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**WORKSHOP:  
DESIGN GRAPHICS  
WITH SECURITY ELEMENTS**

**Workshop Chair**

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Faculty of Graphic Arts

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## **D126 Workshop 11: DESIGN GRAPHICS WITH SECURITY ELEMENTS**

**Organized by: University of Zagreb, Faculty of Graphic Arts**


**(PAPER PRESENTATIONS + DISCUSSION)**

Chairman: Žiljak Vilko (HRV)

Salon Libertas

Printing is presented in the area of new technologies that are planned for product protection. Lectures and authors who develop extrem border areas of graphic design are selected. Novelties have been implemented in the most sensitive parts of printing such as: protection of securities, documents and packaging products. Innovation „PET bottle design“, Infraredesign, pixel mutation and software JDF improvements are considered. In this year's Workshop authors explore themes that discuss black/white vs color photography and new materials for security graphics.





**WORKSHOP  
DESIGN GRAPHICS WITH  
SECURITY ELEMENTS**

**Chair**

**Vilko Žiljak, Faculty of Graphic Arts, University of Zagreb**



## DESIGNING AN INFRAREDESIGN CAMERA

K. Pap, S. Plehati, I. Rajković and D. Žigman

**Abstract:** In contemporary digital cameras CCD fields are sensitive to the visible spectrum part but also to the wider spectrum, one that is invisible to the human eye. When researching the construction of an infrared (IR) camera, we must take into account that there are two different types: a camera with an IR source and a camera without an IR source. This paper is on the research of an IR camera that operates in daylight and under artificial light source. Barrier filters are studied, i.e. their characteristics due to which they filter a certain part of the spectrum as well as the existing CCD fields in digital cameras. One of the applications for this design is detection of the INFRAREDESIGN effect on various types of material. The basic characteristic of this detection is that it is effected in the near IR area around 1000 nm.

*Keywords:* IR, Infraredesign, IR detection, CCD

### 1. Introduction

Infrared cameras are used for detecting the infrared part (IR) of the electromagnetic radiation spectrum. The IR spectrum is divided in 3 parts according to the International Commission on Illumination (CIE): IR-A 700 nm–1400 nm, IR-B 1400 nm–3000 nm i IR-C 3000 nm–1 mm. The IR-A area is considered as the near infrared area (NearIR) and in this paper the IR camera design for that part of the spectrum is considered. In order to design a camera that would meet the requirements in the NearIR spectrum part for the targeted quality detection of the INFRAREDESIGN effect [Pap et al., 2010.] with special design for the NIR spectrum part, we shall consider various filters, sources of light and CCD sensors as the base for this design. After researching various kinds of IR light sources, we will set those lights that are good for detecting the INFRAREDESIGN effect. The set area in which we consider the light source, filters and CCD sensors is from 750 nm to 1075 nm. The value of our area for considering spectral characteristics is 1075 nm because CCD sensors are based on silicon and its compounds are limited with the upper wavelength of 1100 nm where their relative sensitivity drops to zero. Spectral characteristics of CCD sensors will be shown, as well as of filters and sources. The classification method will be used to determine those factors that will have the best characteristics for detecting hidden graphics [Žiljak et al., 2010].

### 2. Light Source Classification

Light may be created from actuated matter coming from different sources. Atoms and molecules forming matter emit light with a characteristic quantity of energy. Emission of light may be spontaneous or stimulated. In spontaneous emission matter emits photons having a characteristic energy on a sufficiently high energy level, and the human eye thereby observes certain colors of light in frequencies of the visible part of light (characteristic for fire flames). Stimulated emission is when in agitated state light photons are disturbed and remote light photons begin to work, usually with the same energy and phase as the agitated photons (lasers). The Nd:YAG laser is often used today and it consists of yttrium aluminum garnet sticks, atom doped neodymium. Nd:YAG gives infrared

emission and is thereby interesting as a source of light for designing IR camera. The active laser media is the three times ionized neodymium ions (Nd<sup>3+</sup>). Neodymium atoms are of similar size as yttrium atoms, and so they can replace it in structure. Nd:YAG is a four-degree laser emitting infrared light with a 1064 nm wavelength. This laser can be adapted for wavelengths of 940, 1120, 1320, and 1440 nm. Depending on the power these lasers can have various applications. Due to limitations of coherent emission beams, it is not sufficient for good quality detection of INFRAREDESIGN effect, whereas the spectral characteristic of such emission is ideal. The first and second groups of studied light sources are mainly fluorescent diodes – LED : Light Emitting Diode that are special kinds of semi-conductor diodes emitting light when there are duly polarized, i.e. when electricity passes through them. During direct recombination of the electron-cavity pair, the light photon is emitted. Such a property is characteristic for the semi-conductors gallium arsenide (GaAs), gallium phosphate (GaP) and silica carbide (SiC). This effect is called electroluminescence. The emitted light's color depends on the semi-conductor, as well as on the substances in it and varies from the infrared and over the visible to the ultra-violet spectrum part. Development of LED diodes began with Infrared and red diodes produced from Gallium arsenide (GaAs) [Schubert, 2006]. With the development of technology and science in respect to material s, shorter wavelengths were achieved for diode light and different light colors. In our first group (A – Figure 1) of observed IR-LED diodes we use diodes that have top emission with maximum relative energy in the first third of our set area (from 750 to 1075 nm for INFRAREDESIGN). LED diodes from this first group have maximum emission at around 850 nm whereas their emission spectrum width goes up to a value from 775 to 975 nm (Figure 1. – A1 to A3). This group is not the best one for lighting INFRAREDESIGN protected material. The second group of light source (Figure 1. – B1 to B4) are IR LED diodes with maximum relative emission at 950 nm, whereas their spectral emission is from 880 to 1030. This group is not fully suitable due to the maximum relative energy drop to 0.2 at 1000 nm wavelength value, but we can use more LED diodes for better emission in order to get higher energy and emission power. Group C (Figure 1-C1-C3) has different types of emission: C1 – daylight, C2-IR LED laser and C3 – light bulb. This group has a good spectral characteristic in the NIR area, i.e. the spectral characteristic of the C3 light bulb (0.85 relative energy) and C1 – daylight (approx. 0.44 relative energy) is satisfactory at a 1000 nm wavelength. The C2-IR LED laser also has a relatively high relative energy. The problem with group C is in certain inefficiencies. The disadvantages with C1- daylight are that we are limited mainly to open and well lit closed premises and we cannot use this lighting in nighttime for detecting the INFRAREDESIGN effect. With light bulb C3 we are not limited with the spectral characteristic, but with energy consumption and it's heating. In order to use this kind of infrared emission it is more difficult to block the visible spectrum part and thereby we have the problem of size, cooling and transportability of such emission. With C2 IR LED lasers we are limited to the spectral width and the coherent emission beam where we cannot simply light the area for detection of the INFRAREDESIGN effect (a separate specially designed construction is necessary to use this kind of IR emission). We come to the conclusion that the best advantages are provided by group B entering close enough to the 1000 nm wavelength, and providing a whole spectrum of simple, energy-efficient and transportable lighting. Lighting of this group is implemented into most of the commercial cameras for detection in the IR area for other purposes too.

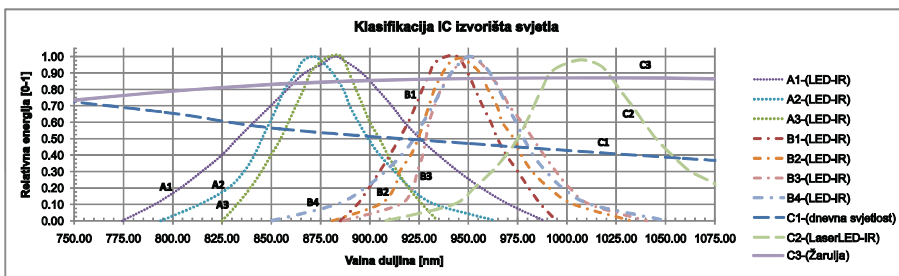


Figure 1. Light source classification

### 3. IR Filter Transmittance Classification

Optical filters are divided into absorption and interference filters. Optical filters block a certain part of the wavelength spectrum or allow them to pass through. There are various groups of wavelengths in the visible part that are set also by the belonging spectral colors. Filters are used in photography, medicine, for scientific, military and other different purposes. Filters are mainly produced from glass with different coatings (that set the wavelengths and determine which wavelengths will pass through the filter).

According to their function absorption filters can be divided into: bandpass, short pass/longpass, polarizer and various others [Omega Optical, 2008]. In this paper filters are classified into three groups: G, H and I. Filters from the G group have a characteristic that is initiated at 650 nm or 700 nm. The characteristic of filter G1 is that it blocks the visible spectrum part as early as 600 nm, and spectral transmittance is beyond 1100 nm. Filter G1 cuts off the visible spectrum part (cold mirror filter) i.e. it reflects the visible spectrum part and transmits only the infrared part. The relative spectral transmittance of the G1 filter goes up to 90%. G2 is a bandpass filter and transmits a band from 700 to 900 nm with a relative spectral transmittance of 90%. Filter G3 is also a bandpass filter with a wider band from 700 to 1200 nm, with a maximum spectral transmittance value of 90% from 800 to 850 nm. At 1000 nm it has a 60% spectral transmittance. The H group filters are filters with narrow bandpasses (H1 and H2) and there is also filter H3. H1 and H2 are narrow bandpass filters and they can be used for filtering that is connected with lasers. The peak values of band transmittance are at 725 nm and 1065 nm, and the maximum relative spectral transmittance is from 50 to 60%. H3 is a typical filter that cuts/absorbs the visible spectrum part at 750 nm, and transmits the infrared spectrum part with a maximum value of 90% of the relative spectral transmittance. Group I consists of two filters (I1 and I2). Those filters cut/absorb the spectrum visible part and one part of the IR spectrum at 800 nm. I1 filter is transmitting as to IR light with a maximum spectral transmittance over 95% at a wavelength of 1200 nm. The I2 filter has a maximum spectral transmittance of 88% and at 1000 nm it reaches a 60% transmittance. This classification shows that the best filters for designing an INFRARED CAMERA are the ones from group I and H, namely I1 and H3.

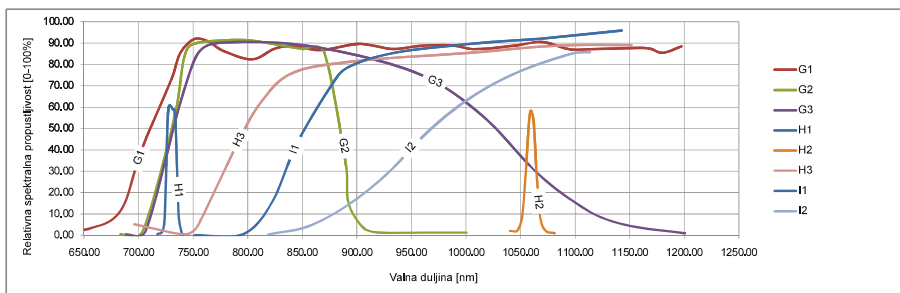


Figure 2. IR filter transmittance classification

### 4. CCD Sensor Classification

Sensor elements that are responsible for the conversion of light photons into electric charge are called pixels that consist of photosensitive diodes and the surrounding electric circuits that are used for transmittance of electric signals from the pixels towards the exit registers. The main factors that influence the overall CCD sensor sensitivity are the factor of fill, quant efficiency (QE) and the factor of charge conversion. The factor of fill is a measure to determine how many light photons actually hit the photosensitive layers of each pixel. This factor differs depending on the CCD sensor architecture and depends on the fact whether the pixel has micro lens. Although CCD sensors are not the only type of technology that allow light detection, they are used in a wide range in the overall consumer consumption, for professional goals, medicine, scientific and military purposes where their application

of digitalized image in the low, average or high image quality, and in wavelengths from UV, over the visible spectrum part to the NIR spectrum part.

There are linescan CCD sensors. We are not taking them into consideration and they are basically used for shooting stationary objects, for instance in scanners for scanning documents or objects. According to their architecture, CCD sensors can be divided into: fullframe, frame-transfer and interline CCD sensors. Architecture issues are mainly aimed at dealing with the speed of lighting (picture shooting speed). With fullframe CCD sensors the whole sensor is active and it is necessary to have a mechanical shutter for image lighting, because if an electronic trigger was used, there would be a smeared or obscure picture. With the frame-transfer architecture only half of a sensor is used: while one half is processing the picture the other half already makes the next picture's exposition.

Interline CCD sensors are mainly found in the majority of consumer cameras where the pixel area is divided into the photosensitive part, door transfer and register of the charge shift. The quantum efficiency defines the relationship as to how well the pixels store the transformed light into electric charge. This is the relationship between the photon hitting the pixel and the number of absorbed photons that create the electric charge. If, for instance, the CCD sensor has a quantum efficiency of 30% at a certain wavelength, then we state that an electron has been created for every third photon that hits the pixel photosensitive area. The quantum efficiency CCD sensor varies in various wavelengths and mainly depends on the CCD sensor construction. The charge conversion factor is a measure that tells us what voltage we will get according to the electrons stored in the pixel. The reason why we are not considering CMOS sensors is the difference between those two technologies in sensor production. The advantage of the CCD technology which is a better choice in comparison to CMOS [Litwiller, 2001] is for the design of a camera that needs to operate in difficult conditions with a small light and where the ratio between the noise and the useful signal is essential (as the design of our camera for the INFRAREDESIGN effect that operates in the IR spectrum). By classifying CCD sensors we have divided spectral characteristics into three categories of CCD sensors. The first group of CCD sensors is from D1 to D4. CCD sensors from D1 to D3 have an almost divided characteristic and their relative spectral sensitivity amounts to about 10% in the visible part of the spectrum whereas in the infrared spectrum part it begins to drop as soon as 850 nm and reaches zero somewhere at 1000 nm, namely at the wavelength that we use for detection of the INFRAREDESIGN effect. The CCD sensor with the D4 characteristic differs from D1, D2 and D3, mainly in the spectrum infrared part where the relative spectral sensitivity grows up to 28% at 800 nm and drops to zero also at 1000 nm. This CCD sensor is more sensitive in the infrared spectrum part than in the visible part. The second CCD sensor group is from E1 to E3. Their characteristics show that those CCD sensors are good for the visible spectrum part where relative spectral sensitivity is gained up to 50%, whereas at the beginning of the NIR area at 700 nm this sensitivity amounts to 20% and at 1000 nm it is almost zero. The third group of CCD sensors from F1 to F3 differs as to design and CCD sensor production. All of them are Back Illumination CCDs, and the F3 sensor is a Deep Depletion Back Illuminated CCD [Holland et al., 2001]. With such production of CCD sensors the results reached for relative spectral sensitivity were much better, so that F1 is sensitive in the best part of the visible and NIR spectrum and begins to drop only at 850 nm, and at 1000 nm the relative spectral sensitivity is at 8%. With CCD F2 sensors the situation is even better; as much as 96% is sensitivity in the overall visible spectrum part, in NIR part up to 90% and all the way to 10% at 1000 nm. The sensitivity of the F3 CCD sensor entering the NIR part at 700 nm rises up to 95% and it begins to drop only at 850nm. At 1000 the F3 sensor reaches the relative spectral sensitivity of the excellent 35%. It is well known that the absorption of silica compounds from which CCD sensors are made from goes up to 1100, so it is great success to able to reach a 35% sensitivity at 1000 nm.

## **5. Results reached for designing an INFRAREDESIGN effect detection camera**

In order to design a camera that will detect an INFRAREDESIGN effect well and created with the help of the method bearing the same name, we applied the method of classifying spectral light sources characteristics, classification of optical filters spectral characteristics, and finally CCD sensor spectral characteristics. Based on the resulting characteristics we can see the cross section of those sources of infrared light, those filters and those CCD sensors that have the best characteristics as shown in

Figure 4. We have discovered that those characteristics depend to a great extent on various production technologies, on the type of materials used for producing filter coatings, the type of semi-conductor element for the light sources, and the manner in which the CCD sensor itself is produced. Figure 4 shows that for INFRAREDESIGN effect detection it is best to have a camera design that contains I1 or I2 filters, F1, F2 or F3 CCD sensors, and B2, B3 and in some cases the C1 infrared light source.

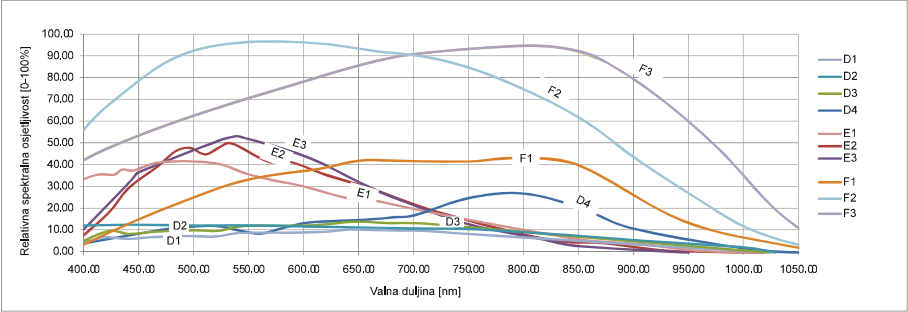


Figure 3. CCD sensor classification

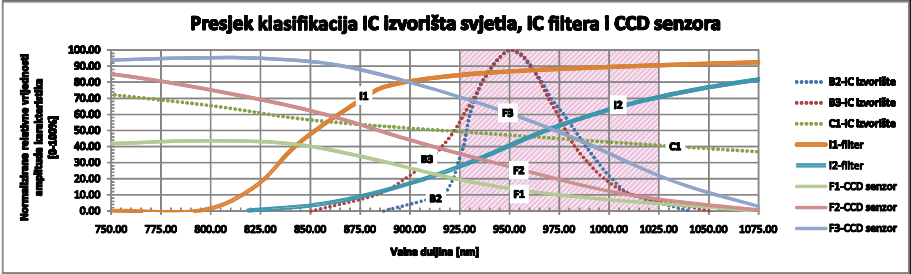
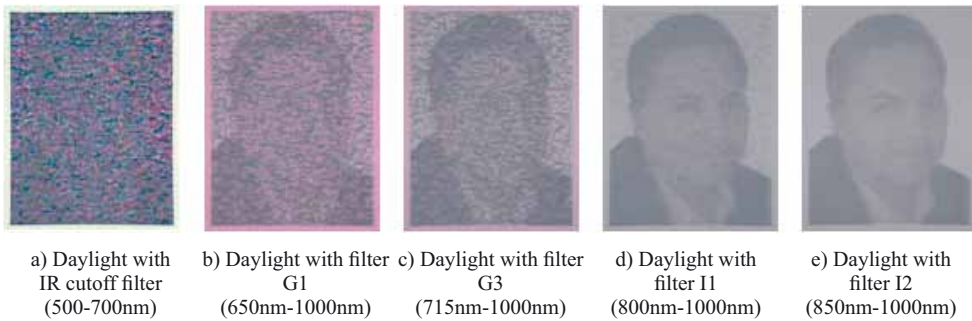


Figure 4. Cross section of light source, IC filter and CCD sensor classifications

On basis of certain lights cross section, filters and CCD sensors, we have carried out the work's experimental part in order to determine and prove the validity of our classification through experimental shots. As an example for experimental shooting we have taken a multi color picture secured with the INFRAREDESIGN method which under daylight (400 – 700 nm) shows multi-colored cubes positioned alternately in different colors. When we used the G1 filter and cut off the visible spectrum part up to 650 nm, the picture became reddish in color (Figure 5a) and we slowly see the double transition of the picture we had seen in daylight and the picture that was set for the infrared spectrum part (1000 nm). By shifting to filter G3 the detection area was decreased to the 715-1000 nm (visible part up to 715 nm is once more cut off. The area is always limited to 1000 nm due to the CCD sensor limit, the detection area of which ends there. In Figure 5b we can see that the reddish color becomes darker the more we move away from the red part of the visible spectrum, and as we enter further into the infrared spectrum part. The next step is transition towards filter I1 (Figure 5d), and in our picture we recognize the portrait which is quite clear now. The surrounding red color is practically invisible; we see some more picture parts we had observed in daylight. The last filter we set as the final filter we found suitable for our camera design was filter I2 with which we obtain the narrow area from 850 to 1000 nm (Figure 5e). In this area that is only 150 nm wide, the picture is clear, we see the hidden picture we had incorporated with the help of the INFRAREDESIGN method. On basis of this experiment we have proven that with the help of the filter classification method, classification of certain sources of light and CCD fields we can significantly influence the quality of detecting the INFRAREDESIGN effect. Top quality detection of the effect is obtained with a top quality design and this detection has been proven by our work.

On basis of classification we have determined what filter classes, what light sources and which CCD sensors are best for designing the camera for INFRAREDESIGN effect detection.



**Figure 5. Experimental results after applying G1, G3, I1, I2 filters along with C1 light source and the D4 CCD sensor in order to detect the INFRAREDESIGN effect**

## 6. Conclusion

Detection of the INFRAREDESIGN effect is carried out in the near infrared spectrum of light wavelengths. In this work we have researched 3 basic designs of an IR camera (IR light, IR filter, and IR sensor) by classifying spectral characteristics with the help of the classification method in order to see which were the most suitable and of best quality in order to get a correctly set detection. In the cross section we could see that the best quality detection was designed in the range from 925 to 1025 nm in the infrared spectrum. We have shown how the production technology of sources, filters and sensors linked with the infrared spectrum part. The following steps are further follow-ups, evaluation and validation of these technologies that continue to develop on a daily basis.

