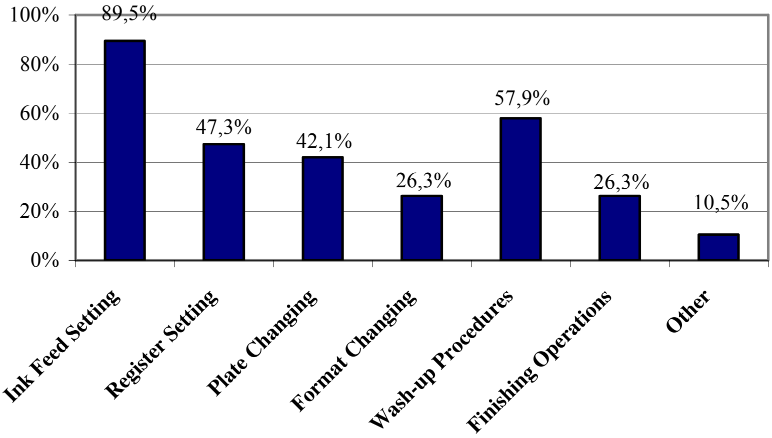

Figure 5
Automatic setting and controll operations (multiple respondes)

Majority of the presses, 67%, can not receive digital data from prepress and can not transfer them to the setting and controlling of the printing and finishing processes.

4.2.6 Digital Asset Management

Digital Asset Management (DAM) is essential component in the working of the printing companies. Close to two-thirds of the respondents, 72%, were using digital asset management internally. Of those respondents not using a DAM they were using a wide variety of methodes, mostly a manual sytem, CDs or DVDs, file server or hard drives.

The digital storage average is 56 MB/page and the storage capacity average is 240 MB/job.

Conclusions

From our results we can concluded that in Hungarin Printing Industry one part of the workflow is based on digital data (for instance in prepress). But the electronics – with above mentiond – first are used for measurement and process controll.

In recent years, computers and automated processing have had a considerable influence on prepress. The integration of prepress and press, as well as automation in printing and the integration of related processes, have also reached a certain maturity. In the other areas of production such as finishing, the integration of computers is by no means standard and is still in its infancy.

Complete digitization and integration of prepress, press, and postpress is unavoidable if computer-integrated manufacture of printed products is to be achieved. Close to one-thirts of the Hungarian printing companies have JDF is needed for the integration of the complet process. But there are two main obstacles to its implementation. At the moment, in Hungarian printing companies partially incompatible systems and interfaces still exist and there is only a limited supply of machines and computers that can be electronically controlled.

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Environmental Contaminants in Foodstuffs

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Abstract: Consumers have specific concerns about food contaminants but often lack the means to make appropriate judgements on what is high risk and what is not. Contaminants in foods can be grouped according to their origin and nature. Environmental contaminants of food-safety concern includes toxic metals and elements, organometallic compounds, agricultural chemicals and persistent organic pollutants such as halogenated hydrocarbon pesticides, polychlorinated biphenyls, dioxins, polycyclic aromatic hydrocarbons, phthalates, nirates, nitrites. These contaminants may present a potential hazard for human health if exposure exceeds tolerable levels. This article shows the characteristics and the dietary intake of these elements and compounds. Further works need to concentrate on mechanism of different contaminants toxicity and metabolism, reevaluation of acceptable limits, and their control in foods and in the environment.

Keywords: chemical food safety, environmental contaminants

1 Chemical Contaminants in Foods from Environmental Origin

1.1 Introduction, Background

Food may be contaminated with many chemicals from the environment that pose the potential for toxicological consequences in humans consuming the contaminated food items [2].

One of the main objectives of the Hungarian Food Safety Program: Decrease of contamination of raw materials deriving from the environment. Keeping the environmental contamination at the possible lowest level is basic condition of producing safe foods. Lowering the level of contaminating, poisoning materials present in soil, air and water build into the vegetable and animal organism and their elimination in the course of food manufacture is difficult or impossible [1]. The contamination of environmental origin gets into the human organism and causes diseases. This article discusses how these type of food contaminants enter the food supply, the types of food items in which they are most likely to occur, and the potential toxicological consequences resulting from exposure to these contaminants. The main groups of chemical contaminants that can be found in food share the following characteristics: they are not intentionally added to food; contamination can happen at one or more stages in food production; illness is likely to result if consumers ingest enough of them [3]. The environmental contaminants are a group of substances with quite diverse chemical structures that exhibit common characteristics in terms of behaviour. These substances tend to be stable and thus persistent in the environment; they tend to bioaccumulate in food chain and can be transformed with increased toxicity. To control environmental pollution and protect humans and animals from the hazards of environmental contaminants a concept of persistent organic pollutants (POPs) has emerged [4].