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## THE INFRAREDESIGN WITH INDIVIDUALISED SCREENING

I. Žiljak Stanimirović, R. Anayath and T. Bogović

**Abstract:** Two independent graphical elements are connected in the security graphics. The screening is done by shape changing pictograms based on the pixels coverage. The double image accepts the INFRAREDESIGN rules by applying the random angle of the raster element. The pictogram is specially assigned to each channel of the four channel reproduction. In the near infrared spectrum, only the chosen pictograms that carry the specific information are visible. That is the so called "Second image" of the Infraredesign method. The final image is shown in a number of various wave lengths.

*Keywords:* CMYKIR, screening, INFRAREDESIGN, NIR

### 1. Introduction

The method of double image execution has been conceived and named INFRAREDESIGN-IRD2 (1,3). After the innovation was introduced, many types of its application have been initiated, not only on paper but also on clothing material and on the leather as well. Testing of the double image print on silk has been carried out with digital technique. The final reproduction is transparent. The infrared image is derived from the coloring combination based on the CMYKIR separation method. The issues on the reproduction quality have been raised in a case that individualized screen elements should be applied that are entirely visible. This would show that certain printing dyes are not observed under a light that is set with a narrow wave length area, without a magnifier or special instruments. This paper has been printed with the help of Xeikon digital printing. The INFRAREDESIGN method can be tested on the original print only (4. I.Ziljak 2008. "INFRAREDESIGN"). The CMYKIR print is in the book Volume 4 from the DESIGN 2010 conference. The attached illustrations can not be reproduced, scanned or copied, in such a way that the double image remains.

### 2. Infrared images Dubrovnik / portrait

We are presenting that two images- A and B- have two solutions and different information in color separation. They are the same in the human eye visibility range (VL). They show the Dubrovnik panorama. The input data into the CMYKIR separation are two independent images. The first image carries the information that it will be observed in the VL visibility range only, and the second (NIR image) carries the information that it will respond in the near infrared specter. The first image was applied twice, intentionally, in order to underline the statement that the two input images in the CMYKIR method were independent. The other images are different; they show portraits. Reproductions A and B are different in the near infrared specter (NIR). They were created with different printing forms.

Conventional discussions state that our eye can see in the 400 to 700 nm area. A filter has been applied in picture No. 2 that allows only 570 nm light wavelength to pass. The colors do not absorb light any more in the generally accepted manner from the colorimetric theory. Our RGB receptors recognize the double image because the relation between the absorption characteristics and the narrow wavelength light reflection have been changed.



**1. Image A, Image B, visible area**



**2. Image A, Image B, barrier filter, 570 nm**



**3. Image A, Image B, barrier filter, 715 nm**



**4. Image A, Image B, barrier filter, 850 nm**

The portraits appear. The reproductions that appear the same in VL give a different color impression. The red component gives a stronger impression in light tones. The barrier filter of 715 nm responds as an even greater contrast between the two Dubrovnik images and portraits. The colors that are presented to be for VL wavelengths remain in the bluish hues domain. The image of the town is observed in this near infrared specter but only with the cyan printing component (1).

The reproduction under the influence of 850 nm has completely lost the image of the city, while only the portraits remain. IR images have “lighter spots” that could not be made to be of the set and wanted blackening. Each pixel of the other image meant for NIR gives its CMYKIR separation maximum with its appearance under IR (2).

The word here is not only about confirmation of efficacy of CMYKIR separation but a new way of proving that the first image (Dubrovnik in VL) is identical regardless of the fact that it has different NIR images.

This picture was created with a barrier filter. However, it could be obtained with an IR camera that has the possibility of “night vision”. Such cameras do not have data on the NIR area wavelengths.

**3. Letter characters as screening elements**

The screens in images 1 to 4 have been made in the conventional manner. We have always known about the screening technique with round or linear form. The screening element is developed from 0% to 100% coverage according to the PostScript principle (6. Postscript programming) Individual screening elements (7. Design of digital screening) with mathematically derived forms have a development from zero to total coverage. The proposal for blackening through pictogram will be given here. Character forms have been used with the assumption that they could interpret the reproduction in a satisfactory manner. Following a number of solutions in developing mathematical models of screening elements (8. New mutation screen element), new “character” screens are applied in INFRAREDESIGN. An image 5 a pattern for joining CMYKIR separation illustration is given, with individual stochastic screen element layout.



WMZBARSEGFLJI871wmbanfi?\*="/";:,,.

**Figure 5. The scheme of blackness, letters and pictograms as a raster elements**

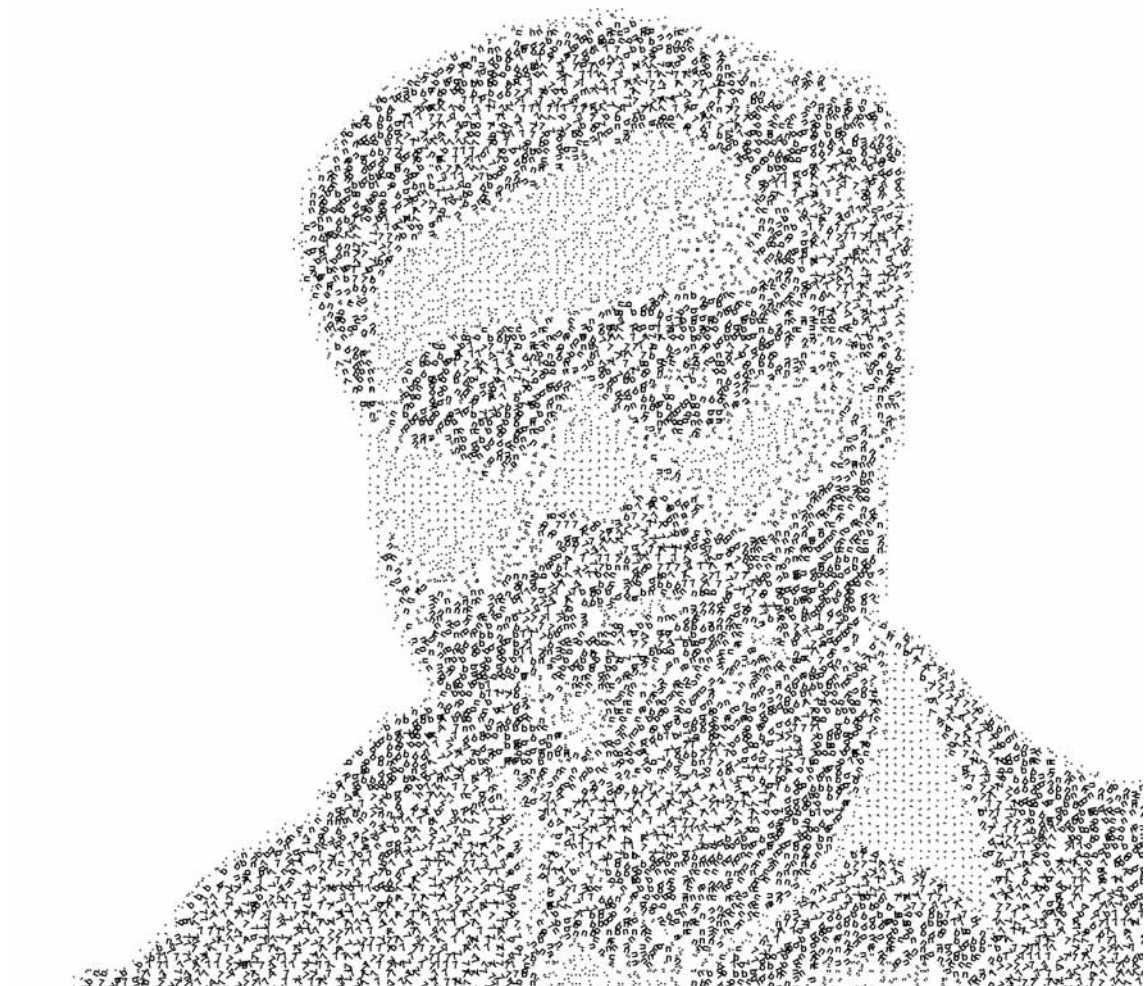
Shading in tones does not have limitations for borders or preciseness. The software design for joining the pictogram with the blackening does not have limitations. It is a free choice that does not have to have continuity. It can be a precise, long row of pictogram. On the contrary, the opposite proposal would be to interpret everything with only 10 steps of blackening. Exceptions could be made too; for example, to carry out the blackening from 50% to 55% with a 20% coverage value. The only goal is individuality in the security graphic service. The example and the discussion lead towards reaching individuality in a new way.

The software with pictogram screening elements supports pictogram rotation within the screening pixel. In images 6 and 7, examples of random choice, as to character sign rotation, has been introduced. This may be developed into random liniature choice. As it is a matter of small, fine characters, it is impossible to scan and reproduce them. This is a novelty in security printing. Interpretation of the reproduction is applied here as part of CMYKIR separation.

**Figure 6. CMYKIR four-color screening with character signs (pp. 1866)**

**Figure 7. IR image with character screening elements (pp.1867)**





**Figure 8. Detail CMYKIR four-color screening with character signs (pp. 1866)**  
**Figure 9. Detail IR image with character screening elements (pp.1867)**

#### 4. Conclusion

The goal is to implement new procedures into security printing through the INFRAREDESIGN method. Our software supports the infrared principles (2) and this is shown through the transforming the town image into the portrait image. An image individualization supplement is introduced and it is in the form of screening elements and in the form of character sign pictogram. This paper describes characters that have their own coverage. The CMYKIR method separation includes support of the IR image with individualized screening, whereby several new graphic technologies are joined in carrying out security printing.

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## STANDARDIZATION OF 3D MODELS CREATION PROCEDURES IN COMPUTER GRAPHICS

Z. Sabati, Z. Novak and A. Bernik

*Keywords: 3D laser scanning, micro scanning, spatial data acquisition method*

### 1. 3D Modeling

A three-dimensional (3D) model is a collection of data used to show an object in a virtual 3D space. Information on virtual object view is available as a collection of data on pixels, coordinates, dimensions, materials, etc. The creation of 3D object mathematical representation is called 3D modeling, and includes using of the polygon or NURBS (Non-Uniform Rational Bézier Splines) as constituting elements of the object. A polygon is a surface bordered with at least three vertices. The modeling process occurs when the polygons are mutually connected by vertices. The NURBS model is a mathematical description representing Bézier curves. The result is a 3 D model containing data on 3D space vertices, which can be rendered to a 2D image or used as resource in real-time graphic simulation.

A 3D model can also be created using procedural algorithms and 3D digitalization of space and objects. Fractal modeling is a well known technique of procedural modeling, based on the process of generation, and not manual creation of the models. 3D digitizing is a procedure used to build a digital 3D copy of a physical surface. The main difficulty resides in obtaining the actual shape of the surface, that is, the volume the surface occupies in space. The 3D digitalization process is conducted with different types of 3D scanners. Because of recent developments in computer vision and sensor technology, light has been used in a number of ways to measure objects. These measuring techniques can be divided into two categories: active and passive technologies. Passive scanners do not emit any kind of radiation themselves, but instead rely on detecting reflected ambient radiation. Most scanners of this type detect visible light because it is a readily available ambient radiation.

### 2. Measuring Methods and Sources of Light

Passive methods can be very cheap because in most cases they do not need particular hardware other than a digital camera. The accuracy of these methods depends mostly on the resolution of the imaging system and the density of identifiable features in the image. Passive 3D Image Modeling Technologies generally use one of the following three length measuring techniques:

*a) Photogrammetry based measurement.* There are two approaches for surface modeling in the photogrammetry and computer vision. The first approach is active projector technique which uses a specified light pattern projected on the surface and a single camera. The projected light pattern must be sharply focused to obtain reliable measurement on the images took by camera. 3D coordinate of the surface points calculated using the image coordinate of the points and geometrical positioning of the projector and the camera. The photogrammetric orientation algorithms need the known inner orientation of the light projector. The second approach is passive projector technique which is based on finding correspondence between projected light patterns on stereo images. The projected light pattern should be focused to obtain reliable measurement accuracy on the image point. The pattern of light may be a random pattern or a coded structured pattern. The surface model is calculated using triangulation between the corresponded points based on geometrical configuration of the cameras and aerial intersection.

*b) Stereoscopic Technique.* Stereoscopic 3D scanners usually employ two video cameras or mirrors, slightly apart, looking at the same scene. By analyzing the slight differences between the images seen by

each camera/mirror, it is possible to determine the distance at each point in the images. This method is based on human stereoscopic vision. This technique usually use a Photogrammetry based measurement. *c) Reconstruction Technique.* The point clouds produced by 3D scanners are usually not used directly. Most applications do not use point clouds, but instead use polygonal 3D image models. The process of converting a point cloud into a polygonal 3D model is called reconstruction. Reconstruction involves finding and connecting adjacent points in order to create a continuous surface. Many algorithms are available for this purpose.

Active scanners emit some kind of controlled radiation and detect its reflection in order to probe an object or environment. 3D Laser Scanning is an active, non-contact, non-destructive technology that digitally captures the shape of physical objects using a line of laser light. 3D laser scanners „point cloud“ data from the surface of an object. A „Point Cloud“ is a set of 3D points or data coordinates which appear as a cloud or cluster. Point clouds are not directly usable in most 3D applications, so they are converted to triangle mesh models, NURBS surface models, or CAD models through a process called reverse engineering to be used as input for design, modeling and measuring. Point clouds collected with laser-based measurement devices may also include characteristics such as intensity and color.

#### *Microscanning and Scanning of Small Objects*

3D scanners used for microscanning include laser and photogrammetric scanners. There are also devices achieve the same results by combining these technologies and methods. An optimum system is determined considering the type of task. The area of microscanning requires approaching the object at 2 m and data collection accuracy of up to 0.02mm.

Photogrammetric measuring uses the method of stereography, or the possibility of creating 3D models with precise and calibrated movie cameras and cameras which acquire object photographs from different positions. Their mutual position has been precisely determined, and the third dimension is achieved based on the photography stereo pairs taken of different positions. Special algorithms are used to automatically integrate spatial 3D vertices and the final result is a 3D model.

#### *Medium and Long Range 3D Laser Scanning*

Operation of medium and long range terrestrial 3D laser scanners is based on the LIDAR (Light Detection and Ranging) technology of known speed of light and a narrow bundle of coherent laser beams emitted into space by the device. The beam moves with the speed of light, and bounces from a physical obstacle back to the receiver of the device it had been emitted from. The device measures time the laser beam pulse needs to travel from the obstacle back to the sensor. The output signal from CCD or CMOS sensors is then converted into a digital signal, which is then subjected to digital signal processing. Using details on distance and angle, that is the interval between measured vertices, each vertex can be presented in space with its spatial 3D coordinates. Such method results in a final and precise 3 D model.

## **2.3. Measuring Using Light**

### **2.3.1. Triangulation Based Measuring**

The triangulation laser range finder used in this 3D capturoor shines a laser on the subject and a camera looks at the location of the laser dot. The laser and the camera are placed so that the direction of the laser and the view direction of the camera are not parallel. Depending on how far away the laser strikes a surface, the laser dot appears at different places in the camera’s field of view. This technique is called triangulation because the laser dot, the camera and the laser emitter form a triangle. The length of one side of the triangle, the distance between the camera and the laser emitter is known. The angle of the laser emitter corner is also known. The angle of the camera corner can be determined by looking at the location of the laser dot in the camera’s field of view.

### **2.3.2. Time-based Measuring**

#### *a) Time of Flight, TOF, 3D Laser Scanner*

Time of Flight laser scanners use a precise time counter to measure time that the laser beam needs from the obstacle back to the device sensor. A laser transmitter sends a short impulse which is split into two parts. The first part is sent to the receiver and starts the time counter. The second part is sent to the measured object. When it reaches the measured object, the laser beam disperses in all directions and only a part of it is sent back to the decoder. The signal is enhanced and sent to time discriminator, which calculates time. Few of such lasers (Optech ILRIS 3D) enable collecting of spatial data of 3 to 1500 m

accuracy within 1 cm. High Density system enables data collection with the speed of 10,000 pixels per second.

*b) Phase Shift 3D Laser Scanner*

Phase shift method uses a continuous bundle of laser beams which serve as a modulated signal support wave, usually as a sine wave or a sinusoid, or a rectangular wave. Length of the signal is determined by comparing the signal sent and received during the phase shift. Phase shift lasers scanners are different from TOF laser scanners because they use higher emission energy, lower laser beam divergence, shorter wave length and higher frequency. The speed of spatial data collection exceeds 500,000 pixels per second, with 100m range and 1.2mm accuracy.

Both scanners use the laser beam to calculate spatial 3D coordinates for each particular vertex based on the distance and the angle.

### **2.3.3. Beam Deflection Methods for time-based measurement system**

To be able to measure multiple points from the same scanner point of view, the laser beam needs to be deflected. Instead of moving the laser itself, a deflection unit is used. Most deflection units make use of a mirror because they are much lighter and can thus be rotated much faster and with greater accuracy. A number of methods exist to deflect the laser beam towards a specific direction without having to move the scanner itself. In general, three methods are employed for this purpose: oscillating mirror, rotating polygon, fiber switch.

Devices analysed in this paper use various length measuring methods, which use different light sources:

*a) Laser; coherent monochromatic light source.* A device that is able to generate a wave of light using only a very narrow of the spectrum is called a laser. A typical laser emits light in a narrow, low-divergence beam with a well-defined wavelength (corresponding to a particular colour if the laser is operating in the visible spectrum). This is in contrast to a light source such as the incandescent light club, which emits into a large solid angle and over a wide spectrum of wavelengths. These properties can be summarized in the term coherence.

*b) White halogen light.* Visible halogen light is a form of incandescent white light. The halogen bulbs look like traditional light bulb and are filled with halogen gas that helps extend the lifespan of the light bulb. Halogen and incandescent light bulbs operate by heating a filament, most commonly made of tungsten until it glows. The glowing filament is what creates the light, but it also creates a lot of heat. To keep the filament from burning up an incandescent light bulb is filled with a relatively inert gas like nitrogen or argon. Since the gas inside the light bulb doesn't react with the tungsten, even at a high temperature, the filament doesn't burn.

*c) Structured light.* Structured light is the projection of a known light pattern (plane, grid, or more complex shape) at a known angle onto an object and capturing this with a camera. By looking at the deformation of this pattern we can calculate the shape of the object this pattern is projected upon. There are various ways of deploying this technique. We scan an object using structured light by a moving a stripe pattern across the object or project a series of different patterns on the object. The key problem of 3D vision measurement using triangle method based on structured light is to acquiring projecting angle of projecting light accurately. In order to acquire projecting angle thereby determine the corresponding relationship between sampling point and image point, method for encoding and decoding structured light. This technique can be very useful for imaging and acquiring dimensional information. Scanning the object with the light constructs 3D information about the shape of the object.

### **2.4. Collected Data Analysis and Processing**

The main product of 3D laser or photogrammetric scanning is a measurable 3D model taking a form of a point cloud, in which every point has its particular spatial coordinate defined by Cartesian coordinates X, Y, Z. The original point cloud in real colors may be used to connect the points into a system of triangles to make 3D models with surfaces to be used in further analysis, cross sections, creation of 3D replicas or 3D physical models on 3D printers, and in composing simulations or animations.

## **3. Converting Inscription Formats of 3D Computer Graphics**

In addition to classical 3D modelling, graphic programs support downloading data from other programs operating in 3D graphics. These input data may include 3D models or scenes generated by modeling or alternative techniques such as 3D scanners. Input data can be used only if saved in a compatible format.

There are numerous specific tools used for generation of 3D models. Each of them develops formats for saving 3D information and is usually of a closed type. Their connecting is possible through plugin files. If plugin is not available special converters are used.

The final 3D model can be stored from the 3D graphic program either as 2D or 3D data. 2D presentation of a three-dimensional model is possible only with image. The method enabling this conversion is called rendering. Rendering can create a single static image or a sequence of images based on which a post production video image is generated. If the completed 3D model is to be further processed with other techniques and in a different environment it should be saved into a compatible 3D format. The predefined/default 3D formats are usually included in the 3D graphic programs but special program solutions may require special 3D formats. In such case, plugin solutions to connect the two programs or alternate converters providing the required compatibility are searched.

An extensive analysis of various types of 3D scanners, 3D print devices, a Sub-Surface Laser Engraving machine (SSLE), 3D scanning and 3D modeling program tools provided important information on the possibilities and procedures for mutual conversion of inscription formats or 3D models. The results are shown in Table 1.

Based on information included in Table 1, a significant deviation relating to compatibility of inscription formats was noticed for different 3D program tools, i.e. possibilities of converting the 3D model into other 3D graphic programs. The most frequent inscription formats enabling mutual compatibility are obj, ply, dxf.

The obj data format is an ASCII format, representing a compatible system for saving and transfer of 3D models where compression is not necessary, and which supports a range of colors and 3D geometry. obj is geometrically defined format which contains information on all polygon elements, coordinates and attributes of NURBS curves. obj information may define and access external MTL information containing definitions of various material types. obj reading and writing routines are based on FORTRAN90 library. Its compatibility makes obj one of the most spread 3D data formats and many programs can convert the obj into another 3D format. 3D models, created in any technique (3D scanning, 3D modeling, generating from photographs, ...), are easily transferable to other specialized application. This results in a wide area of application and advanced manipulation of models providing wide connectivity of 3D computer graphics. The structure of obj format may be explained in seven key parts shown in Table 2.

**Table 2. obj format main parts**

Edge points/vertices	Geometric and textual (v, vat) Normal edge (vn) Area edge (vp) Curve edge (cstype)
Model key elements	points (p), straight line (l), polygon face (f) curve (curv), 2D curve (curv2) surface (surf)
Curves and free form surfaces	Parameter values (parm) External and internal edges (trim, hole) Special curves and points (scr, sp) End status (end)
Connection between curves and free form surfaces	Connection (con)
Grouping	Group name (g) Smoothing (s), merged group (mg) Object name (o)
Plotting view and attributes	Interpolation of color, bevel (c_interp, bevel) Diffraction interpolation (d_interp) Level of details (lod) Material name and details (usemtl, mtl lib) Shadows, light beams (shadow_obj, trace_obj)
General inscription	Arguments, .OBJ file name, location.

**Table 1. Comparison of program tools by application and inscription format compatibility**

Application	Manufacturer (SSE)	Equipment Type	3D camera	Software	Input/output File Format
Application 3D Surface Laser Engraving	Hanzhoun Shining 3d Tech Co. <a href="http://www.shining3d.com">www.shining3d.com</a>	EID300C-HI	M1/M2	3D Vision	3DS, DXF, OBJ, CAD, ASC, WRL, SDV
	Wuhan Synony Laser Co., Ltd. <a href="http://www.synony.com">www.synony.com</a>	STNDP-803B4	inSpeck 3D Mega Camtutor	Inspect EM Software	Softimage 3DS, Maya ASC, DXF, OBJ, STL, VRML, FBX, HRC
	3d Laser Engraving Systems <a href="http://www.3dlaser-machine.com">www.3dlaser-machine.com</a>	LE-X-4000	ZL1/Z3M2	Software OS	STL, OBJ, 3DS, LTM, TGL, WRL
	Wuhan Lead Laser Co. <a href="http://www.leadlaser.com">www.leadlaser.com</a>	LD-EG-603B	inSpeck Cyelops 3D Mega	Inspect EM SSOLENT	Softimage 3DS, Maya ASC, DXF, OBJ, STL, VRML, FBX, HRC
	LeLee Laser Tech <a href="http://www.leelaser.com">www.leelaser.com</a>	LE-X-Advance	LE-5C-3d camera	3D Software Creation	ASC, DXF, OBJ, STL, CAD; STL (BOTH ASCII and Binary), OBJ, PLY, GSF, CAM, CDM,
	Perfect Laser Co <a href="http://www.perfectlaser.net">www.perfectlaser.net</a>	PE-DP-820B3	MEGA II	3D Grafical Software	3DS, DXF, OBJ, 3DV
Application	Manufacturer	Scanner/Camera	Software	Input/Output File Format	
Application Spatial Data Collection	LEICA Geosystems <a href="http://www.leica-geo.com">www.leica-geo.com</a>	Leica HDS 2500	Leica Cyclone Software	ZFS, SCAN, SC2; DXF, COE, ASCII, PTZ,	
	Riegl Laser Measurement Systems <a href="http://www.riegl.com">www.riegl.com</a>	LMS-Z390i	RISCAN PRO	3DD, DXF, ASCII, SOP, 3PF, ASC, PTC, OBJ, STL, PLY, POL, VRML	
	Artec Group, Inc. <a href="http://artec-group.com">artec-group.com</a>	Artec 3D Scanner	Artec Scanning Software	STL, OBJ, PLY, WRL	
	DeltaSphere, Inc. <a href="http://www.deltaspHERE.com">www.deltaspHERE.com</a>	DeltaSphere - 3000	SceneVision	VRML, ASCII	
	3D Dynamics Byba <a href="http://www.3ddynamics.eu">www.3ddynamics.eu</a>	Mephisto Extreme	RapidForm XOS Software	OBJ, PLY ASCII, PLY binary	
	Optech Inc. <a href="http://www.optech.ca">www.optech.ca</a>	ILRIS-3D	InnovMetrics/PolyWorks, MenciSoftware	Optech pif/xf, zfs, ptx, 3dd, fts, 3DS, eme, dxf, nas,obj, ply, pol, pkg, stl, wh, ASCII	
	Zoller+Frohlich <a href="http://www.zf-laser.com">www.zf-laser.com</a>	Z+F Imager 5600i	Z-map Geomagic, 3D Reconstructor	zfs, xyznm, zfc, ptx, ptz, osc, wrl, ascii, bin, pte, dx, dxf, xpm	
	Topcon Positioning Systems, Inc. <a href="http://www.tps.com/tpsi.htm">www.tps.com/tpsi.htm</a>	GS-1000	ScanMaster Software	PTX, OBJ, PLY, ASCII	
	Manufacturer	Equipment Type	Scanner/Camera	Program Tools	Input/Output F. Format
	Menci Software Srl <a href="http://www.menci.com">www.menci.com</a>			Scan View	Prip, vtp, vbl, ASCII
NexEngine Inc. <a href="http://www.nexengine.com">www.nexengine.com</a>		Desktop 3D scanner	Z-Map ScanStudio HD&HDPRO	AutoCAD, DWG, DXF VRML, STL, U3D, PLY, XYZ, OBJ with JPG TEXTURE	
Z CORPORATION <a href="http://www.zcorp.com">www.zcorp.com</a>	ZPrinter 650	ZScanner 800	ZScan, ZPrint	STL, PLY, 3DS	
Dimension 3D Printers <a href="http://www.dimensionsprinting.com">www.dimensionsprinting.com</a>	Dimension uPrint Personal 3D Printers		Catalyst EX 3D Print Software	STL	
3D Systems Corporation <a href="http://www.3dsystems.com">www.3dsystems.com</a>	ProJet 3D Printing		V-Flash Desktop Modeler	STL	
Objet Geometries Ltd. <a href="http://www.objet.com">www.objet.com</a>	PolyJet TM		Objet Studio Software	STL, STC	

Polygonal file format called ply is a format used for saving graphic objects described as a group of polygons. There are two versions of the ply format: simple ASCII and binary, enabling fast saving and downloading. ply format describes an object as a group of points, faces and other elements together with their attributes such as color, direction of normals, etc. This format can store data on only one object. Some features which may be stored together with the object are: color, surface normals, texture coordinates, transparency and other options linked to polygons.

The format does not contain any transformation matrix, hierarchy inside the model or object's sub-parts. It also does not include square surfaces nor operations on hard geometry, polygons with holes or information on the very texture. The ply format structure includes: the heading, the list of points, the list of faces and the list of other elements. The ply file heading is a group of textual data describing the file system and each contained element. The number and the name of the element is saved as well as the list of their features.

dxf (Drawing Interchange Format, or Drawing Exchange Format) is an Autodesk format used to exchange drawing created in different AutoCAD applications. In this format, all information is specially numbered. Every data element in the file is preceded by a whole number called a code group. The code group value determines the data type and the meaning of the data element which follows.

It has been developed as the binary and the ASCII data type, where the ASCII type may be edited in all text editors. Conversion between the dxf and other formats is easy, which makes this format widely useable, especially in CAD, CAM and CAE systems. The inscription structure is very complex and difficult to monitor, particularly due to poor documentation available on the format. The drawback of the dxf is its size and speed of accessing data, which is several times bigger than other formats of the same application.

#### 4. Conclusion

The tree-dimensional (3D) model is a group of data used to show an object in the 3D virtual space. Information for virtual object presentation may be in a form of data group on points, coordinates, dimensions, materials, etc. 3D modeling implies the use of polygons or NURBS, as fundamental constituents of objects, the use of procedural algorithms by fractal modeling and 3D digitalization of space and objects.

3D scanning is used for detailed and accurate data collecting and processing in the area of microscanning or scanning of small objects and 3D medium or long range laser scanning. The main product of 3D laser or photogrammetric scanning is a measurable 3D model in the form of a point cloud in which each and every point had its space coordinate defined by Cartesian rectangular coordinations X, Y, Z.

There are numerous highly specific tools used for 3D model generation. Each of them develops own formats for saving 3D information. They are usually of closed type. If more applications are used and they do not have mutually agreed data transfer standard, plugin data should be provided to enable functionality. If there is no direct plugin, converters are used to convert special formats into any of generally accepted formats. If the completed 3D model is to be further processed using other techniques in other environments, it should be saved in a compatible 3D format. Usually, the predefined/default formats fbx, obj, mb, ma, dae, dxf, etc. are already included in the 3D graphic programs. Conducted analysis showed that the .OBJ format is the most widely used conversion format.

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## THE OLD SHARES SECURITY GRAPHICS APPLIED TO THE NEW SECURITY DOCUMENTS

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**Abstract:** This work analyses the old security document design methods, comparing them with today's solutions. The old security samples were chosen for their uniqueness and beauty. Analysing the old and new shares will show the design similarities as well as the graphics designers' tendencies to create a unique and inimitable product. The modern design is developed by computer techniques imitating the handcraft in many parts. The decorative techniques and the security lines design shows that the designing process of the security documents was always in the hands of the artists.

### 1. Introduction

Old shares have been chosen and used for description in the paper. Their design is unparalleled. Each detail is unique and formed nicely and stylishly. A lot of effort and handwork were incorporated, making the product priceless.

Throughout history a graphic designer spent hours of his time making one printed matter in order to get an aesthetically pleasing end product. Besides graphic techniques, the designer needed to know decorating techniques, therefore, he also had to be an artist. He had to improve his talent through the years, in order to finally make such a product which would make people admire it for decades. Securities in those past times were of exceptional appearance, with precisely made decorative details, which had not only the aesthetic function, but also provided protection.

Nowadays, the tasks set before designers of securities and executing workers are exceptionally demanding. Besides the visual components, a designer needs to know how to implement the most up-to date types of protection such as holograms and newly discovered INFRAREDESIGN protection.

Elements such as fonts, protection lines, tone backgrounds and decorative lines have always been present in production of securities. During history such elements were a sufficient kind of security, however, man's need to counterfeit and produce fake securities has resulted in that they became more and more beautiful and complex, with incorporated, one could say today, sophisticated security elements. The basic connection between contemporary and historical shares is that they are beautiful, there is a lot of professional knowledge invested in their design and craftsmanship, and their production cost is not an issue.

One of the steps forward in designing contemporary securities has been achieved through the Postscript graphic program language. Many points are defined in vector and pixel graphics in a special way that is essentially different from the way work had been done by graphic designers in the past.



Figure 1 Share of Hrvatska poljodjelska banka (Croatian agricultural bank)



Figure 2 Share of Dubrovačka banka d.d. (Dubrovnik Bank D.D.)

## **2. Experimental Part**

In this part of the paper, some previous older designs are analyzed and compared with contemporary solutions. The comparison was made on chosen securities and their common differences and similarities were pointed out.

### **2.1. Typography on Securities**

Typography is the merging of functionality and aesthetic form with the help of which works of art of unique beauty can be created by using seemingly simple character signs.

The most noticeable text on Share no.1 is positioned centrally in the share's upper part. The important parts of text are emphasized by size and weight of the font, outline, shadows, upper- instead of lowercase letters, and by using outline typeface. The less important part of the text is set with simpler grotesque typeface in small size and lighter weight. The essential word, "Dionica" (Share), is additionally accentuated by its curving along the elliptical arc, by drop shadow and white outline, and by adding circular elements at the beginning and the end of the word. The initials in "Hrvatska poljodjelska banka" are emphasized and decorated with ornamental intertwined lines.

Similar methods were used for emphasizing parts of text in Share no.2; central position, font size and weight, uppercase characters. However, the visual approach in Share no.2 is a bit simpler, so there are no emphasized initials, added shadows, arc curving of text or additional decorative elements around the letters. The dominating word again is "dionica", and it stands out of the remaining text in a most prominent way. This is achieved by using a significantly larger font size in respect to the other text parts, by using outline typeface, whereas the remaining text is set using simpler antiqua in lighter weight, and especially by colouring the letters yellow, in contrast with the rest of the share which is, with exception of two smaller details, in various shades of blue.

### **2.2. Numbers in securities**

The main element of each share is the number that marks its nominal value. In accordance with its importance, it is usually emphasized by size, central position, by being placed in specially decorated frames, and even by its repetition (usually in the corners).

In Share no.1 the nominal value is placed inside a very intricately decorated frame, written in words in the middle, and followed by numbers on each side.

Share no.2 has a somewhat simpler but not in the least less noticeable design. The number is written using outline typeface in large font size which, in contribution with the central position, results in its domination in the overall composition.

### **2.3. Position for the owner's signature on securities**

The personal signature is a necessary part of almost any document. Except for its legal significance, it also provides security because it is unique and difficult to counterfeit.

In both of the chosen shares, the signature area is at the share's very bottom, and it is marked by text of small size and light weight. Positioning the signature at the bottom is customary and logical, meaning that the signee has marked the document and agrees with the text thereby.

### **2.4. Numerical Designation on Securities**

The numerical designation on securities marks the issued share's sequence number. It has a protective function and must be in accordance with the control number in the bank. It is usually printed in the share's corner on a separate colour tone background that makes it difficult to counterfeit the numbers.

In Share no.1 the numerical designation is situated on the share's front side, in the upper left corner, on a small protective background, whereas in Share no.2 it is found on the back side. It is an important component and the integral part of any share.

## 2.5. Colour Background on Securities

Colour tone or security backgrounds are an excellent way to protect securities due to the many elements they are made from. The tone backgrounds used today are much more complex in respect to the ones made in previous times, in order to make counterfeiting and false production as difficult as possible.

In Share no.1 the background is an emblem of the shareholder in light olive-green. It is positioned centrally and sized in accordance with the main text.

Background to Share no.2 consists of a full light-blue tone with repeatedly printed white-coloured emblems with two different motifs. In the centre, positioned in the same way as in Share no.1, appears a drawing of the town of Dubrovnik.

## 2.6. The Colour in Securities

Precisely set colours with exact ratio of cyan, magenta, yellow and black component are another way of protecting securities. Such colours are called spot colours, have their unique number and formula, and are patent protected. While today they are the usual means for providing security, it was not so in former times. This can be observed with share no.1 where the used colour had not been set precisely; it has been mixed by the printer according to his experience.

The background of Share no.2 is interesting because it is completely coloured with a full light-blue tone, whereas the decorative elements and the text are of a darker blue, with several yellow accents.



Figure 1 Share of Tehničko veleučilište u Zagrebu, 2009.

## 2.7. Illustration in Securities

In addition to being the unique mark of a joint stock company, illustrations are usually the most beautiful parts in any share.

At the bottom of Share no.1 there is a very detailed illustration made with fine lines, which simultaneously shows agricultural work in a symbolic manner (ear of corn, scythe) and in the literal sense (ploughman with oxen).

There is no separate illustration in Share no.2, but only the afore-mentioned image of Dubrovnik which also has the role of a tone background to the main text.

The approach to illustration is similar in both shares as it associates with the main description characteristic – the agricultural bank shows agricultural work and the bank from Dubrovnik the image of the said town. In contemporary securities it is usual to use images of towns, famous buildings or important historical figures.

## 3. Securities TODAY

Through the graphic business development and computerization of data, we are witnesses of contemporary times.

Securities are an exceptional example where it is recommended to appreciate tradition, graphic and visual settings, and at the same time follow up on the newest developments in the field of security and possibility of application in graphic design. Discoveries such as INFRAREDESIGN and HOLOGRAMS are exceptionally significant in the protection of any security document.

The recommendation shown by this example has the tendency to show the approach of respecting traditions in this exceptionally sensitive area while simultaneously applying new achievements in security protection. The goal is to maintain tradition, but in combination with contemporary security methods and IT support.

## 4. Conclusion

It is possible to make a conclusion that working with securities through history was methodical and thorough. Producing each share required a great amount of time and effort. The quality of the shares in past times could be compared to contemporary share quality. One could say that the previous shares were much more complex and more beautifully designed and that they were by far more difficult to counterfeit than contemporary securities. Shares in the past were based on handwork, the printer's and owner's experience. The greatest wish of any artist was to create a unique product that would serve many generations to come.

Nowadays there are less and less securities of the type shown here. Tendency is to have everything stored in the computer databases. Opinions are diverse. In addition to storing them in databases, share owners wish to own the adequate document in printed form, enabling them to demonstrate their ownership.

Digitalization of securities is a positive tendency, but it does not waive away the need to create contemporary top quality security methods, to follow-up with new achievements and to be in accordance with contemporary times that mark a certain security document. One must also take into account witnessing of computer experience catastrophes, counterfeiting of data, or erasing server memories that do occur from time to time. Owning an up-to-date secured document respects tradition, adds to the ownership significance and is one of the essential factors in fighting counterfeiting.

Old shares described in this paper have been chosen due to their unique beauty. Each one of the chosen security documents is specific, special in its own way, evidences zealous work and efforts made by their creator, and their love towards graphic technology.

Contemporary times should at the same time respect tradition and new achievements like holography and INFRAREDESIGN, and by quality design incorporate both into new contemporary securities.

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## SECURITY DESIGN

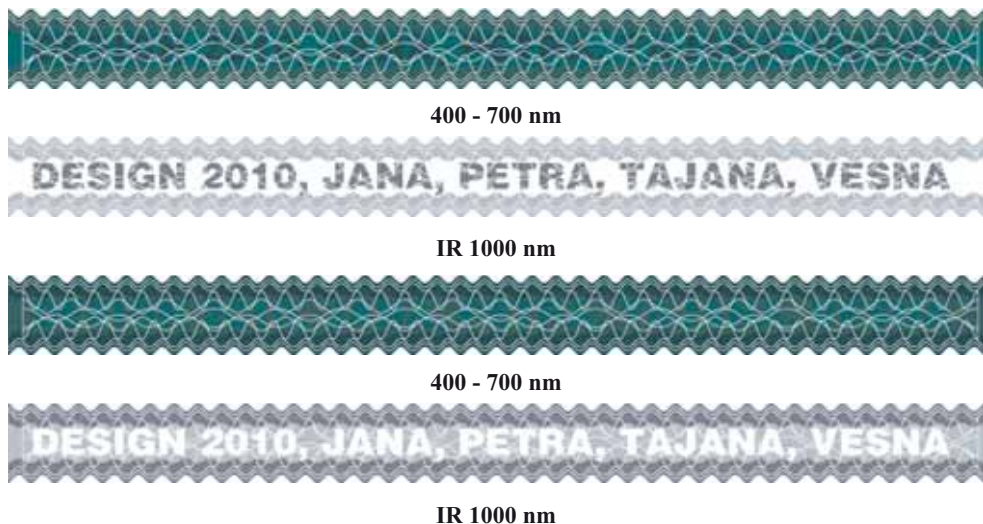
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**Abstract:** The designing of the new official government banknotes is a highly sophisticated process. The perfect banknote would be totally unique and absolutely controlled by the manufacturer, and would also appear authentic without doubt when released to the public. It could only be made by the original manufacturer, in a simple and cost effective process. The perfect banknote would be longlasting and highly resistant to all wear and tear during it's lifetime. It would also be highly attractive and would represent without doubt the country that prints it. This work defines the creative processes and new technologies behind the designing of the completely new series of banknotes.

*Keywords:* banknotes, security, Infraredesign

### 1. Introduction

“Security design” topic is being observed through planning and implementation of banknotes. It is supposed that the best anti-forgery materials are being built in them in the moment of issue. Infrared design as an innovation on security documents becomes a real discovery in implementation. IRD with its contribution to a designer trade offers completely new possibilities of development and realization of ideas. Creating an idea is possible to realize on two levels – visible / unvisibly visible. Exactly this new possibility improves the system of communication.



**Figure 1: Vignette in INFRAREDESIGN solution**

On the same surface and with the same financial means which are reserved for the realization of the project two messages can be communicated. These messages can be linked by their content or completely different. One content can be seen under day light or artificial lighting, while under these lights the invisible content is being revealed when we light the surface with IR lighting. One of the biggest advantages of IRD is that the content and the surface are not conditioned. A designer has open hands to use his author creativity to set up a concept and choose the material on which the infrared design or messages will be applied. The mentioned advantages are luring us to think about applying of a code which would be there as an anti forgery protection and which would remain hidden by its invisibility feature.

Considering that in today's world a lot of money is being invested in promotion, as well as in creating a new product, discovery of IRD gives a contribution to designer trade development and it does not limit the author's creativity in any way. There is no hidden information, only remote surfaces printed with the infrared color. Discovery of IRD creates a space of a vast number of colors on the same document, by integrating spot and process colors. Securities and especially banknotes and post stamps, get a new tool, new technology in order to improve the design and security.

Assessment of solutions based on a set of characteristics brings in the need of introducing creative designers opposed to the pure artistic side. Creative designers enable a top design to every technological solution. (Cross 2000). They are able to adjust creativity, aesthetics, style and functionality to the customer's opinion as well as to public opinion (Hubka 1998).

## **2. Freedom of a creative approach to design**

The beginning of the banknote design represents confronting a problem (Van Renesse 2005) of changes in running the state. No matter the problem, we can use it to refresh the design. Inclusion of unconventional artists would show a moment frozen in time and space, without norms and rules. All the changes around us can be used for changing the banknote design. Changes in the society, technology, innovations, inflation and changes in new forgery trends.

### **Changes in the government**

Political changes have been followed by setting up new values and new assessments of historical events. It is possible to set a nominal value that would follow such changes. To keep the quality banknotes on the market, damaged and used ones are constantly being withdrawn and new ones are being printed. That can be used in a designer sense. Half of the most frequently used banknotes on the market, lasts for only two years. If we compare that information to cadre changes in the state apparatus, a proposition could be made to set the banknote design in a correlation with changes in the government. New president, new portrait on a banknote.

Change of currency, name of the currency, inflation, all those are opportunities for a drastic design change. Design recommendations state a whole number of processes which should connect past and present, inspirations and aspirations, to symbolize stability (Archer 1979). Conventional reflections like these are not easily achieved in reality. Even in school books it is impossible to link past and present. Since the winners write history, it is clear that historical figures that once looked at as from all banknotes are no longer wanted on any of them. It is a similar situation with inspirations and aspirations. How to recognize inspirations and aspirations of every human being. Something like that is impossible to achieve. So the aspirations of the majority have been represented on the banknotes. For example, banknotes which are in circulation in a few countries, regions, nations, cannot take portraits of famous people. Such agreement could not have even been achieved in preparations for the European's currency EURO design.