1.2 Particular Contaminants

1.2.1 Toxic Metals and Elements

Lead is ubiquitous in an industrial environment. Ingestion or inhalation occurs as a result of environmental contamination, including food and water [6]. People with certain macronutrient and micronutrient deficiences are prone to experience increased absorption of lead in the diet. Adults may normally absorb approximately 15% of their lead intake, pregnant women and children may absorb up to 3.5 times that amount [2]. Toxic effects of lead involve the nervous system, the liver, gene function, the composition of circulating blood, kidney function, the vitamin D endocrine system and bone [2].

Cadmium: Humans can be exposed to cadmium through either diet or industrial contact. Toxic manifestations of cadmium ingestion include renal dysfunction, osteoporosis and bone pain, abdominal pain, vomiting and diarrhea, anemia, and bone marrow involvement. Only 2-8% of dietary cadmium is absorbed and significant cadmium ingestion is accompanied by vomiting [2]. There is epidemiological evidence that cadmium exposure may be carcinogenic [6]. Cadmium accumulates in lower marine life, such as plankton, molluscs, and shellfish, and continues through the food chain as these organism are consumed. However cadmium is toxic to fish and fish embrios. Cadmium is take up by the leaves and roots of plants (vegetables), so those near industrial sources may be very high in cadmium.

Mercury: The primary portal of mercury contamination of food is via its industrial release into water, either fresh or salt water, and its conversion to methylmercury by methanogenic bacteria. With regard to toxicity, mercury affects the skin, kidneys, nervous system, and marrow, with consequent effects on the blood cells, immune sysem, and bone formation [2]. Seafood is probably the primary source of dietary contamination with mercury [6]. People with regular diet of fish containing high levels of organic mercury, or shellfish containing inorganic mercury, are at greatest risks [6].

Arsenic is widely distributed throughout the earth and reaches food sources. Arsenic is present in food in different forms (species) which vary in toxicity, with inorganic forms considered to be the most toxic. Arsenic compounds have occurred in seafood, eggs, and cheese. Most arsenic in the diet is present in the less toxic organic forms [3]. Chronic poisoning from arsenic is unusual unless it occurs naturally in the water supply Inorganic arsenic is a documented human carcinogen [6]. Foodstuffs that have been mentioned as important source of inorganic arsenic: rice, seaweek (especially hijiki seaweed), drinking water. To be considered also: baby food on rice basis.

1.2.2 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are ubiquitous and occur in all environmental compartments. In the environment PAHs result from combustion of organic matter. They are some of the major carcinogenic constituents isolated from cigarette tar and products of air pollution [5]. PAHs have been found in a wide variety of foodstuffs. Common sources of PAHs in non-processed foods are thermal treatments (grilling, roasting, baking, frying) and processing procedures. The highest PAHs levels were found in grilled food, smoked and broiled fish, mussels from polluted waters, and leafly vegetables grown in areas heavily exposed to air pollution [6]. High PAH levels may be found in oilseeds, and vegetable oils.

1.2.3 Polychlorinated Compounds

Halogenated Hydrocarbon Pesticides: Organochlorine insecticides (DDT, aldrin, endrin, heptachlor, etc.) were widely used and many persist in the environment today. Because of their stability, metabolites of these and other organochlorine compounds have reached all parts of the world's surface [6]. Many organochlorine pesticides have been linked to hormon disruption and reproductive problems in aquatic invertebrates, fish, birds, and mammals. They degrade slowly and accumulate in the food chain, eventually ending up in body fat [6].

Polychlorinated Biphenyls (PCBs) have a tendency to accumulate in animal feeds, particularly those of animal and marine origin, and are subsequently introduced into food. More than 90% of human dioxin exposure derives from foodstuffs, with a large portion of this derived from foodstuffs of animal origin [6]. Milk is a useful indicator of environmental pollution.