Color as a symbol of stability and definition according to the state organization has been tried in a number of countries. Bigger number of nominals has different colors. However, there are exceptions. One currency that has definitely been accepted throughout the world is the American dollar. While designing it, a green color has been chosen because it, allegedly, symbolizes stability. Nowadays we have witnessed a new design of so called, colorful American dollars. Does by that dollar lose on the stability of currency? How important is the symbol of stability anyway? It cannot automatically by simply existing on the banknotes, secure stability. Today's general globalization could prompt various

reflections about designing the banknotes in such way so that the color of it implies the country it has been produced in. Security design is threatened by forgery. Design planning always includes a combination of protection elements. Nowadays conventional and new security elements are being combined (Van Renesse 2005).

Which combination is the best, how much is enough, how much is a surplus...? There are two separate groups of protection elements. The first one is subjected to mechanical detectability and the second one is subjected to feeling the banknotes with our own senses. Even in technical implementation of a banknote, optical and mechanical checking has been planned. That led to perfection so the banknotes can be taken over through ATMs which have access to a huge database on establishing the banknote's authenticity. A more severe problem is when it gets to receiving notes through another person. We rely on his senses so that the forgery does not enter the circulation (for the first time). Touch plays a very important role. Recognizing the right kind of paper and big layers of color. This is why some techniques are even nowadays irreplaceable. Through touch many information can be designed telling us what kind and which banknote we have in our hands. Using the sense of sight reached out for mass use of holography, lenticulars and variable colors.

Togetherness of the instrumental and visual ascertaining of authenticity of the banknote leads us to a wide space of radiation. Colors that look differently in the ultraviolet and infrared spectrum considering the space of wave lengths that our eye perceives are being used. Many methods allow freedom in design, they let the designer move in his own world which is because of its unique implementation incredibly motivating for an author piece. New patents are being recommended every day, innovations with the intention to secure the protection not only of banknotes but also the persons using them.

### **3. Visual identity as an aspect of changes**

Most of the graphic experts consider the banknote's format a classic from which we should not try to escape. If we are familiar with the fact that the biggest format is being chosen according to the standard size of a wallet, we begin to realize that even banknotes are part of fashion. Bigger bags, bigger wallets and the other way around. Fashion collections used to change with every season, while nowadays we have three collections per year. Maybe design changes should follow fashion changes. But, how far should it go? Softer cuts, softer banknote paper – tighter models, harder banknote paper. Even though material development should be able to take smaller adjustments, for bigger ones we still need time. Even today's situation is far from ideal. If we try to fit 15 new banknotes into our wallet and then bend the wallet, we will feel resistance. Taking such details into consideration, it is not bad to look for changes even when it gets to the design of the protected paper itself.

Mechanical implementation that insists on some accordance will oppose to such suggestions. For example, we would not be able to put different currencies into an ATM, paper that has a broad spectrum of structure and quality. Going back to coins is out of the question.

Frequency of changes could do good and bad to the visual identity. We should also stress out a need of today's generations for constant changes. Marketing became an inevitable part of our lives. Changes are so frequent that it is difficult to keep track of them. Visual identities, new products, new purposes of old products, etc. However, when it gets to banknotes, surveys show a tendency to the traditional design and minimal changes. Traditional is not bad when looked from the aspect of connecting the past and the present and stressing out the origin. But if everything around us changes in such a quick pace, won't the banknote redesign become boring too? And when it becomes boring, who will pay attention to them? From the artist's point of view, what is enough is one constant and permanent change of stories. The constant would be one big nominal value in the middle, easily noticeable, in a contrast color. Stories, important events would change constantly. Only one visual protection. Contemporary hologram with a dozen of newish patents which push high 3D and movement in space. Everything else could be keel to our eyes but with many information in the infrared and ultraviolet space of reflection and absorption of light.

Frequency of changes can also have the opposite effect. Common redesign could lead us to thinking that every creation is an original, even when it is about an invented pattern. Frequency of changes could be applied to colors which are out of our visual area. Most of the new information should be detected

by simple cameras, and the general design should stay the same. Portrait changes, information about government changes, description of various occasions, anniversary celebrations, could be moved to an infrared area.

#### Modernization of national connotations

Emphasizing national connotations through a banknote design is mostly past oriented. Why wouldn't we emphasize our national pride by today's successful stories in sports such as football, handball, skiing? If we use skis instead of a portrait as a water mark, it still stays an important security element. It is still impossible to reproduce it in print. What about Janica Kostelić's portrait on a kinegram or a hologram? Maybe it is not nice to hear it, but in today's time more people know the way she looks but some of the historical figures used on today's banknotes. If we go deeper into security sphere, it is possible to connect it with the present. Even though many people think of ultraviolet as attractive in the sense of fluorescence, the real protection could be achieved by introducing steganography with UV colors. Let us imagine a banknote showing Zagreb Arena, water mark could be a basket ball. Under UV light of 365 nm in full fluorescent glow a cup would be visible, over the whole banknote surface. Linking the story with security elements would bring life into a design. Most of us like something new, as well as something hidden. Checking of security features provides exactly that.

### 4. New design of classics

#### Occasion banknotes

Classic features of designing certain themes and banknote security elements should not be avoided. However, it is necessary to bring in changes. Why shouldn't we determine a nominal for historical national features and a nominal for modern events that reflect the present. It is possible for smaller countries whose currency is oriented almost exclusively to the territory of the country itself. Suggestion is to expand occasion nominals from coins to banknotes. Occasion banknotes can contain a big number of new security elements. That way, they will be special in any aspect. Freezing of a particularly important event, peak of technology in a given moment and small quantities of printed banknotes. All that together would represent a top numismatic work. Even though such important things do not have a price, there is always a chance just for occasion and not mass print.

Digital print with a dry toner enables controlled tactile effect. That is being suggested as a novelty since two chapters have been opened – possible implementation in the individualized security segment and both sided tactile print. Intaglio print that has been used so far is impossible to imagine in the role of changing the printing form. On the contrary, dry toner can be processed according to the designer's idea and a digital printing form enables taking the information from a data base or generating data during the printing itself. Both sided application of dry toner's cone would enable designers to control the tactile effect in a new way. Digital printing turned out to be successful in implementation of infrared design innovations. With this discovery and with combining different roles of the tactile effect, new management spaces in security printing are being gained.

Considering the need to design banknotes according to a fast life style, it is necessary to mention night life too. Security elements that enable the authenticity check in the dark are necessary. (Hill 2003). One of the suggestions are different kinds of asperity and convexity through the whole banknote surface. Intaglio print offers unbelievable possibilities and it is constantly being developed in the sense of a bigger relief. Why would not marks for the blind be in the center of the banknote, easily spotted both visually and tactile by adding different types of asperity on the edges?

One of the suggestions could contain as it follows: different shape of banknotes depending on denomination, always the same place for a watermark, big surface with tactile elements different depending on denomination, dominant hologram in the shape of nominal value in the center of the banknote, a whole banknote in one tone. Under ultraviolet and infrared light continuation of the story visible under day light. A novelty would be three independent information: first visible under day light, second one visible under UV light and third visible under IR light (Ziljak 2009).



**Figure 2: Proposal for a tactile structure design, Xeikon digital print**

## **5. Conclusion**

Banknote design is still a slave to tradition. Conventional thinking methods are trying to tie down creativity by adjusting the design to technical solutions. In that way new ideas cannot be noticed. Starting with the idea that a currency represents a country, an idea of designing modern idea solutions has been promoted. Unconventional methods of designing new series of banknotes would contribute to the surprise effect and making of the banknotes in the aspect of art works. By that a boost for a better research on banknotes would be given. Combining knowledge, skill and new technological accomplishments with freedom of creative thinking would enable designing banknotes as paintings. As a work of art they would last forever.

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## INTEGRATING INDUSTRIAL ECOLOGY INTO THE PRINT PRODUCTION PROCESSES

D. Milčić, A. Vučina and D. Donevski

*Keywords: DFE, print production, industrial ecology*

### 1. Introduction

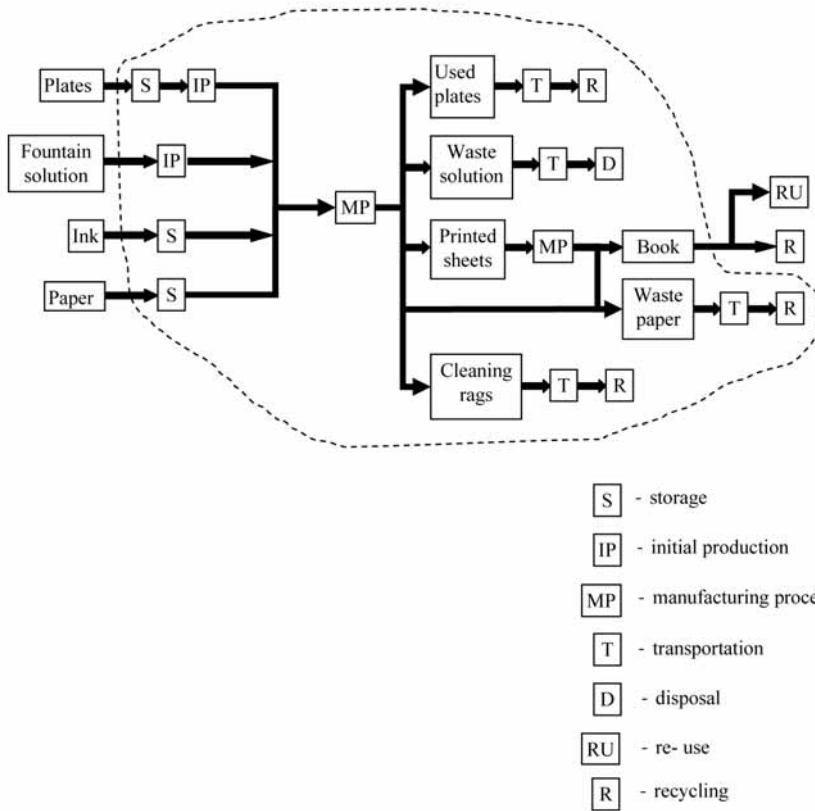
The traditional approach within a company is to regulate the output of harmful materials. However, in the late 1980s a new approach was introduced. Industrial ecology takes the view of the company as an eco-system [Frosch and Gallopoulos, 1989]. Ideally, the waste streams from one process should serve as materials for another process, thereby allowing the company to obtain as much monetary value from its raw materials and processed materials as possible.

How does a company begin this process? In general, a company begins this process introducing design for the environment (DFE) as a set of tools and methodologies that can help guide a company to include environmental objectives into their purchasing, design, and manufacturing processes [Allenby, 1994]. The field of intervention of DFE is considered to cover the design of both products and processes. For this reason a distinction is made between 'environmentally conscious product design' and 'environmentally conscious process design' (Zhang et al., 1997).

### 2. Mapping the product life cycle

To estimate the impact of a product on the environment, a product's life cycle must be assessed. Only by taking into account all of the stages, from raw material acquisition, to the product end-of-life, can the environmental impact be estimated in its totality. The sphere of influence comprises those parts of the product life cycle that the company can influence. It is a DFE (design for the environment) tool used to mark out those parts as a first step of identifying the stages and processes which can be improved.

As shown in Figure 1, the book production process consists of acquiring raw materials (plates, fountain solution, ink and paper), storing and preprocessing those materials before the manufacturing process, output from which are the printed sheets and some solid and liquid waste. The printed sheets are the input to another manufacturing process, or to be more correct, a series of processes (postpress operations), resulting in the final product and waste paper. The area marked out with the dashed line in Figure 1 represents the sphere of influence. The case presented here did not take into account the production of raw materials and their choice, so most of the steps fall within the sphere of influence. The only stage that isn't under the company's direct control is the final product's end-of-life.



**Figure 1. Product life cycle with defined sphere of influence**

### 3. Application of inventory tools

The inventory tools, used to determine the materials and energy flow through the manufacturing process, are the flow chart and the energy balance. Figure 2 shows the flow chart of a book production process. It shows all the materials entering and exiting the manufacturing process. In addition to flow chart, the energy balance has to be made in order to assess the amount of energy going into the process, and the amount of waste energy going out of the process.

From the data collected using the inventory tools, a SLCA (streamlined life cycle analysis) matrix was derived. The matrix is shown in Table 1. The scores ranging from 0 to 4 were assigned to different categories in different life cycle stages. Zero corresponds to the least acceptable result, and 4 corresponds to the most acceptable result. Such notation was introduced in earlier work because the authors of the method believed that in the business environment it is better to set higher scores to represent better results. From the matrix presented in Table 1, it is obvious that the most critical stages are the incoming and outgoing transportation, and the chemicals used in the plate making and the printing process.

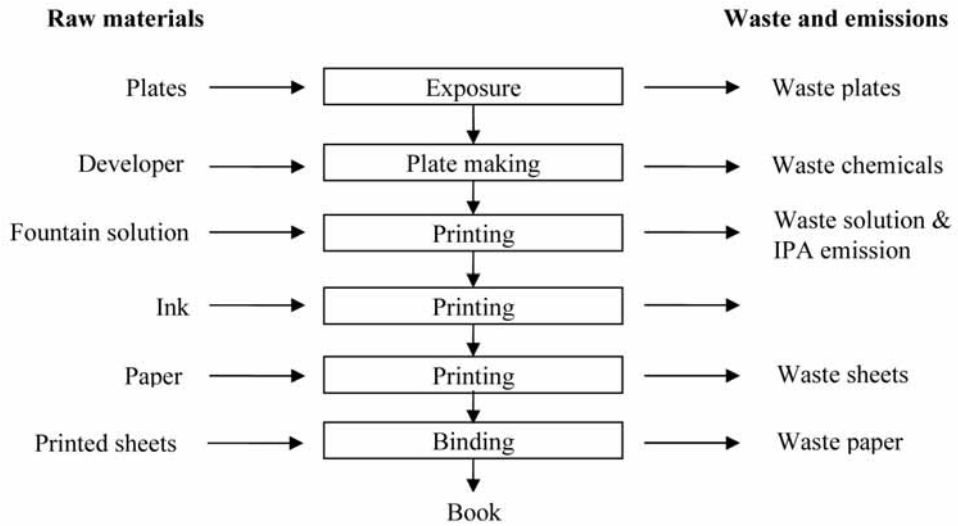


Figure 2. Flow diagram of a book production process

Table 1. SLCA matrix of a book production process

Life Cycle Stage	Environmental Stressor			
	Health Hazards	Energy Use	Waste & Emission	Total
Incoming transportation	3	2	1	6
Incoming Packaging	4	2	4	10
Plate making	3	3	0	6
Printing	3	2	1	6
Binding	3	2	2	7
Package	3	4	4	11
Transportation	3	3	1	7
Use	4	4	4	12
Totlas	26	22	17	65

The process is therefore redesigned within the current sphere of influence. The incoming transportation is not under the company's direct control. The outgoing transportation currently has no alternatives, but is possible to improve in the future if the recycling companies become available locally. The plate making process can be improved by adopting the chemistry free technology, which requires an investment, but on the other hand reduces the costs of waste disposal. The waste fountain solution from the printing process, in addition to being the major environmental problem, causes significant costs of disposal. The adoption of some of the fountain solution purification systems can both extend its life and improve the product quality. By reducing the amount of waste fountain solution, the disposal costs are also reduced.

The concept comparison matrix shown in Table 2 was used to evaluate different concepts for quality, environmental impacts and cost. Each concept was evaluated on the scale from 1 to 10, and the scores were placed in the appropriate row (concept category) and column (selected evaluation criteria). Weights were assigned to each of the three categories, quality, environment and cost. Additional weights (importance factors) were assigned to each of the evaluation criteria. Those values were used to calculate the satisfaction scores for each concept, which are a measure of how each of the concepts

compare in satisfying the three requirements of quality, environment and cost. The difference [%] is the measure of improvement between concepts and is calculated from their scores. The estimated improvements in the case presented in this paper, shown in Table 2, can be considered significant. Therefore, both process redesign concepts are considered to be worth adopting.

**Table 2. Comparison matrix**

Concept	Quality	Environment			Cost				
	Product	Waste mass	Waste hazard	Human health	Waste disposal	Raw material	Capital equipment	Satisfaction	Difference
Chemistry plate making	7	3	4	6	4	3	5	79,4	
Chemistry free plate making	7	10	10	10	10	7	8	139,4	76%
No fountain solution purification	5	6	5	7	6	6	5	89	
Fountain solution purification	7	8	5	7	8	8	7	114,2	28%
Weights	0,4	0,2			0,4				
Weight (1-10)	9	7	8	9	7	3	9		

#### 4. Conclusions

This paper illustrates how the principles of industrial ecology can be integrated into the engineering methodology using DFE tools. Appropriate DFE tools were identified for design phases and shown how they integrate into those phases. Using a tool such as sphere of influence, boundaries within which the environmental performance of products-books can be affected are defined. However, it should be noted that environmental protection cannot be achieved through an approach addressing purely technical problems, localizing to a single actor – the ‘producer’. Since it is interaction between government, manufacturers, recyclers and consumers (Sun et al., 2003) that finally determines the environmental performance of a product over its entire life cycle, the development of the issues raised must be accompanied by a complex study of the mechanisms of the entire system.

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## M-DESIGN-STRATEGIC APPROACH TOWARD BUSINESS SUCCESS

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**Abstract:** Although today all the conditions of realization of a quality mobile web site seem to be fulfilled many research and experiences shows huge disparity between best practice and common practice, with most mobile websites with poor effectiveness. The restrictions imposed by the keyboard and the screen and various other limitations deriving from mobile environment without losing usability feature, require a different approach in projecting and designing for a mobile web. The aim of this article is to give cross section of best practice elements in designing for mobile web, considering and understanding a comprehensive mobile sphere and essence. Publishing on m web and appropriate implementation of new technologies is interconnected with achievement of competitive advantage, business excellence and profit growth and integral component of a new paradigm of be present everywhere, all the time.

*Keywords: mobile web, mobile design, business success*

### 1. Introduction

Mobile phones today except of the standard functions such as calls and sms, have technical possibilities for loading and browsing web pages, various application running or playing games with complex and demanding graphic. Increasing processing speeds, better use and battery charging, cheaper and larger memory, higher resolution displays, more powerful Java programs, 3D images and animations make of mobile phone a device oriented on vast specter of communication, information, playful and business services.

Access to Internet via mobile phones is not something new, but in the past few years due to technical improvements it became much more efficient and meaningful. In addition, network speeds in mobile environment are constantly increasing, the operators of mobile telephony are offering numerous models of services use to meet customer's needs and wishes. Today, there are many mobile phones' categories, often formed by manufacturers themselves, and so is the experience of Internet contents accessed by mobile phones. It is presumed that the buyers of m- device are familiar with the technical possibilities of the product and are purchasing according to their wishes and possibilities. There is a need for coherence between technical possibilities and quality and number of services that user legitimately expects. So the question is how to effectively present and design the content on mobile web and meet user's expectations.

### 2. Mobile web as a business opportunity

The firms today must deal with extremely fast technological up growth, changes of customer's requirements and sharp competition, and all that leads to abbreviation of product lifecycle. Surviving and profit realization depends more and more on capability of fast and successful innovation, so it is essential in time designing, development and marketing of the products and services.

Internet offers speed, retrieval and multimedial advantages, it changes the way firms communicate with their clients, suppliers, employers and competitors [Bodily, Venkataraman, 2004]. The firms

invest more and more in online presentations and online marketing, and users use of internet increases constantly. More users use online technology, the higher are their expectations related to type and availability of offered services [Armistead, Kiely,2003]. Gaining competitive advantage using IT today represents a big challenge to the firms [Luftman, 1996].

Let imagine that almost all the firms today have the web site. Additional reasons to adjust their site to be appropriate for mobile phones are:

- Having a content available anytime and anywhere
- Broaden the scope of the customers, providing the content the way they prefer to see it
- Phone is the ubiquitous device that people don't leave home without
- Mobile enables immediate thought to action: when the customer sees, hears or even thinks about certain product, there is an immediate action available to them.
- Google search on Google mobile for only mobile-friendly sites: importance to be on that list when potential customer make a search

### **3. From web to m-web**

Speaking of usability of m-web, first will be considered classic desktop web site usability. Projecting and designing the web which should fulfill user's requirements must be based on 4 requisites: Navigability-existence of system of navigation that helps orientation on web and finding desired content.

Completeness of content and expected functionality – availability of informations and services that user might request, fulfillment of user's visit scope. Content adaptation for all profiles of users.

Information clarity and communication efficiency –form and quality of presenting information and content that are close and conceivable to the visitors. It is the reflection of communication strategy on graphic interface.

Graphic attractiveness – Graphic quality and visual attractiveness of web site [Visciola, 2006]

M-web navigability is extremely important requisite because of the reduced display size, and a soecific m-web structure. With redesign of web site for mobile phones it is necessary to determine goal hierarchy which can be realized with m-web, and it serves as a base for site usability testing and covering all possible needs and demands of many users' profiles.

When considering content presentation on the mobile web the first question to be asked is: Does it make sense? It is not enough to have content available via mobile web, it must be chosen and created in a way to be useful to the users with wide variety of mobile phones. In mobile context it is very important that informations are structured as simple as possible. When creating information structure of m-web the guiding-query must be: how much time will users spend to reach a specific information? It is true that third generation of mobile phones offer high retrieving speed but are still much lower than the speeds of desktop computers. Some content doesn't make sense in mobile context, so it is not recommended redesign of complete desktop to m-web, and the content that remains must adjusted for the vertical structure of m-web.

### **4. Mobile context and mobile device characteristics and limitations**

Hereafter are some cross section of important guidelines concerning basics of logical structure, navigation and content design for mobile web, given by the W3C[2] group of experts It is very important to comprehend physical characteristics and limits of mobile device and mobile environment when starting an m-web building project. The input is often difficult when compared with use of a desktop device equipped with a keyboard. Mobile devices often have only a very limited keypad, with small keys, and there is frequently no pointing device. One of the difficulties of the mobile web is that URIs are very difficult to type. Lengthy URIs and those that contain a lot of punctuation are particularly difficult to type correctly.

Because of the limitations of screen and input, forms are hard to fill in. This is because navigation between fields may not occur in the expected order and because of the difficulty in typing into the fields. Many modern devices provide back buttons, some do not, and in some cases, where back

functionality exists, users may not know how to invoke it. This means that it is often very hard to recover from errors, broken links and so on.

Mobile networks can be slow compared with fixed data connections and often have a measurably higher latency. This can lead to long retrieval times, especially for lengthy content and for content that requires a lot of navigation between pages. Mobile data transfer often costs money. The fact that mobile devices frequently support only limited types of content means that a user may follow a link and retrieve information that is unusable on their device. Even if the content type can be interpreted by their device there is often an issue with the experience not being satisfactory - for example, larger images may only be viewable in small pieces and require considerable scrolling.

Web pages can contain content that the user has not specifically requested - especially advertising and large images. In the mobile world this extra material contributes to poor usability and may add considerably to the cost of the retrieval. Mobile devices typically have quite limited processing power which means that page rendering may take a noticeable time to complete. As well as introducing a noticeable delay, such processing uses more power as does communication with the server. Many devices have limited memory available for pages and images, and exceeding their memory limitations results in incomplete display and can cause other problems. In the mobile context it is especially important to structure information as simply as possible. Placing the right information in the right place is an important part of providing a usable experience; getting it wrong means providing a poor experience.

## **5. Understanding user perspective, interests and goals**

Traditional website customers are most likely sitting at a desk facing a large monitor that has a decent resolution. Visitors who are browsing the mobile website are unlikely to be in the same circumstances. They may be waiting in line, riding on the train or bus, running to the departure gate or lost in an unfamiliar town late at night and trying to get somewhere.

Mobile web users usually have different interests to users of desktop devices. It is likely that they have more immediate and goal-directed intentions than desktop web users. Their intentions are often to find out specific pieces of information that are relevant to their context. Equally, mobile users are typically less interested in lengthy documents or in browsing. The ergonomics of the device are frequently unsuitable for reading lengthy documents, and users will often only access such information from mobile devices as a last resort, because more convenient access is not available.

Mobile browsers often do not support scripting or plug-ins, which means that the range of content that they support is limited. In many cases the user has no choice of browser and upgrading it is not possible. The widely varying characteristics of mobile devices can make it difficult for a web site to provide an acceptable user experience across a significant range of devices. For example different devices support different markup features and different screen sizes may demand different sized images. Consequently, it is very common when delivering content to mobile devices to vary the details of the markup, format of images, image sizes, color depths and so on to suit the characteristics of the device in question. Providing variations on the user experience that are appropriate in different cases requires the content provider to know a significant amount about the characteristics of the device, the properties of the browser in use and the transparency of the network connection to the device. For simple sites that present an interface which is similar across a broad range of contexts the need for such information is diminished when compared with a sophisticated site that has an optimized navigation structure, presents different size images or carries out other adaptations to suit the particular delivery context.

## **6. M - design around users**

“Design with the mobile in mind instead of just taking your Internet site and making it mobile.”

“Mobile web sites aren’t just repackaging and reformatting - it’s rethinking what the mobile user wants and needs and distilling that down to an essential few things.”

“Great mobile sites tend to be custom built by specialists. Aesthetics are just as important on the small screen as the desktop web. Unfortunately, a lot of big brand mobile sites are still built to templates.

Don't forget the basics of marketing just because it's a new medium.”[The Best& Worst of the Mobile Web, 2008]

User-centered design is a smart way to approach interaction design. Understanding the needs of users helps humanize the process and keeps your project in check with their goals. Users know best and will cast their vote by giving their attention to the site or not. A user-centered design approach fits especially well with mobile. There is a need of thinking about how and where people will interact with the content or application and what content would they want to get through a mobile device? Thinking about how someone interacts with a mobile device and the context around that provides the best first step in creating an effective mobile experience.

Knowing the audience is an important principle in developing a mobile strategy. It is important to understand what the audience is looking for to anticipate how they will want to navigate the site, and so provide them with quick and efficient navigation. The basic navigation should be provided, which should be placed on the top of the page. Any other secondary navigational element may be placed at the bottom of the page if really needed.

It is important the users should be able to see page content once the page has loaded without scrolling. The basic links should be on a single line. Design of a mobile site must grant reaching of frequently accessed information with a minimum number of page retrievals. Navigation to less frequently accessed information may take more retrieval as a result. A guideline is that users become frustrated if it takes more than four retrievals to reach their objective [1]. Whether this can be achieved depends on the nature of the site and, in particular, how items in menus group together to provide understandable themes. Users in a mobile context are often looking for specific pieces of information, rather than browsing. Content providers should consider the likely context of use of information and, while providing the option to access all information, should offer appropriate information first.

The general prescription to use clear language is of particular importance for mobile delivery, where brevity and directness are generally more desirable than a discursive style. Placing distinguishing information at the beginning of headings, paragraphs, lists, etc. can also help the user contextualize when using devices with limited screen area.

Mobile users often pay for bandwidth, so offering them content that is extraneous to their needs, especially advertising, costs them time and money and contributes to an unsatisfactory experience. In general, the user's consent should be sought before initiating the download of content. If pages are too big they may take an unduly long time to load. In addition, mobile devices typically have restrictions on the largest page they can accommodate. On the other hand, if pages are too short then the user will be required to make multiple requests to read the relevant information. This can lead to an unnecessary delay, since each request typically takes a measurable time to complete.

The balance between pagination and scrolling is partly a matter of taste and partly a matter of necessity. Devices with severe memory restrictions can only have small pages delivered to them. Equally some devices offer a poor scrolling experience and a better page retrieval experience. The popular mechanism of using a 1 pixel graphic for absolute positioning does not work on a variety of screens [1].

Graphics shouldn't be larger than necessary, for example by having a higher resolution than is displayable on the device or by having too many colors. Mobile devices often do not have good color contrast and are often used in non-ideal lighting conditions. Hence information highlighted in color may not be visible to users. If color is used to indicate a feature then that feature should generally also be indicated in a way that is not color dependent. In particular, do not use blue or purple text, as this may be confused with hyperlinks, especially on devices that do not underline links. Before using background images, there is a need to consider objectives for doing so and then eventually use alternative techniques to achieve similar objectives. Yet, if using a background image, the content should be readable with and without the background image for devices that do not support them.

A descriptive title for the page is needed to provide to allow easy identification. Many mobile browsers do not display the title of a page. Where the title is displayed the available space may be limited. The device may use the page title as the default label for bookmarks. Again, space may be limited, so it is better to be used to help identify the content and not for other purposes.

Mobile devices often have few fonts and limited support for font sizes and effects (bold, italic etc.) As a result of this, the use of font size, face or effect, for example to highlight an answer or a stressed

word, may not achieve the desired effect. Given the typical input limitations of a mobile device, the interface must as far as possible minimize user input. Where possible, use selection lists, radio buttons and other controls that do not require typing.

The best choice for obtaining a solid foundation for a usable mobile website is to incorporate clean and semantic markup. Clean markup will help ensure that the browser is capable of properly displaying the website, and it will help give visitors a pleasant experience, with no unnecessary difficulties.

And on the end, among many of advices that the experts offered on [The Best& Worst of the Mobile Web, 2008] the followed are chosen

- Use the common mobile naming conventions and make sure they all re-direct to your mobile site.
- Make sure that a desktop web site detects mobile visitors and redirects to the mobile site. Also add a link to your mobile site on your PC site and vice versa.
- Make sure your mobile site is picked up by all the main search engines.
- If you want your site to serve every user, you need to be able to detect the device they're using and serve up the right content for it. Don't build a site for a minority audience – because most people don't have an iPhone.

### **6.1. Designer's perspective and trends**

Because mobile technology is always changing, screen sizes are changing, too. Fortunately for designers, modern mobile devices typically have bigger screens and higher resolutions than those of a few years ago, but of course those older phones are still in use. The results of some of the recent studies in and [3] [4] shows that 240 x 320 should be the standard for mobile development. With the rise in popularity of the iPhone and its competitors, the most recent numbers most likely favor larger screens even more. Like any other technology, rapid change is a constant. Of course, web designers need to stay on top of the industry in general, and the mobile web is no different. As technology and trends continue to change, the mobile web will evolve accordingly. The challenge of change isn't really anything new to designers; the mobile web just presents another area in which designers need to stay up to date

The design of usable mobile applications is not trivial. The environmental constraints of mobile devices, such as limited processing power and memory, affect not only the functional aspects of these devices but also the user interface. Mobile applications must be carefully designed to account for the limitations of their size, lower processing power and low bandwidth [Uden, 2007]. Web designers know that the industry involves plenty of change, and continuous adaption and development of skills is required in order to stay up to date. In the past few years, one of the biggest areas of change has been the amount of Internet users who are accessing websites via phones and mobile devices. As a result, it is very important for web designers to be educated in this area and ready to design websites that accommodate this audience.

## **7. Conclusion**

New services offered on different media and reachable via various devices are continuously transforming our lives. With decreasing costs of these services, more and more consumers will acquire devices that connect, entertain and inform them wherever and whenever. Today, in hypercompetitive era, for firms to survive and make profit is necessary to be quality driven. That means the firms should tend to fulfill customer's wishes and requirements, implement new technologies, provide all the content and services to be available in appropriate form in all possible devices. The mobile web is reaching critical mass and after years of anticipation, all the pieces are finally falling into place. There is no objective reason for not having a web site specialized for mobile users and close the eye on that new communication sphere. Following the guidelines and advices of mobile design experts, the firms should offer quality content and services considering and always having in mind mobile context and the essence of mobility. Differentiation in content design and delivery, for different customer's profiles on different devices seems to be the key for firms to prosper today and in the future.

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## THE STEGANOGRAPHY OF THE TYPOGRAPHY IN THE DIGITAL PRINTING TECHNOLOGY

T. Koren, I. Žiljak Stanimirović, A. E. Politis and M. Barišić

*Keywords: steganography, CMYKIR, near infrared*

**Abstract:** The steganography is the art and science of hiding the information. In this work the informations are being hidden in a form of text or a typography applied by using the printing colors. Graphics visible to a human eye contains the hidden typography, visible only in the near-infrared part of the spectrum. Steganography is achieved by using the values of the colors specially evaluated and adjusted for each printing technique separately. The steganography achieved by a determined printing technology is not possible to produce by any other technology, due to a different colors' reproduction.

### 1. Double separation

This paper is on experimenting with hidden typography as vector defined elements in the digital printing environment. Color settings for digital printing were used so as to make it possible to see double information in the prints, i.e. in my published paper. One image is visible to the human eye (VL graphics); the other is visible by using infrared light (IR graphics). Several randomly chosen process colors were used, separated in different ways. Two manners of separation are used for the same color tone in RGB, i.e. transformation into the CMYK system. Those two colors are not seen as different by the human eye, but when applying an infrared camera, a completely hidden typography appears on the graphic; one that is visible to the human eye.

Steganography could have a wide area of application in typography; from protection of diplomas, securities, bank notes, packaging material for medicaments, to securing designer clothes. This manner of hiding information is applicable on all surfaces where prints can be made with the help of known to date printing technologies. With the advancement of manners and methods of counterfeiting, typography in vector definitions with double appearance is the ideal security method because it is impossible to copy. All traces of integrated information are lost after scanning because there is transition from the CMYK to the RGB system. If efforts are made to make a reprint, only the text graphic will be the result - the one visible to the human eye at the beginning, whereas the hidden information will be lost in the process. Even if the content of the hidden information is known, it is not possible to implement the colors into the initial graphic without knowing the technology of preparing process colors for the specter infrared area, and to produce the same IR graphic. Furthermore, it is necessary to carry out extensive color research work in the printing technology environment, as well as of the utility on which the printing will be done. And finally, it is essential to have top knowledge in the segment of control programming with light absorption characteristics in the contiguous infrared area. The technology called INFRAREDESIGN, i.e. "Infrared printing with process colors" was patented and is owned by scientists coming from Croatia [V. Žiljak & al 2008]. It is a unique invention, an innovation that has not been discovered by anyone else anywhere in the world. Due to its brilliant characteristics this innovation has won over 20 gold medals, special awards and awards as best innovations at exhibitions all over the world.

Depending on the printing technology it is possible to use the double CMYKIR separation [V. Žiljak 2009] or printing with two physically different colors [T. Koren 2010], that appear to be the same when viewed by the human eye, for instance, by using spot dyes or dyes produced by certain dye producers (pantone). In case when spot or pantone dyes are used, it is necessary to do more experimenting during the actual printing process in order to achieve full steganography. It is very difficult to achieve steganography in one-tone coloring. Therefore, thin lines or graphics are used that contain white area as well. Steganography carried out in this manner is far more difficult for human eye detection when trying to recognize hidden elements. By introducing multi-colors, the human eye observes multi-coloring and it is impossible for it to recognize the hidden information in daylight with the bare eye. When all initial conditions for achieving hidden steganography in the role of hidden typography are met, some problems may still arise during the printing process.

The case may be with digital printing, for instance, where color setting has been carried out manually, that after a large number of printed pages there may be a difference between the printed matter and what we observe on the monitor. Certain discrepancies appear in respect to some colors and print technologies. The discrepancies may depend on the situation whether the prints had been made on one or the other paper sides, whether the print had been made in the paper center or corners. Other factors may influence discrepancies, such as the printing drum condition, the condition of the developer and a whole number of other details, such as the paper type (dull, shiny, canvas, silk), and process colors (UV process colors, dyes, digital printing dyes, dry inks, inkjet printing). Because of these details it is necessary to create several color settings for one and the same facility, for instance, with a new developer and a “wasted” developer so as to apply the most adequate color settings, depending on the facility condition [V. Žiljak 2010].

## **2. Rules for color settings for CMYKIR separation.**

Trial digitally printed prints have been made in order to create color settings for top quality steganography, all in accordance with color setting development instructions; a full tone of each CMYK component, followed by all combinations of CMY tones, also in full tone. It is necessary to print each of the CMYK components with coverage percentage amounting to a range from 2% to 90% (2, 4, 6, 8, 10, 20, 30, etc.). Print measurements were made several times. Mean measurement values were then put through regression analysis, i.e. unifying of data. Such data was then included in the necessary places when making new color settings. When observing within certain color settings, each color has many different possibilities of transition from the RGB into the CMYK system. Firstly, for the same color values in the RGB system there are characteristic CMY values for K with zero value (K0). Secondly, decreasing CMY components until one of the components comes down to zero value. This condition is called Kmax. Thirdly, all other combinations of CMY components in the range from K0 to Kmax for the same color tone in RGB will be the same to the human eye. The color that is in transition from the RGB system into the CMYK0 system (the K component equals to zero) will not be visible in the infrared specter part. These are the second and the third initial points of CMYKIR separation based on the 5 principles of CMYKIR separation [Pap, 2010].

Only after this will the graphic programming begin, i.e. typography steganography within a certain graphic element in such a way that the graphic visible to the human eye will not be visible in the infrared specter part, and that the steganographic typography is visible only in the near infrared specter area above 800 nm. The examples below will show the achieved typography steganography, the reason why such steganography is impossible to counterfeit, and what becomes of the information if the wrong color settings are used for the same color tone in the RGB system.

## **3. Experimental work results**

All experiments described in this paper have been printed digitally. The reflex and light absorption measured with an infrared camera, photographic camera or scanner with infrared filter will show the real situation, i.e. what is actually visible in that specter part (1000 nm). The first example shows thin curves between which the hidden typography is found. Two different colors in respect to CMYK

separation were used (for the same RGB value), and white – applicable also to the use of spot dyes. We have used digital printing process colors for the steganography because it is not possible to create (buy) two spot colors with identical characteristics in the visual area that have different characteristics in NIR wavelengths.

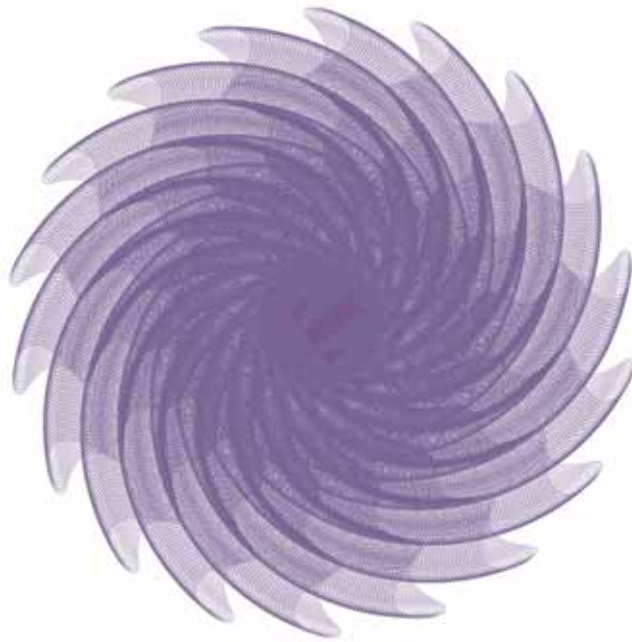


**Slika 1. Proposal for typography steganography in security graphics**

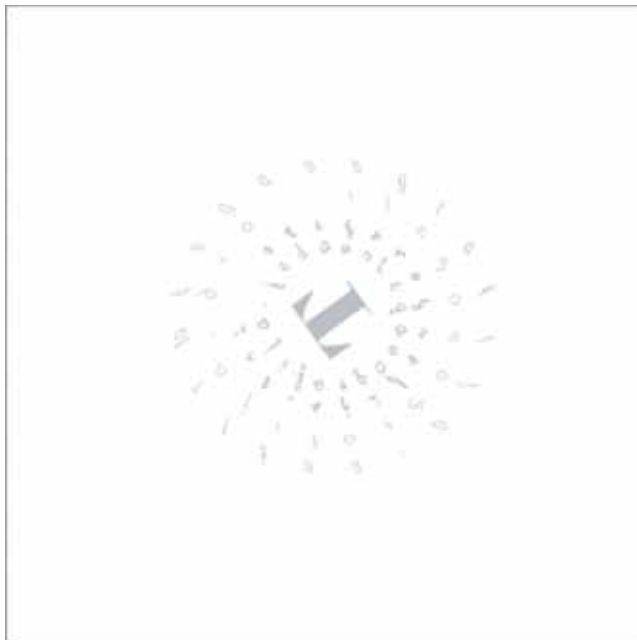


**Slika 1a. Simulation of visible typography in the NIR specter part**

The example, i.e. Image number 2 shows an even more complex graphic where the thin lines and curves attract the attention of the human eye. The steganographic typography is in six different fonts. Thus it is even more difficult for the hidden information to be recognized by the human eye. Due to the graphic’s complexity, it is practically impossible to counterfeit it. The fonts used for printout have been especially created for experiments in this report. They are not found among system fonts and they are not commercially available. Bitmapping of letter characters was initiated from the graphic defined by vectors. By copying and scanning (of pixel graphics) lines and character structures would be destroyed, gaining thus transition colors that will not provide adequate hiding for the two sources of information. The security provided by such graphics is by far greater than many of the known graphic securities in the market today.

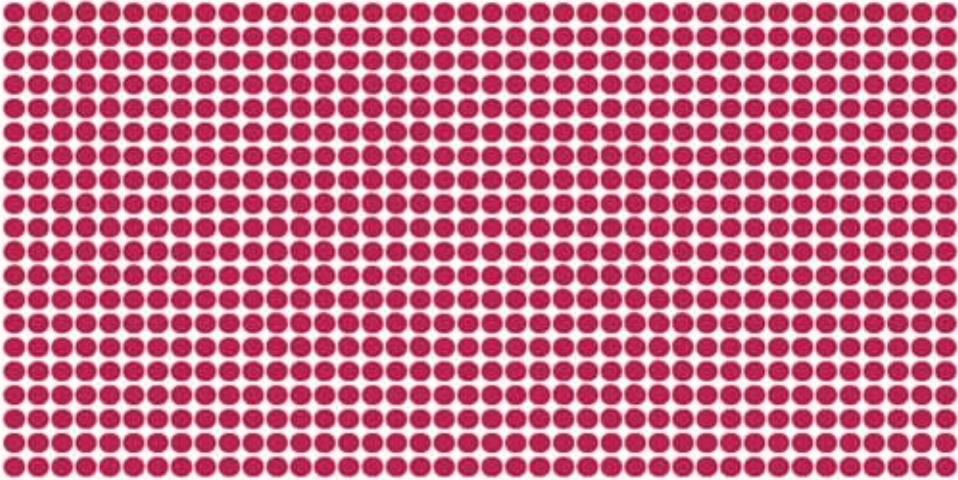


**Slika 2. Steganography in network graphics**



**Slika 2a. Simulation of Image 2 in the NIR specter part**

Picture number 3 shows a graphic that is very difficult if viewed by the human eye. Graphics are known which at first sight give one impression, but show a completely different picture if viewed for a longer period of time. This graphic shows many dots, but there is hidden typography between them, i.e. numbers. But even the dots themselves were created by using random numbers, and therefore their coloring is not the same in the CMYKIR method sense. However, it is always the same in respect to the color tone in the RGB system. This is the development of individualized steganographic typography and it depends on the information for starting and maintaining the congruent method of pseudo-random sequences.



**Slika 3. Typography hidden in dots**



**Slika 3a. Simulation of Image 3 in the ic specter part**

## 4. Conclusion

Hiding typography in the CMYKIR separation of vector graphics is a contribution to steganographic solutions carried out with digital printing. The characteristics are merged of programmed full control as to the participation of colors on one side, and characteristics of individualized typography choice on the other side. The paper shows the way towards possible applications in carrying out double typography; double information in the print.