Dioxins: The dioxins of potential toxicological concern are polychlorinated dibenzo-p-dioxins (PCDDs). They are related, both sructurally and toxicologically to polychlorinated dibenzofurans (PCDFs) and PCBs. Specific chemicals belonging to this family are referred to as congeners. A set of toxic equivalency factors (TEFs) has been developed in order to express the concentrations of each the congeners into one figure, which represents the group as if it was only the most toxic congener 2,3,7,8-tetrachloro-dibenzo-p-dioxin [3]. PCDDs and PCDFs are primarily introduced into the environment as by-products of combustion processes [2].

1.2.4 Polybrominated Organic Compounds

This type of compounds are used as flame retardants. They are persistent organic pollutants, so they tend to accumulate in the food chain. As they are lipophilic, the major sources in the diet tend to be fat-containing foods of animal origin.

1.2.5 Phthalates

Phthalates are a group of organic chemicals that have a variety of industrial uses, including use as plasticisers in wide range of household and consumer goods. Their use in plastic food packaging materials is now limited [3]. As a result of their extensive use and their moderate resistent to degradation, phthalates are widely distributed in the environment and are often found at low levels in food.

1.2.6 Nitrates, Nitrites

Nitrates and nitrites themselves are not carcinogenic, but nitrates can be reduced to nitrites, which can be converted in the body to nitrosamines, potent liver carcinogens. Eighty percent of the nitrates and nitrites in the diet are from naturally occuring sources, with only 20% coming from food additives [5]. Nitrates and nitrites are used to preserve (cure) meat products [4]. The EU set maximum levels for nitrates in water, and for spinach and lettuce, depending on the season in which they are harvested [6].

1.3 Regulation of Chemical Contaminants in Foods

Enhanced food safety problems and the increase in international trade in food are important factors that drives international regulation of contaminants in food. Authorities respond to consumers concerns by more stringent food safety assurance systems, including both lower maximum limits and more efficient control, but also self control and certification control systems [3]. The Joint FAO/WHO Food Standard Programme and the Codex Alimentarius Commission elaborate international food standards and codes of practice for questions related to food. It has also stimulated work on general code of practice for source-directed measures to reduce contamination [3]. Codex Committee on Contaminants in Food (CCCF) is working on setting maximum limits, developing recommendations for contaminants.

In the European Union (EU) the responsibility for initiating work on legislation on heavy metals, nitrate, pesticide residues, mycotoxins, etc. rests with the Commissions's Directorate-General for Health and Consumer Protection (DG SANCO) [3, 7]. All Community legislation are published in the Official Journal of the European Communities - including the maximum limit regulations (e.g. 1881/2006/EK Regulation). Methods of sampling and analysis to check compliance with the maximum levels laid down are also published. Within the EU, harmonisation of certain areas is a continuing process [6]. However, existing limits on contaminants in each member state apply where no level is laid down by EU.

1.4 Conclusions, Current and Future Trends

The control of chemical contamination of food is clearly developing. Key part of this process is the international harmonisation of controls. Main goal of the National Food Safety Program of Hungary is to ensure a high level of human health and consumer protection by enhanced food safety [1]. The key is to ensure that action is taken when problems are found. Main options are: control the availability and usage of man made contaminants; limit or eliminate the source of contamination; police limits; advise; halt the supply of contaminated food [3]. The society shall take every reasonable and realisable measure to reveal and decrease environmental contamination influencing food safety and prevent formation of a new ones.

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Spectral Radiosity Rendering Application for Lighting Researches

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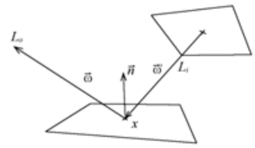
Abstract: Lighting research often requires human surveys for defining subjective qualities. Creating new settings, new test scenarios is usually a time and resource-consuming task. As today many preference and comparison investigations are carried out on computer displays, the pictures to classify might well be generated. The aim of my current work is to create a rendering application that can model light appropriate enough to be used in lighting researches.