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## THE POPULARITY OF BLACK-AND-WHITE PHOTOGRAPHY IN THE WORLD OF DIGITAL PHOTOGRAPHY

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*Keywords: photography, digital, black-and-white, colour, technique*

### 1. Introduction

There are two basic photography techniques, black-and-white and colour technique. The black-and-white technique was the first one discovered, followed by the colour technique some 40 years later – the first permanent black-and-white photo was taken in 1826, and the first colour one in 1861 (Greenspun, 2007). Nowadays, digital photography makes it easy to use both techniques – all digital cameras take colour photos, while some offer the black-and-white option, and even if they don't, it is very easy to later change a colour picture into a black-and-white one on a computer. With analogue photography, this is not easy to do because of black-and-white and colour film rolls, and before placing the roll in the camera one has to choose the shooting technique, as it is not possible to change it later. As far as developing film goes, black-and-white films are more easily developed, and many photo-enthusiasts have done it at home in their own darkrooms. As far as studio developing goes, the development of colour film was more expensive than black-and-white development. All of this contributed to making black-and-white photography quite popular for a long time, until colour photography was rendered simpler, cheaper and more accessible in the second half of the 20th century, when colour photographs began to emerge in family albums.

The question this paper asks is directed towards the problem of black-and-white photography in today's digital age. It is apparent that black-and-white photography is seldom used, and the main question is why it is so – is the technique obsolete; was it used before only because it was simpler; do people think that black-and-white photography is only meant for artistically oriented people? Do they even ask themselves – black-and-white or colour? Do they think it is all the same, as long as you can see what is in the picture? What do they think of black-and-white photography?

From an artistic point of view, there does indeed exist a widespread opinion that black-and-white photography is more artistic. As soon as someone sees such a photo, they think: "This one is artistic..". And black-and-white photography does hold a more artistic value in photographers' and artists' circles. The question we ask is why is it so, is there any truth behind the statement?

The basic questions posed in this paper related to the subject of popularity of black-and-white photography are the following:

1. Why is black-and-white photography much less used today than colour photography?
2. What are people's tastes in photography, do they prefer black-and-white or colour photography?
3. Why is black-and-white photography considered more artistic?

### 2. Literature overview

An overview of photography-related literature has allowed us to establish that even in the case of famous photographers, most of whom have published at least one book, there are different opinions

on black-and-white and colour techniques; some prefer black-and-white, some colour, and some like both equally, depending on the situation they are shooting: “Black and white are the colours of photography.” (Frank, 1961). Edward Weston words: “The prejudice many photographers have against colour photography comes from not thinking of colour as form. You can say things with colour that can’t be said in black and white... Those who say that colour will eventually replace black and white are talking nonsense. The two do not compete with each other. They are different means to different ends. (Bryn, 1978). Paul Outerbridge (1896 – 1958), an American photographer known for early use and experimenting with colour photography, said: “One very important difference between colour and monochromatic photography is this: in black and white you suggest; in colour you state. Much can be implied by suggestion, but statement demands certainty... absolute certainty.” (Scully, 1976)

There are countless books which could serve as references in this paper. With the development of digital photography and its globalization, numerous editions of guidebooks, instructions, consultancy books, etc. continue to appear. Virtually every better known photographer has published a book on photography, and each of these books contains at least a paragraph dedicated to thoughts on black-and-white photography.

### 3. Hypothesis

There exists a widespread opinion that people who are more into photography, who don’t just take pictures in order to record an event permanently, but because they love photography, who are more knowledgeable about it, more artistically oriented – that they also possess a greater sense of black-and-white photography, and that is why they use it more often than those people for whom it does not represent any great value.

It therefore follows that those who have the eye and the sense for photography, those who are privy to its values and possibilities, can best use it in order to gain the best results in certain situations, as opposed to those who do not possess that sense for art and photography. The former make good use of it, but such aficionados are rare compared to the rest, who only find a use for colour photography. That is why it seems that black-and-white photography is less used than colour photography. It is true, when viewed from the perspective of the whole society, but from the perspective of that small segment of society that takes photography more seriously, the ratio of black-and-white versus colour photography is much smaller, if not equal.

As far as taste in black-and-white or colour photography is concerned, it differs from person to person; some prefer black-and-white, some colour pictures, and to some it is all the same, so all in all, the results would be more or less equal.

We think that black-and-white photography is considered more artistic due to some kind of psychological effect, primarily because it was the first to be discovered, and also because it offers a different picture of the world than the one we are used to seeing with our own eyes. Then again, from a historical point of view, photography was considered an art long before the advent of colour photography, so that might also provide some answers to our query.

### 4. Methodology

In the first part of the survey the respondents are divided according to age, sex, and photographic interest. Then their taste in black-and-white and colour photography is surveyed, in two ways: via direct questions, as well as with the help of examples that the respondents have to rate, consisting of same photographs shown in black-and-white and colour technique. In that way, the same question is answered in two different manners, thereby becoming more accurate and precise. The examples are followed by direct questions regarding the popularity of black-and-white photography, why it is so rarely present today, and why it is considered more artistic.

## **5. Research**

### **5.1. Respondents**

#### *5.1.1. Age and sex of respondents*

Research was conducted primarily among the younger part of population, with both sexes equally represented (male 51%, female 49%), ages 18-29. 131 participants responded to the survey.

#### *5.1.2. Interest of the respondents in art*

Respondents mostly possess a developed sense of art and enjoy it. Female respondents are more interested in art than male respondents, since three times as many female respondents gave maximum votes to their love of art. Also, none of the female respondents rated their feelings with a ‘ I’m not interested in photography at all’, while four male respondents did.

#### *5.1.3. Interest of the respondents in photography*

Nearly half the respondents feel a slightly bigger interest in photography, but have never ventured deeper into that sphere of art. Despite expectations that most people would describe their interest in photography in light of taking pictures and watching them on Facebook, in newspapers, etc., many respondents rated their interest in photography with a ‘ I’m interested in it as a hobby’ and ‘ I’m very interested in it and everything related to it’, that is, photography interests them more as a hobby, or even more than that. This all proves that photography is still popular today and that to most people it doesn’t just represent a focusing of the lens and pressing of the shutter button, but something more, which is understandable, since photography is an art form that has the possibility to permanently stop time, events, feelings, which is what man has always wanted to do.

#### *5.1.4. Respondents’ pursuit of photography*

Out of all the respondents, the majority (58) pursue photography doing what is normal today, carrying their small cameras around with them and taking pictures of family gatherings, travels, events, celebrations, etc., while a staggering 31 respondents pursue photography because of their love for it.

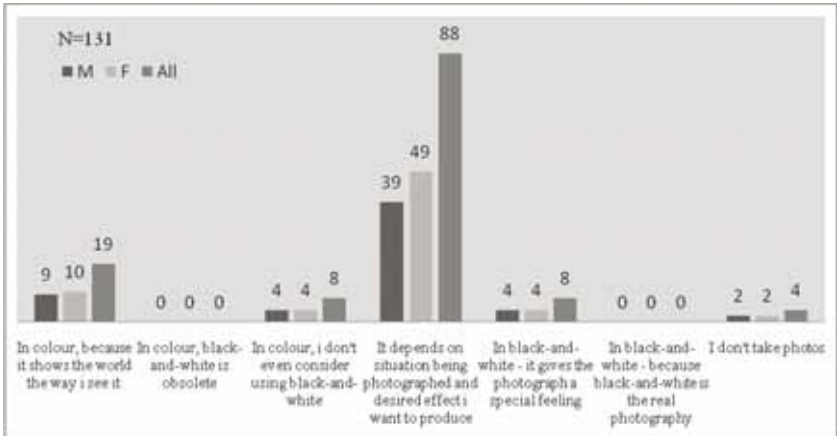
#### *5.1.5. Respondents’ knowledgeability about photography*

Nearly 65% of the respondents know the basics of photography and exposition – in other words, a bit more than just pressing the shutter release button. It is interesting to note that none of the 131 respondents dared say that they know absolutely everything there is to know about photography. This only goes to show that photography is a very wide area, although it was discovered not two centuries ago, and that people have respect for it, know its value and importance, so they dare not claim they know everything about it.

### **5.2. Black-and-white technique**

#### **5.2.1. Black-and-white or colour**

When asked which technique they prefer for taking photographs, 27 (20%) respondents answered colour, and 8 (6%) chose black-and-white technique. A staggering 88 (67%) answered that the choice depends on the situation being photographed and on the desired effect. It is interesting to note that none of the respondents consider black-and-white photography obsolete. This shows that black-and-white photography is still very much popular today, although it appears much less frequently than colour photography.

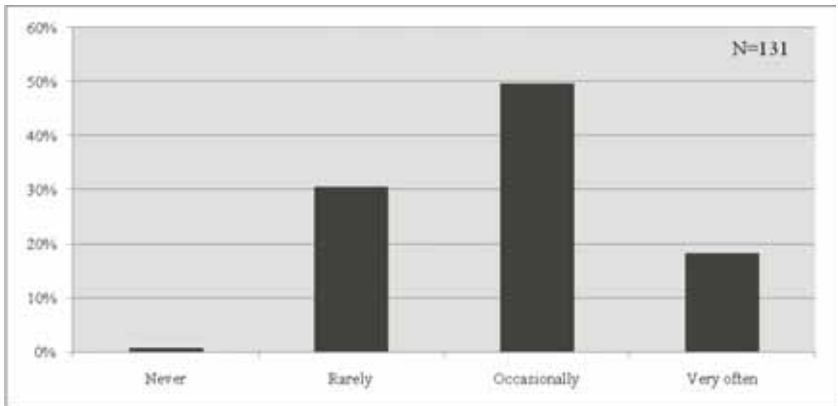


**Figure 1. Black-and-white or colour – photographing**

When asked which type of photography they generally prefer, a whopping 83% answered that they like good photographs, regardless of whether they are black-and-white or colour. This proves the claim that black-and-white and colour are only two photography techniques, and the choice depends on the artist himself/herself, and there is no law saying which technique is better or more beautiful.

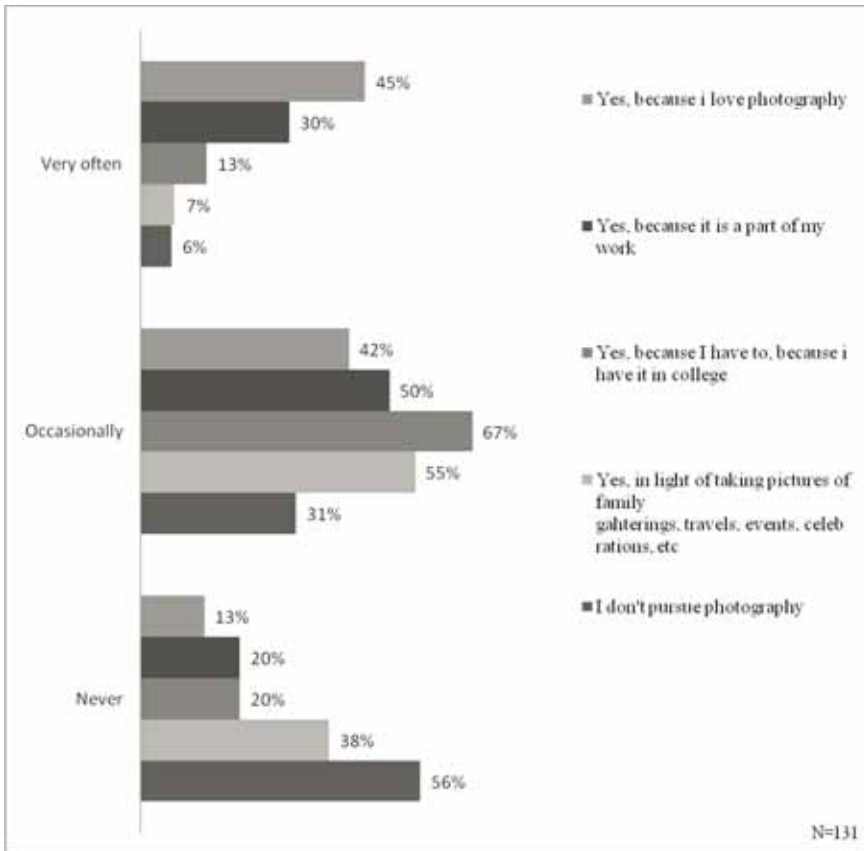
*5.2.2. The frequency of black-and-white photography*

When asked how often they run into black-and-white photographs, how often they see them in newspapers, magazines, on the Internet, or anywhere they go, 50% answered that they run into them occasionally, 30% rarely, and 18% run into them very frequently. Only one respondent claimed to never come across black-and-white photos, as shown in Figure 2.



**Figure 2. Frequency of black-and-white photography**

If answers to the same question are divided according to the respondents and their pursuit of photography, as is shown in Figure 3, it is clearly visible that those who pursue photography because they love it, or for work purposes, also come across it more often, while on the other side, those who do not pursue photography at all, come across it much less frequently.



**Figure 3. Coming across black-and-white photography (according to pursuit of photography)**

### 5.2.3. Photography ratings

The following infographic shows all the photographs offered in the survey, which had to be rated according to their general mood. We must stress that these photos were taken by known art photographers, and they are originally colour photos, which means that the photographers shot and published them in colour. They have been rendered in black-and-white for the purposes of this research in order to elicit people's thoughts on which technique would suit the particular photo better, whether they would agree with the original photographer or whether they might think differently. The photos are classified in size and order according to the points (ratings) they received.

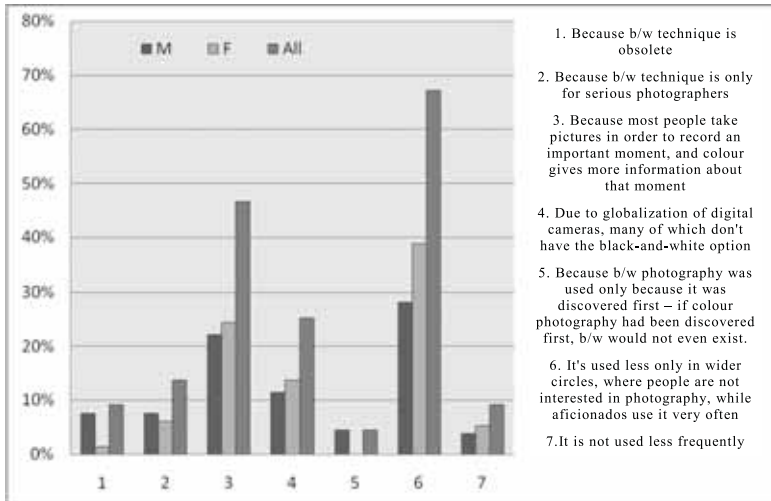
The largest photo has therefore received the highest ratings, and the smallest one the lowest ratings. This shows which photo is the best in the respondents' opinion, and which is the worst. It also shows clearly that colour photographs received higher ratings than the black-and-white ones. We can therefore conclude that the photographers knew well what they wanted to achieve with their photos, and, beside the chosen exposition, shooting angle, composition and other important points defining a photograph, they also chose their technique well.



**Figure 4. Photography ratings**

*5.2.4. Why is the black-and-white technique less frequently used?*

As expected, 70% of respondents answered that black-and-white photography is less used only in wider circles of photography, by people who are not so much into photography, while aficionados use it very often. 46% of answers point to the fact that the reason behind the less frequent use of black-and-white photography is that most people take pictures only to record an event that is important to them, and colour gives them more information about the event. This corroborates previous answers, which claim that black-and-white photography is less used only by wider circles, because people in these circles indeed take pictures only of events that are important to them, and colour does indeed suit them better in that case because it gives them more information about what that event looked like in reality (Figure 5.).



**Figure 5. Reasons behind less frequent use of black-and-white photography**

The third reason, accounting for 25% of the answers, is that the globalization of digital photography is to blame for less use of black-and-white photography, since many digital cameras do not even have the option of shooting black-and-white pictures. This also only corroborates the first answer, since it, too, refers to a wider circle of camera users, while those who are more into photography either have a camera with that option, or use a computer program to change colour photography into black-and-white.

5.2.5. *Why is black-and-white technique considered more artistic?*

Three of the most common answers to this question were the following: because it shows the world differently than man sees it, and because it lends itself to a more artistic result, while the third answer posited that both techniques could be equally artistic (Figure 6).

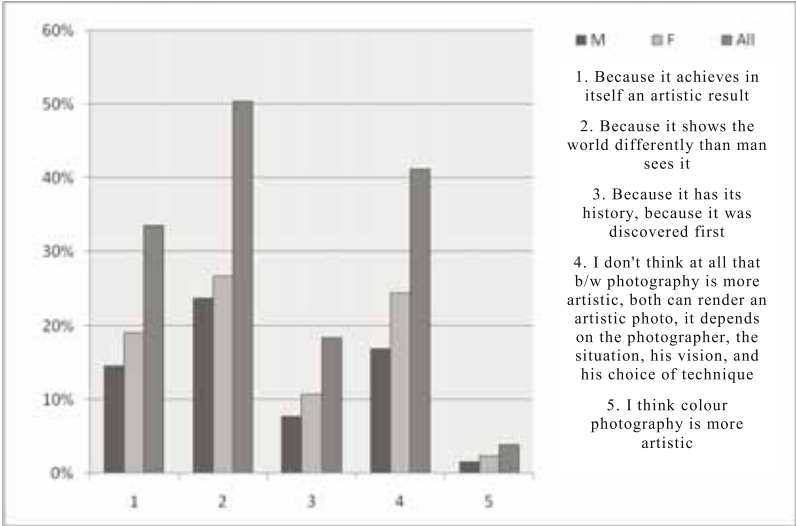


Figure 6. Why is black-and-white photography more artistic

6. Discussion

The results gleaned from the survey were mostly expected, although some represented pleasant surprises in terms of the popularity of photography in the world. Only 9 out of 131 respondents are not interested in photography beyond a mere snapping of a shot, while all the rest feel there is more to it than that. This proves that photography is a very popular art form, probably because it is accessible to everyone and has the potential to satisfy everyone who gets into it. From this, as well as from answers given to the question, “How much are you into photography?“, to which only 16 out of 131 respondents answered with a negative, we conclude that today photography is the most popular and most used branch of art, although much discussion could be made about whether it represents art in everyone’s hands. It cannot be called the most popular technology because only a look at mobile phones would disprove us. It suffices to say, though, that photography is very popular in today’s world. As far as black-and-white photography and its popularity are concerned, the results of the survey show that the majority of respondents don’t care if the photograph is black-and-white or colour, as long as it is good. 67% answered that they use either technique depending on the situation and the effect they wish to produce, and that is the most important conclusion gleaned from this survey. It says that black-and-white and colour photography are only means, instruments, different styles, with each giving a

special sound or feeling. The answers received to the question about why black-and-white technique is less used only corroborate the above mentioned conclusions, because these answers lead to the conclusion that black-and-white photography is less used in wider circles of camera users, by those who do not experiment with photography, while a narrower circle of professional photographers and aficionados use this technique very often.

## 7. Conclusion

The three most common reasons given as answer to the question why black-and-white photography is considered more artistic are the following: because it shows the world differently than man sees it, and because it lends itself to a more artistic result, while the third answer posited that both techniques could be equally artistic. This opens up a new topic, one which could be much discussed. As we have already concluded, each technique is special, each possesses characteristics which make it unique, and each is artistic in its own way. This question was only meant as a test to show how many people would answer that black-and-white is not more artistic, that both techniques are artistic in their own way. And a little over 40% of respondents did just that.

This paper has proved, that black-and-white photography was not merely a transitional process towards colour photography, since it was discovered first. It proved that black-and-white photography has something special in it which fascinates human eyes, which makes it unique and extremely popular, even in today's age of global digital photography.

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## USES OF RESOURCE LINKS FOR METADATA FLOW IN AUTOMATIC WORKFLOW

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*Keywords: Automate, JDF, Node, Resource link, Workflow*

### 1. Introduction

The workflow of printing production is integrated from a variety of inhomogeneous systems. Non-uniform implementation of IT solutions is reflected in different production resources that are sometimes rather old-fashioned, as opposed to the management (MIS), which finds its foundation in a new generation of control systems. During creation of graphic products, the information about a given product has the function of linking systems and manufacturing resources in a homogeneous structure. The function of JDF protocols as a unique communication standard is to connect the prepress department to all further stages of work. Exchange of administrative and technical information on a given product is of crucial importance for the overall implementation of graphic product. Further development of printing is directed towards networking, i.e. distribution of information over the Internet, local intranet or telelinks. The code files for such information flow should be uniformed and as such represent the standard for further development and the creation of repositories, the main storage of all data on the product and associated workflows. JDF as a holder of integration has its base in the XML (Extensible Markup Language) markup language and as such is ready for further distribution to all aspects of publishing and multimedia.

Architecture of production workflows depends on the installed capacity, but also on the ability of production management and the manner in which the remote control of work processes and the necessary adjustment of work orders within the production are implemented. XML and its file structure provide the communication of different applications with a database (repository) and become a reality in graphic reproduction. Logical codes and structures of communication systems are created .

The World CIP4 Consortium (CIP4 brings together vendors, consultants, and end-users in the print communications, graphic arts industry, and associated sectors, covering a variety of equipment, software, peripherals, and processes. Members participate in focused working groups to define the Job Definition Format (JDF), PrintTalk, and other standards relevant to process automation; to study user requirements; to test product interoperability; and to develop a range of JDF software development tools. Information on CIP4, including membership details, is available from the organization's website: [www.cip4.org](http://www.cip4.org).) was founded with the intention of co-ordination of all production processes (prepress-press-postpress) into a unified whole, and certain processes that are reflected in management tools for production. Any previous individual effort was a failure because it was not measurable as a standard on which the entire graphic production would rely on. The main common goal was to arrange the current situation and to create a prerequisite for the introduction of a new unique code format that could integrate a complete graphic production, by integrating and managing work processes.

## **2. Strategy of implementing JDF protocol**

Managing work processes takes a significant place in the business of printing industry due to increased business volume and aspirations of increasing automation of production. MIS as a major creator of processing the required documentation, begins the working processes with general information about the client and the given product in a single technical document that is filed in a central repository. The JDF workflow provides automation of networking and exchanges work assignments within the printing office, as well as all the links that rely on work assignments in the form of outsourcing. Sequence of information takes place in both directions so that all participating in the execution processes would be familiar with the prospective subsequent changes.

A typical work assignment starts in the department of graphic preparation which prepares the worksheet according to the client's request, taking into account the installed capacity and capabilities of the printing office. Despite the increasing implementation of information technology in the graphic production, some documentation has not yet been digitized. The former file allowed presetting of colouring zone on the printing press, and it was presented in the form of PPF files (Print Production Format), i.e. CIP3 protocol (In an international cooperation well-known manufactures from prepress, press and postpress areas formed the CIP3 group. CIP3 stands for International Cooperation for Integration of Prepress, Press, and Postpress).

JDF is actually the program that acts between applications and network, i.e. given specifications within the printing industry. The list of tasks is set up for changing the administrative phase (information about the client) and job execution phase, in which tasks are developed by work nodes in the pyramidal and hierarchical form. In addition to the printing office, the working list is a document for the client where all specifications of a product, as well as flowchart of actions, are listed. From the list of tasks, the production planner can perform the inclusion of all the stages of production in the corresponding program for the definition of production.

Prior to the formation of JDF protocols there were other formats for the attempted integration of production and the current system is only a continuation of the previous ones. Among the most important formats there were PJTF (Portable Job Ticket Format), developed by Adobe in the prepress department. The continuation of the started integration was PPF format, developed by CIP3 Consortium and it integrated the prepress-press-postpress phases of work, but without the described process which was later presented in CIP4. The advantage of the PPF file compared to the previous file format is in its filing and distributing within different production levels.

One of the key developments in the automation was presetting the printing press in the colouring zones and filing of the tasks. But at that time automation of the processing machinery was rather rare because finishing machines were not fully automated and therefore most of the work operations were still performed manually. The pioneers of automation in the graphic finishing were high speed cutters that worked on a system of sliding pairs of coordinate system. The network of pairs of x and y coordinates was used to position the point of incision horizontally and vertically within two-dimensional systems. The created file was described in CIP3/PPF protocol, and it uses PostScript file in an imaginary raster system with 1/72 inch density.

## **3. Construction of network exchange of information**

The intention of the research used in the analysis of exchange of information in a network environment of graphic reproduction is to improve the process itself. The results obtained are the subject of analysis in the quality of implementation as well as the methodology of the process execution. By subsequent analysis after completion of the graphic process the workflows are compared with the database of such workflows if they exist in the data repository, the analysis of the function of each working node is performed and, if necessary, alternative solutions are examined. Such work avoids narrow product lines, and prevents the overlap of specific production processes. The proposed design solutions that were previously subject to a simulation and analysis are transformed to the ready-made solutions, which take the final dimension in an actual reproduction. All such ready-made solutions are stored in a central repository that is used as a base for further development and improvement.

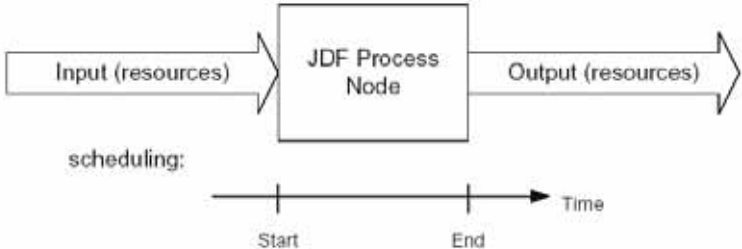
The process of constructing the network information exchange on graphic product performs the necessary actions in order to achieve the specifications of the given product. The process of flowchart design is usually a synthesis of the existing situations into a whole that can be implemented with the existing installed capacity. The proposed flowchart is possible to realize in more models and information exchange through the work nodes under the current workload and availability of resources. In such situations, the process of constructing and designing workflow becomes more efficient and economically realistic. The present communication is mainly based on TCP/IP protocol (Transmission Control Protocol/Internet Protocol) or transmission of all information on a single infrastructure. The structure of such exchange can be observed through working nodes and less productive phases that ultimately make up the structure of the entire graphic process. One of the tasks of design process through which the given product is produced, is the transformation of information from e.g. CIP3/PPF files after each specific phase of work that describes a graphic product. In addition to immediate production, the automation includes also a department of production materials and creates the preconditions for the on-line order, thus avoiding overlapping and unnecessary use of the resource capacity (financial and space savings). Special benefits of networking of printing office are also used by administrative departments that included in the vertical exchange of information all the data about products that are especially useful for the client. That provides an insight into each stage of the hierarchical key responsibilities due to open standards and a uniformed format such as PDF, XML located on the Internet or Intranet networks. The next step in the development of communication is expected in the virtual internet communication which allows clients direct communication with the printing office and their impact on the finished product.

**4. Exchange of information within productive working nodes**

The structure of JDF protocols is presented as a pyramidal flowchart with all the graphic elements of the given product that are necessary for its execution. Exchange of information is an automated manufacturing process which, as a whole or in segments, transmits tasks on the product to all participants in the performing process.

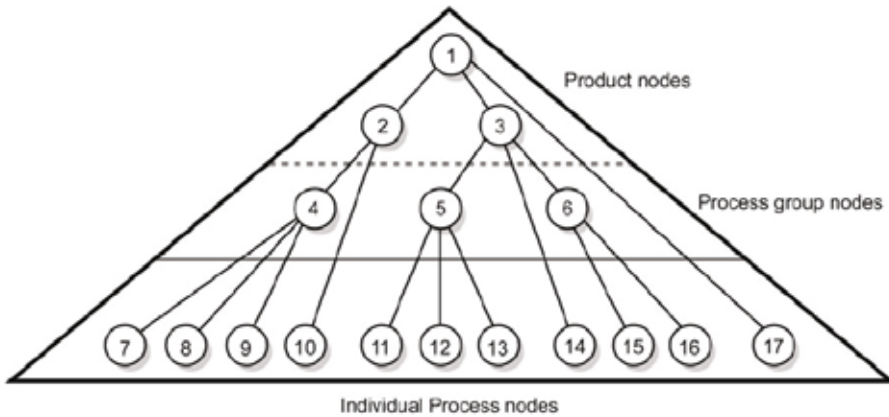
JDF provides some basic features for performing the communication within the graphic reproduction and the integration of production systems:

- feature of JDF as XML code mechanisms for the exchange of information which integrate the differential IT systems and integration of various production resources,
- information flow by subsystem that provides communication within the whole work system for each workstation where individual control is realized,
- ability to implement any documentation that describes the process necessary to complete the real execution process.



**Figure 1. Flow of information through a control node**

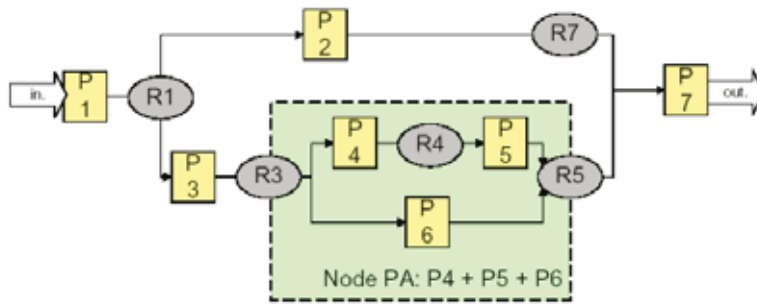
Work assignments are placed on key execution nodes such as technical features of the given graphical product, basic information from management to production departments (MIS), information about the client, deadlines, delivery and more. Architecture in the exchange of information is constructed in the shape of a pyramid which is divided into several management levels. Transfer of information about the product with all elements and network integration is distributed to individual workstations. The flow inside the pyramid takes place using “nodes” to form a hierarchical control pyramid.



**Figure 2. Control pyramid with JDF nodes and hierarchical information (JDF Specification)**

The top of the pyramid includes the general information about the product, i.e. it comprises the key information about the client and his/her demands for a graphic product. The information is placed in the production nodes and prepared for distribution to the process nodes. The lower control level determines the processes necessary for the realization of the graphic product. The base of the pyramid consists of narrow specialized information about the work product that describes every single working step that is associated with the executor. JDF nodes contain attributes and elements, while the elements contain their attributes and subelements, which again contain their various elements.

The distribution of tasks creates pre-conditions for optimization of the entire work process, with the description of each working node separately. Adjusting the distribution of information to the description of the commands in the executive operating points (nodes) provides a complete view and clarity. Working documents applicable to printing and finishing machines that support it and can be connected to MIS departments, must be adjusted to their level of computerization. Recording of all work places should describe each phase of work (node) and through the digital record in the JDF determine its validity or the need for change in the organizational chart. In cases of economic non-rentability it is necessary to exclude such a position, and distribute the information about the product to the next node. The distribution points that describe the production flowchart, describe each phase separately or process to be performed.



P = Prosesi  
R = Resursi

**Figure 3. Exchange of information within the process and installed resources (JDF Specification)**

Executive function of the work node is divided into three types according to their purpose:

- Product nodes - transmit information on the work or the information on the given graphic products.
- Process nodes - transmit information about the necessary phases of the work or the proposed workflow that needs to be executed in the implementation of the task.
- Individual Process nodes - describe each phase of work individually i.e. each position separately.

Nodes also support other information related to the product and they are located in the subgroups of primary functions and describe actions to be subsequently executed. The relations between the nodes are positioned in two categories: in a hierarchical (vertical) or laterar (horizontal) direction. The combination of horizontal and vertical nodes forms a complex network environment and describes the entire production process. The output information of a node is usually input into the next node, where the exchange of process and resource files takes place. In simpler situations JDF document is shown as a node, which describes the function holder of a certain segment of the production (manufacturing, printing, finishing). The nodes from the perspective of separation of individual work phases represent distinct phases that include the data on imposition, time of printing, information on finishing stages and information about the final result.

## 5. Conclusion

Today there are more than hundred different versions which are presented on the market as ready-made solutions for printing which will be installed using the plug and play system and have their integration solved. Subsequently, however, the deficiencies and inefficiencies of such ready-made solutions are recognized. Many such projects have never been activated in a real graphic production, and the reasons for failure are in their unsystematic approach and in not recognizing the whole complex production. The concrete solutions are not presented and the individual production model that will suit the respective printer are not suggested. Only the solutions derived from the real production that were tested in concrete situations in the form of digital models and stochastic simulations can confirm the validity of the proposed model.

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## NEW ELEMENTS IN SECURITIES DESIGN

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*Keywords: banknotes, forgery, securities*

### 1. Abstract

Banknotes, identification cards, passports, diplomas, certificates of citizenship, and other securities currently represent top technology and they attribute to the visual identity of a particular nation. Thus the most recent accomplishments in graphic technology can be recognized by looking at the securities of a country.

In order to represent the country with dignity, the securities ought to have certain characteristics of the country with some famous historical persons, to satisfy the highest design criteria, the paper they are made of needs to be highly resistant to wearing out and tearing, and it has to contain certain safety forms in itself. Moreover, they are the most frequent target of forgery and that is why special attention is dedicated to protective elements during the creation of securities. In this paper, the development of protective elements throughout history is described, today's methods of protection are presented, and new protective solutions in the field of securities design are suggested.

### 2. Introduction

From the beginnings of the first print media until today, much attention was given to the surface intended for printing. The oldest material which the Egyptians used for writing in the year 2000 BC was papyrus. Since it had certain drawbacks, something better was sought. Two millennia later, it was replaced by the parchment, which was more durable and moisture-resistant. The improvement of the print material quality was obvious. However, not only the quality of printing materials was increasing, but also the quality of the elements for the protection of securities. In the beginning, the most common elements of protection were visible with the naked eye; for example, numbering, safety metallic threads, watermark, or fine line texture on the surface. Today, more sophisticated methods of protection are used: they are invisible unless viewed with the help of special equipment. In this way, using ultraviolet (UV) and infrared (IR) colors has helped in decreasing the tendency to counterfeit securities. The printed parts are invisible unless viewed under special UV or IR light. Since the progress of information technology has led towards the greater availability of the newest technologies to the wide circle of users, an everyday need for sophisticated methods of protection is present. It is of extreme importance to be one step ahead of those who would keep trying to counterfeit securities. Technological developments in printing are always visible first on the securities which represent the country. Together with the development of print, forgery of securities appears and it successfully follows current technological developments. Different securities and documents are the target of people who would like to obtain them in an illegal way. Precisely because of that, protective elements are put on them and they make the forgery a little more difficult.

Forgery is an activity as old as the first money. Even during the Babylonian ruler Hamurabi IV, in the 17th century BC, forgery was also registered with old Greeks and Romans. Technical developments

(lithography in 1797, dageryotype in 1837, galvanoplasty in 1839) open up new possibilities for the making of counterfeited money.

Nowadays, banknotes are counterfeited the most because of the technology which is available to everyone, whereas coins are counterfeited less because that is not as profitable. Banknotes which are made in offset print are more suitable for forgery because of the lack of elements made in letterpress printing. These elements can be felt by running one's fingers across them. Some other features of forged notes are as follows: the difference in the thickness of paper, its crispness and tearing of the paper, precise drawings, and watermark which is different from the one on the original. The colors and the drawings also make the forgery more difficult because it is very hard to guess the correct shade of the original banknote color or to draw each and every one of those thin and tiny lines, drawing details, or the background texture. Original banknotes mostly have some elements printed in blindruck so the counterfeits got with copying or offset printing do not have the sharpness and depth of the drawing. Whether the banknotes are genuine can be checked with naked eye, with a magnifying glass, under a UV or IR light. The old banknotes had security elements which were visible with the naked eye, while nowadays, they more and more feature microprints invisible unless viewed with a magnifying glass or some parts printed in colors visible only under the special light.

### **3. History**

The beginnings of the development of money reach into the 7th century BC, in Anatolia. The money was made by hand from natural alloy of gold and silver. A good blacksmith could mint 100 coins in one hour. Moreover, Ancient Greece had its own coins. Since it was divided in hundreds of cities, each one of them had its own money. Even then the coins had portraits of heroes and gods, who were honored by the ancient cities. The first person who put his own portrait on the coin was Caesar. He put his own portrait on a silver coin called silver denarius. In the 6th century, the symbols of Christianity started to appear on the reverse of coins, while from the year 726 to 843, during the period of iconoclasm, religious motifs on the coins were banned.

In the 12th century, the Croats started to mint their own money, and in 1778 the first Croatian paper banknote appeared. It was called paški assignat.

## **4. Overview of elements in the securities design**

### **4.1. Comparison of safety elements on the old and current banknotes**

The development of money happens together with the development of printing. Every accomplishment in the field of graphic technology is applied to banknotes first. It is even possible to see a two-color print on the obverse and one-color print on the reverse of the Russian banknote from 1898. Decorative typography and precise ornamental texture on the background can be registered. However, it is not the same on the both sides of the note. The lines in the bottom of the obverse side are extremely uneven, of different length and paint amount, probably made by hand type.

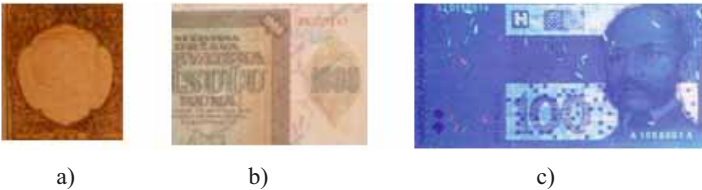
The numbering is printed in blue, both on the left and the right side of the banknote obverse. On the more recent notes, the numbering is usually put in the top left and lower right corner, or vice versa.

In the beginning, the banknotes were numbered with a stamp in different colors, whereas later, they tried to synchronize the color of the print and the serial number. Nowadays, by implementing the digital printing, the problem of individualized print making has been solved. This also partially solved the problem of safety. Every next print can have its own additional feature like numbering, line or pixel graphics, barcode, a change in the text, etc. On today's kuna banknotes, the numbering has yet another advantage – under the ultraviolet light it shines in fluorescent green.

The banknotes that were printed only on obverse side are interesting but were easily counterfeited especially for the reason that the print on them was in one color, while the reverse side was absolutely empty.

Watermark is also an element used in securities design. It started to appear on the banknotes very early. For example, on the banknote of 2 crowns from 1917; on the 10 dinar banknote in the Kingdom of

Serbs, Croats and Slovenes from 1926; on the 100 dinar banknote of the Kingdom of Yugoslavia from 1941; and on many others. Nowadays, watermark is almost an inevitable element on the banknotes. The novelties in the element are the spot colors which are also used in offset printing. One of the good solutions for the protection was the colorful threads which were manufactured into the paper. That kind of solution was implemented on the 1,000 kuna note from 1941. On today's kunas, there is a similar example of protection, only that invisible fluorescent threads are woven into the paper of the money itself. Under the ultraviolet light, they shine in fluorescent blue.



**Figure 1.a. Watermark on the 100 dinar banknote from 1941 in the Kingdom of Yugoslavia**  
**Figure 1.b. Protective colorful threads manufactured into the paper on the 1,000 kuna banknote, from 1941**  
**Figure 1.c. Invisible threads which shine in fluorescent blue under the ultraviolet light, on today's banknotes.**

Today's kunas are printed on both sides in a simultaneous dry offset, and on the obverse with intaglio printing with a rainbow effect (iridescent effect). They also have a sign for blind people, a circle or a square with "The Republic of Croatia" imprinted with microprint; that part is very difficult to be counterfeited.

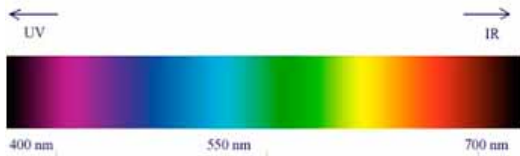
Apart from that, they have some other methods of protection, like the golden thread, different ultraviolet safety colors, and a watermark visible under the light. The safety metallic thread is woven into the paper of the money itself, but it is not embedded completely into the paper – at intervals it shows through on the surface of the obverse as small shiny metal spots that are partially visible. On these visible places, the thread is fluorescent under the ultraviolet light [5]. For the purpose of recognizing whether the securities are genuine, ultraviolet and infrared detectors are being more and more often used.

**4.2. Printing in UV and IR colors**

Human eye is sensitive only to a "visible" light which is represented by electromagnetic waves which are approximately 380-760 nm long. Everything outside that area is visible only by using special equipment.

The light which comes right after the purple edge of the visible part of the spectrum is called ultraviolet light.

UV printing is the most modern subtype of inkjet printing which is ecologically more acceptable. It also enables printing on different materials and the higher quality of drying and evenness of the print is achieved. The drying is done by using special UV lamps whose wavelength of the emitted UV light corresponds to photochemical receptors which can be found in ink.



**Figure 2. The spectrum of electromagnetic emission**

Infrared light begins above 700 nm, exactly after the red edge of the visible part of the spectrum and in that area there are no colors that are visible for the human eye.

UV and IR color printing was for a long time reserved only for a few lucky people and for the most sophisticated products, whereas today it is used on all securities that are of some importance, especially on the banknotes. Infrared and ultraviolet effects add value to the product and decrease the possibility of counterfeiting. Since they are not visible with the naked eye, special devices are used. UV and IR detectors are massively used in recognizing of genuine securities and in control of special areas [4]. However, not everybody has devices needed to identify counterfeited banknotes and that is why many counterfeited banknotes are put into circulation without people even being aware of it.

### **4.3. Elements in securities protection which make counterfeiting more difficult**

Apart from UV and IR color printing there are some other modern elements of securities protection:

-Micro Lettering (It consists of fine structures of tiny writing or elements which appear as a thin line to the naked eye, but you can read the lettering with the aid of magnifying glass. New, special font is designed for every security, which makes its forgery even more difficult. The small signs and letters cannot be reproduced by copying them.)

-Printing in the rainbow spectrum or the iridescent printing (The colors vary and change from one shade to the other. Counterfeited copies can be easily recognized because color copy machines cannot reproduce this effect.)

-Intaglio printing, although used for a hundred years, it is still considered to be the safest printing when it comes to securities. It is the combination of copperplate and “pregen” indented printing in the steel printing form version. In most cases, it is the print that has paint layer on one side only while on the other there is an indent.

Some professional digital printing machines can imitate recommended forms of protection which could be accomplished only by controlled printing techniques like intaglio printing. A digital print is characteristic because a large amount of color can be programmed; it has depth and is resistant to rubbing. It can be felt when touching and that is why it is used to check securities with one’s hand and on places which enable blind people to recognize graphic parts designed exclusively for them [2].

-Hidden Image (IPI – Invisible Personal Information is made in a way that a special software is used for implementing a hidden text or an individualized safety feature, for example in a photograph. The feature becomes visible only when using a special decoding lens. The element of that kind is copy protected.)

-OVI printing (OVI – Optical Variable Ink consists of special pigments which add a different shade to a color when they are viewed from a different angle. In order to achieve a good effect, OVI color always has to be printed in a dark shade of a color.)

-Holographic stripe (Security thread – it may contain logos and signs which are individual for a client. It is embedded into the securities horizontally or vertically, under the transparent layer.)

-See-through register (Some parts of an arbitrary sign are printed on the front of the securities, while certain parts are printed on the back of them. When the securities are held up to the light, these irregular shapes form a complete value and the sign becomes recognizable [8].)

The most recent ways of protection against counterfeiting represent the introduction of stochastic processes into programming while choosing the type of raster, color, font size and type, or the design of some special signs on securities. By introducing pseudorandom numbers the desired effect is completely controlled, while the way and the possibility of repetition are known only to the author of that type of protective element.