Keywords: radiosity, lighting, spectral radiant exitance

1 Radiosity

There are many rendering algorithms to simulate a real, shaded 3D environment on a computer screen. Most of these however apply strict limitations such as the limiting the number of repercussion of rays, photons or taking in account those of special angle. Though there are methods to compensate the errors caused by these limitations, these are usually just cosmetical improvements, making the resulting images even less appropriate for accurate lighting researches.



$$L_o(x,\vec{w}) = L_e(x,\vec{w}) + \int_{\Omega} f_r(x,\vec{w}',\vec{w}) L_i(x,\vec{w}')(\vec{w}' \cdot \vec{n}) d\vec{w}'$$

Figure 1
Shading equation

However, there are global illumination algorithms which handle light physically appropriate. These methods aspire to solve – applying inversion, iteration or expansion – the shading equation (Figure 1) without disregarding the full caustic part. This equation is an accurate model of light-surface interaction and serves as a basic integral equation for all rendering algorithms. One of the most well known methods solving it without simplification is called radiosity.

1.1 Theory

The approach was originally used for thermal engineering purposes, radiative heat-transfer theory. In the mid eighties the method was introduced to photorealistic image generation indepently by Goral et al. and Nishita and Nakamae although the credit for the first images rendered by the algorithm must go to Moon and Spencer.

Considering mathematics of the method, it is a finite-element inversion solution of the shading equation. It reduces the space to elemental surface patches, thus simplifying the integral equation into simultaneous linear equations. Technically these equations distribute the original radiant flux of the light sources on the patches.

Algorithmically the method can be divided into two main phases. The first one covers the determination of the quotients of the linear equations, called form factors. These quotients are computed from the geometry of the scene applying double surface integrals.

The second part of the algorithm is to solve the radiosity equations for all nominated wavelengths. This can be done by Gaussian elimination (slow and numerically instable) or by iteration (like Jacobi-, Gauss-Siedel- or Southwell-iteration). However, the generation of the form factor matrix ensures that the matrix of the radiosity equation is invertible, thus it can also be solved by matrix inversion. By solving the set of these equations we obtain the radiant exitance, radiance and ultimately the luminance of each elementary patch.

1.2 Limitations

Although radiosity models light accurately, there are some restrictions on the environment. The main limitation of the algorithm is that it handles Lambertian surfaces. These are ideal diffuse surfaces with a constant radiance or luminance that is independent of the viewing direction. This means no specular reflections can be rendered, though it also permits to display the resulting scene via an incremental rendering system after solving the radiosity equation. This enables the real time exploration of the environment.

An obvious limitation is the discretisation by tesselation. Each patch, surface element has a uniform exitance and irradiance distribution. As a result, the scene must have immense number of patches to render continuous transitions that eventuates lengthy computation time. A theoretically inaccurate but widely used solution is the application of incremental shading methods like Gouraud shading while displaying the rendered scene.

There are also some other restrictions on the environment, like no transmissive materials can be simulated, that the intervening medium is nonparticipating, or that the algorithm cannot solve the interaction of the different wavelength samples (like UV luminescence).

We have to point out that none of these assumptions represent fundamental constraints for the theory, they make solving the equation a tractable problem for computers.

2 The Application

Although radiosity rendering applications are quite numerous, up to now – to the authors' knowledge – none of them allow to define materials with spectral reflectance distribution. Most of these are developed for computer graphics, imagery instead of lighting research thus the common three channels are used. This prevents researchers from applying them in appropriate light simulation, investigations based on computer generated images. Our goal was to develop software especially for this purpose. To make it a viable tool for adequate researches we had to put special emphasis on computational accuracy. Thus we had to find the most precise algorithms for the two phases of the radiosity approach.

The software is supplied with a MEL exporter script, which enables to export scenes from Autodesk Maya modelling package. This permits easy environment building (provided knowledge of and access to the Maya).

Figure 2

Flat shaded radiosity rendering of "Scene C (Office)" by the application

The application is able to display the final radiosity rendered scene with flat shaded (for precise but uniform patches) and Gouraud shaded (for smooth transitions) method and can be explored in real time. These are obviously displayed on the limited colour gamut of a monitor display, but spectral data is also stored. The software is fitted up with a wireframe and unshaded flat (colours derived from reflectances only, no geometry) display mode too for debugging reasons.

2.1 Generating the Form-Factor Matrix

To generate the radiosity equation the first task is to calculate the form-factor matrix. This can be done by a number of methods each different in its computational accuracy and time requirement. The following algorithms are implemented in the application:

2.1.1 Simple Method

A quick approach, disregarding all geometrical data except the actual patch sizes, angles between patch normals and patch distances. This results prompt form-factors for rapid imagery not suitable for lighting research concerns. Nevertheless it has it raison d'ętre for swift testing of the scene.

2.1.2 Hemisphere, Quasi-Hemisphere Method

This method projects one patch on a hemisphere over the other and calculates the form-factors based on the surface size of this projection. Exact projections onto the hemisphere are hard to implement (analytical solutions boost run-time greatly), thus these methods usually apply some kind of estimations (discretizing the hemisphere or simply reducing the projection into a polygon). However that may be this approach still is a simplification, it disregards the form of the patch on which the hemisphere is built. This method provides images of different usability according to the estimation used with reasonable run-time.

2.1.3 Analytical Solutions (Monte-Carlo Sampling, Numerical Integration)

The most precise solution is to solve the double surface integrals. There are numerically imlementable methods for this reason. The Monte-Carlo sampling approach employs random samples to compute the results. It is also possible to reduce the surface integrals analytically to curvilinear integrals which could be solved numerically. These approaches yield accurate results, though their time requirement is rather large. For lighting research purposes we recommend these solutions.

2.2 Solving the Radiosity Equation

To solve the radiosity equation a Matlab program is applied based on matrix inversion. Due to the huge size of the matrix of the linear equation it is subdivided into smaller matrices and the final output. Though this approach implies a great number of operations which usually tends to generate calculational errors, the evaluation of the software showed that these remain in a acceptable range.

2.3 Evaluation

To verify the accuracy of the application the results of the software were first tested against the sample settings of diffuse, Lambertian materials defined by CIE. Though these only specify simple layouts and a restricted set of measured illuminances it served as an effective evaluation. The curve fitted on the given sample points matched the monochromatic illuminances generated by the application (with analytically derived form-factor matrices).

To test special layouts, complex environments, the software was compared to DiaLux, a commercially accessible lighting simulation software. The results show high correlation.

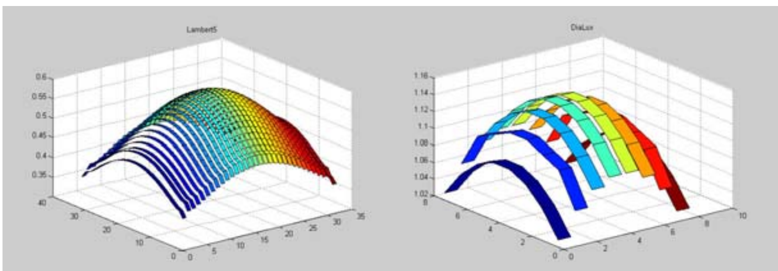


Figure 3

Monochromatic illuminance distributions on a floor rendered by our application and DiaLux

Comparison of results to measurements of real life scenes is the final step of the evaluation. Up until now the development lacks this phase of the evaluation, reference settings are being collected.

2.4 Limitations and Future Objectives

Besides the limitations of the approach mentioned previously, the application of the software in lighting research suffers from additional obvious limitation namely the monitor colour gamut. Although the result of the rendering equations is spectral data of desired sampling rate, computer monitors are not able to display all of these correctly. Thus some colours must be projected on the gamut resulting fake colours. This cannot be helped, although this is not a limitation of the application instead of lighting investigations based on images displayed on computer screens.

Another limitation is the Lambertian nature of light sources. This would reduce the usability to indoor settings, though – with an initialisational step – directional or arbitrary light sources can also be simulated.

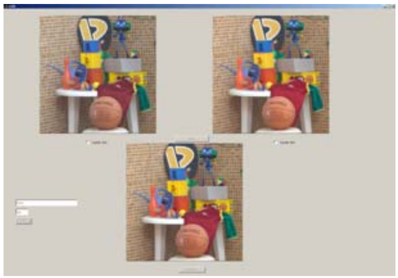


Figure 4
Screenshot of a comparison test application (courtesy of Gábor Madár)

Our future plan is to utilize the application in specific comparison and preference investigations previously concluded with measured data and compare the results of the two.

Conclusions

As a conclusion of this work we can state that radiosity is an apt tool for generating optically appropriate images feasible for lighting research purposes.

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