The possibilities of protection are enhanced by introducing new raster shapes. Besides protective elements some very attractive design solutions are created by using individual raster shapes whose algorithms are known to their authors only.



**Figure 3. The use of new raster elements in program application of graphics**

```

/romb {exch 2 mul sin exch dup 3 1 roll add abs sqrt exch abs sqrt exch sub
abs } bind def
/l 10 def /k 0 def /gr 0 def
300 200 translate
8{gr setgray 0 0 moveto -70 150 70 150 0 0 curveto fill
/gr gr 0.1 add def l k {romb} bind setscreen 45 rotate}repeat
showpage

```

Program code of graphic solution of figure 3

As one of the possible examples of protection in safety graphics, we suggest the example that can be seen in Figure 3. Moreover, the program code is given for the use of “Flower” graphics. By using a simple program solution, complex graphics is achieved; the application of raster and its changes in dimness from the petal to petal can be noted. The angle and liniature of the raster are constant, while the dynamics is achieved by changing the surface coverage. “Rhombus” raster, which is used in this example, under different degrees of dimness changes its shape. By changing the dimness from 5% to 95%, the change in the raster shape can be seen from a thin horizontal line over rhomboid shape to a thick vertical line.



**Figure 4. Random choice of raster elements**

Figure 4 presents the use of four different raster elements, which are chosen with the help of random numbers generators in a stochastic way. They are applied as a surface for text writing – letter “N” in negative. The change of raster elements moves from a circle to a circle of the loop which creates concentric circles with larger radius. The change in coverage is changed for 0.04 % for every new circle. This kind of solution is impossible to be repeated without knowing the Postscript for raster elements and the numerical value of random numbers generator.

For this example, four raster elements are used; they are defined by relation /ros named [ {r22} {r21} {r68} {r66} ] def whose algorithms have been published earlier [3].

## 5. Conclusion

The development of safety elements was happening together with the development of printing: all the way from hand press, which created uneven prints, to conventional techniques like copperplate, letterpress and offset printing, and finally to the new technologies like UV or IR colour printing. Precisely because of that, the banknotes gain quality; with these methods the quality of a product is better and the possibility of counterfeiting is reduced to a minimum. There is one simple fact that led to the present state of transformation: the technology keeps developing while the banknote presents top technology in a given moment. The development of computer programs and digital print has enabled the testing of new types of raster and spreading the ways of protection against the counterfeit of securities. However, nowadays we meet a new kind of challenge in the field of computers and digitalization. Since different tangible applications are being replaced by digital media, in the future the securities will be more and more digitalized. In today's era of credit cards less and less money goes through the hands, and more through ATMs or electronic cash registers. This leads to searching new elements of protection which will make securities protected from illegal procedures and activities and which will continue to follow the newest technological developments.

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## MODELING AND SIMULATION OF EXTREME SECURITY PRINTING

K. Pap, J. Lajkovič, A. Koren and D. Posavec

**Abstract:** Designing, construction and execution of any new extreme security document is a job where the optimum workflow, costs and time consumption have not been determined yet. It is best to explore and learn about such extreme tasks in graphics technology with the system for modeling and simulation that has the possibility to define new virtual machines. In real life production such extreme experiments are impossible so that by using modeling and simulation, errors can be observed in advance, enhancing thereby the confidence of entering into extreme security printing graphic projects and their further development and sustainability.

*Key words:* modeling, simulation, graphic technology, security

### 1. Introduction

It is possible to design a new security product with the help of a virtual printing house that includes data on the printing and the standards for all processes, from prepress, to printing and postpress. There are about a hundred similar processes in the printing process alone, and as many as several hundred in postpress. There are some in the graphic product prepress as well, in the preparing of the printing form as well as in the intermediate additional processes. In order to make planning preparations for a job in security printing, it is good to make a model of job workflows for the new security product in digital form. Such a model then gives results for individual settings. We change the settings for making a concrete task. We change the machines, the printing run, materials, colors and other parameters that determine the production of a certain graphic product. If we design several different workflows for a certain job, then we shall choose such a job workflow that will be the best according to certain criteria. If we change many different parameters, we come to the best, optimal solution before entering production. This can be the best approach to researching most extreme models of security printing, as for instance image reproduction in the near infrared area with the help of the Infraredesign method [Pap at al., 2010]. Also can be studied a special technique to hide informations [Žiljak at al., 2010] or extreme types of separation [Žiljak at al., 2009].

### 2. Modeling and simulation of a virtual printing model

The WebPoskok system for creating graphic workflow models is used in this paper; the system that can be applied in learning about extreme tasks in the graphic field of business. With the help of this system it can be estimated how long some graphic production phase lasts – measuring of the time period, cost efficiency, whether we can use some other workflow for the same graphic product [Žiljak at al., 2004a]. It contains many simulation experimental variables that can be altered on basis of the previously designed model [Žiljak at al., 2004b].

In the workflow modeling unit a virtual product model from the security printing area can be made. A complete estimate of the security graphic product can be designed and made, starting from graphic prepress to the printing and postpress. A virtual model of the graphic product is chosen from the model menu in the base for designing a new simulated model of a secured graphic product. In case the desired model does not exist, a model that is most similar to can be remodeled, or the desired model can even be made by starting from the very beginning. When the page number is written in the book block, the

program automatically recommends the model that optimally plans the printing sheet out of which a new virtual security product can be made. After getting information on the best printing sheet layout, we can search for the target model in groups with the help of a complicated type of display. When a list is received from the base of the graphic product virtual models, the one with the greatest resemblance is chosen, and it is the starting point for developing the security product model. In this way a new virtual model is created and we can store it in the database.

We begin with creating a completely new model only if we do not have any similar product in our database which we could alter in order to get the product that would suit us. WebPoskok insists on working with the model database and using base models. This program has tools for searching all over the model database through virtual variables that describe the printed product. Modelling of a completely new virtual model requires more time and it is made only if we had never had requests for similar products before..

If we are making a completely new virtual model for an extreme security graphic product, it is good to plan spending a longer period of time in doing it and to make several similar products. Thereby we shall add more models to our virtual graphic product model database. There are no limitations as to the number of products in our database. The program has the top tools for searching, selecting, grouping products in respect to different criteria, and a complex approach to selection according to technological and production variables. After storing a large number of graphic models into the database, the virtual program offers the technology of pulling out and selecting those graphic products that are most similar to the new task. The program offers the use of various different criteria. The criteria that are not activated will be skipped during research. A bigger number of criteria narrow down the choice, thus finding the target models in a shorter space of time. Such models are the base for making new models. By constant increasing of models a wide database is created for finding ready models, the ones that resemble the new required offers.

### 3. Designing the simulation experiment for a security document

The simulation experiment is shown here is one where we experimented with a model for a secured product, and three simulation variables were altered. The first simulation variable was the number of cylinders with the help of which we indirectly altered the machine types (with one cylinder, with two cylinders, with four cylinders and with eight cylinders); the second was altering the number of security products produced, i.e. the printing run. Each time we changed the machine type and applied the machines for different printing runs for a specific product, the simulation system calculated the price per copy (Table 1). The other experiment variables that were not altered during the experiment were the following: size 210 x 297 mm, number of pages – 2, number of pages in the machine sheet – 32, plate B1 and process colors 6/0.

Security document description:

Format: **210 x 297 mm**

Number of pages: **2**

Number of pages on the machine sheet: **32**

Machine (standardn Speedmaster): **SPM (single-color, two-color, four-color, eight-color)**

Offset plate: **B1**

Book block colors: **6/0 - CMYK + 2 security colors** (invisible color that shines through in the UV specter as yellow and UV green that changes into red in the UV specter)

**Table 1. The security document price depending on the cylinder number and printing run**

<b>Naklada/Br. cilindara</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>8</b>
<b>100</b>	<b>2,38462</b>	<b>2,16746</b>	<b>2,24973</b>	<b>2,1893</b>
<b>500</b>	<b>0,50022</b>	<b>0,4526</b>	<b>0,46736</b>	<b>0,45431</b>
<b>1 000</b>	<b>0,26435</b>	<b>0,23765</b>	<b>0,24442</b>	<b>0,23708</b>
<b>2 000</b>	<b>0,14641</b>	<b>0,13032</b>	<b>0,13281</b>	<b>0,12832</b>
<b>6 000</b>	<b>0,06811</b>	<b>0,05902</b>	<b>0,05869</b>	<b>0,005615</b>

Figure 1 shows the module for experimenting with simulation variables and the resulting simulation variable is marked. Changes of all the other supporting variables can be controlled during the overall experimenting time period.



Figure 1. Module for experimenting with simulation variables and a display of the resulting variable *Price per copy*

On basis of Table 1 and Figure 2 we can see that with a 100 copy printing run the price for a security document was the lowest because it had been printed on a one-color machine (standard Speedmaster). Therefore the price for one copy following a 100 copy printing run on an eight-color machine was very high. The simulation variable gets lower in case of a larger printing run and is almost equal for all machines.

Number of cylinders

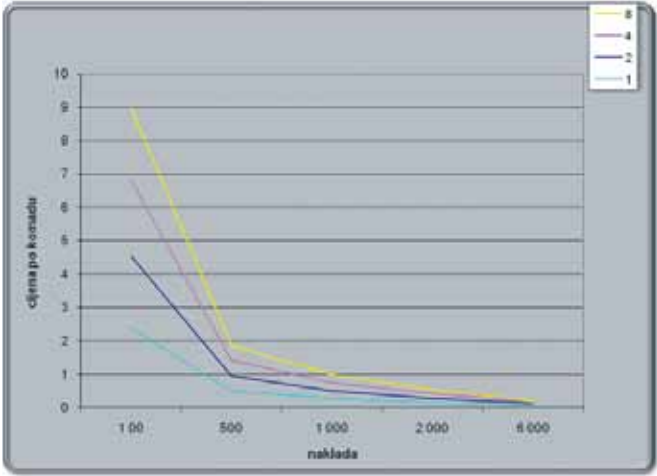


Figure 2. The price of the security document depending on the printing run and the number of cylinders

We are also demonstrating a simulation experiment where we experimented with the same security product model by altering simulation variables. The first simulation variable was the number of cylinders; the second was the printing run and the simulation system calculated the production time each time when we changed the machine and cylinder type. During experimenting we did not alter the size, number of pages, and number of pages on the machine sheet, plate type or colors.

**Table 2. Production time of the security document depending on the cylinder number and printing run**

Naklada / Broj cilindara	1	2	4	8
100	1,04	0,53	0,5	0,48
500	1,06	0,54	0,51	0,48
1 000	1,08	0,55	0,51	0,48
2 000	1,13	0,57	0,53	0,49
6 000	1,31	1,05	0,58	0,51

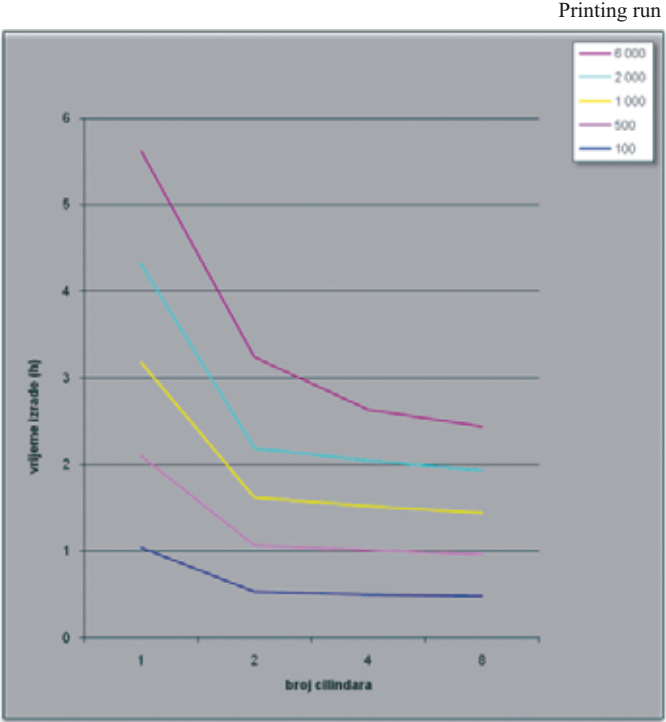
Figure 3 shows the module for experimenting with simulation variables and the resulting variable is marked as *Printing time*. The chosen machine type can be seen in the left window during the overall experimenting time period, as well as the other variables and model parameters. In the part where the printing machine is described, all the production rates of the machine are seen. With each machine change coming from the machine base, there is a new calculation for the whole model. A machine is determined by its nominal speed, number of cylinders, the time necessary for preparation for the first and every following sheet, the time necessary for washing as well as the time for preparing the mechanism for rotation of the sheet on machines that have such an option.



**Figure 3 Module for experimenting with simulation variables and display of the resulting variable *Printing time***

Table 2 and Figure 4 show that the security document production time was the longest on the one-color machine (standard Speedmaster) with a printing run of 6000 copies, and the shortest with the eight-

color machine and the same printing run. The simulation variable for the time period became lower in case of a smaller printing run. With a 100 copy printing run and by changing simulation variables for machines with more cylinders, the production time period remained almost the same for a two-color, four-color or eight-color machine. This occurred because of the stronger influence of the necessary time for preparing the said machines.



**Figure 4. The time period for producing the set security document depending on the printing run and the number of cylinders in the machine**

**4. Conclusion**

Designing a new security document is a job that has an unknown optimal job workflow. It falls into the category of extreme borderline areas in graphic technology. This paper gives research data on simulation variables as to the security product prices and the time periods necessary for its production. By modeling and simulation we have altered the machine parameters (cylinder number) and the printing run. Such experiments would be too expensive and practically impossible in real life printing, so that in simulation errors and misses can be seen in advance, and the security of entering into extreme security graphic projects is enhanced. The digital form of a virtual printing works is necessary nowadays because we can fill databases with workflow production rates necessary for producing certain secured products. With such a system it is possible to research, for instance, how long it would take to complete the printing of different printing runs, on various machines, and also to calculate prices for different printing runs. When some new product is set, then the necessary data describing the product must already be in the relation data base in the form of production rates. Such data is specific for a concrete printing works and changes during it lifetime and development.

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## MODULAR APPROACH TO PET BOTTLE DESIGN

D.M. Novaković, G.D. Vladić and N.D. Kašiković

**Abstract:** Shortening time from creating initial idea to market placement of final product places in unfavourable position everyone involved in production process. CAD and CAM solutions and optimization can solve part of the problems, but creative process involving aesthetics, function, ergonomics, etc. demand time and that time directly effects the quality of final product. Manufacturer must be able to deliver high quality products at low cost in short time so he could survive on the dynamic market. Packaging industry is not excluded from this trends and searching for solutions of these problems is more important every day. This paper offers innovative approach to PET bottle design. Modular approach to design process offers speedy and highly responsive replay to clients needs and demands. The PET bottle is segmented in 5 modules designed separately but in that way to ensure quick assembly of modules in one unified form. By this approach to the design number of possible combinations is by far greater than the number of modules designed. Goals of this approach are speed and reduction of design costs intended for less demanding clients seeking quick, less expensive, not personalized solutions.

*Keywords:* PET bottle, design, modules, modularity, shape

### 1. Introduction

Today's market trends dictate shortening the time from creating initial idea to market placement of final product, everyone involved in production process is placed in unfavorable position. To be able to deliver high quality products at low cost in short time is crucial for manufacturer's survival on the dynamic market. By the words of Earl Hall, The complex product markets of the twenty-first century will demand the ability to quickly and globally deliver a high variety of customized products. Ongoing conflict between customization and limited resources forces manufacturers to adopt new approach to production. Term agile manufacturing describes ability of manufacture to deliver large variety of products at lower cost in a shorter time. The agile manufacturing is possible by means of modular approach to the design and production process. Modular products and reconfigurable processes are crucial to agile manufacturing and provide a way to produce a variety of products that satisfy various customer requirements in time [Kidd, 1994].

Packaging industry is no exception to the rule, demands for flexibility and ever growing competition is forcing manufacturers to rethink whole design and production process with a goal to achieve what is called agile manufacturing. PET packaging with its wide application is main objective of this paper. This paper has a goal to present the concept of modularity and its application in PET bottle design process and to highlight advantages of modular architecture in comparison to integrated architecture. The goals are achieved by theoretical explanation of modularity concept and application of the principles to PET design process.

## 2. Theoretical basis of modular product design

### 2.1. Definitions

Modular architecture opposes monolithic (integrated) architecture which refers to something that is created in a single piece, therefore modular means assembled from a number of separate parts (modules). Modularity can be defined as a special form of systems design in that it intentionally creates components that have a high degree of independence. It emphasizes the parts of a system over the system as a whole. Modules interact with one another on a weak basis known as “loose coupling.” Since interdependence between subsystems is minimal, the system as a whole will not suffer if some subsystems are damaged or are being upgraded [Kohalyk, 2006]. Term modular product refers to products, assemblies and components that fulfill various functions through the combination of distinct building blocks (modules) [Pahl and Beitz, 1988]. A Module is a self-contained component of a system, which has a well-defined interface to the other components; something is modular if it includes or uses modules which can be interchanged as units without disassembly of the module [Karlsson, 2008]. Modular components in order to function together as one unit must have defined interface by which it connects with other modules in the system. When talking about modularity it is important to consider three things: system (made from modules), subsystem (module) and interface Figure1.

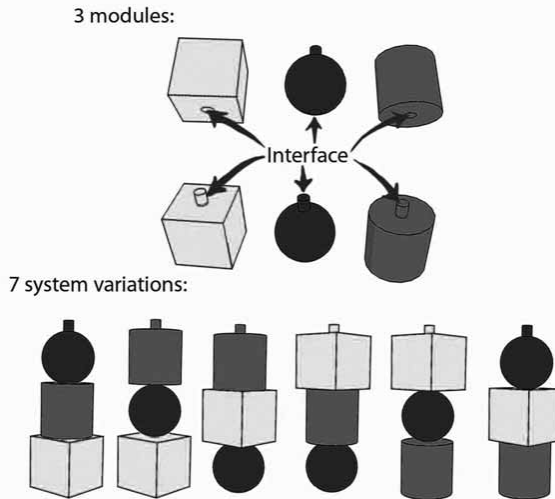


Figure 1. Illustration of modular variations

### 2.2. Benefits and disadvantages of modular architecture

Although a product performance may not be enhanced by a modular architecture, there are benefits to adopting modular design and there are some disadvantages to. [Huang, 1999],

- Modular product allows a company to respond to changing demands by rapidly and inexpensively creating product variants derived from different module combinations.
- Modularity enables parallel work; since modules are independent from each other a module can be used or upgraded without impacting the rest of the system.
- Changing a few isolated design elements of a product may not affect the design of other modules.

- With a good design most module components can be used repetitively, thereby offering obvious savings.
- Each module will usually be used more times, natural economies of scale arise.
- Increased product variety. The use of modules means that a great product variety can be achieved using different combinations of modules.
- Reduced order lead-time. Since modules are pre-manufactured, the logistics of production can be organized so as to reduce manufacturing lead time.
- The ease of product upgrade and maintenance. Since a product is decomposed into modules, only certain modules need to be replaced when upgrading or repairing.
- Ready documentation is available for tenders, project planning and design. Design is done once and for all, though it may be more costly for that very reason.
- Additional design effort is needed for unforeseeable orders only.
- Computer-aided execution of orders is greatly facilitated.
- Short delivery times

Nothing is perfect, so there are some disadvantages derived from modular approach. When approaching the task of modular design one has to consider these disadvantages and make the decisions accordingly. Disadvantages being:

- Costs of designing and producing variety of modules that will be used at later time if needed.
- Limitations due to standard interface limitations.
- Potentially static product architecture and product similarities.
- Special wishes cannot be met easily.
- Certain quality characteristics may be less satisfactory than they would be with special-purpose designs.
- Production costs are increased.
- Increased assembly effort and care are required.

### **2.3. CAD and remote collaboration in design of modular products**

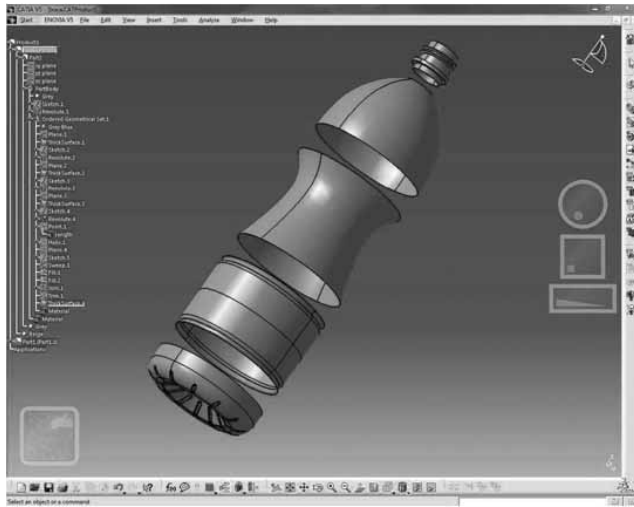
CAD and CAM applications are widely used in today's product design process. Applications that offer wide variety of tools for modeling, analyzing, assembly etc. are necessary for achieving agile manufacturing. By using up-to-date CAD applications it's possible to make virtual tryouts of system assembly and module interfaces without a need to produce prototypes in material form, hence the modularization is easier. Opportunity to design and review modules in virtual environment is used to present wide range of possibilities to customer without building actual modules and products until the customer decides on the final design.

By producing computer models and exchanging the defining interfaces it's made possible to involve more people in design process, developing new modules thus widening products usability and features. Simultaneous work on the product design is also possible. Real time data exchange is possible by any means of computer communication LAN or internet. Involving customers in early stages of product development is very important and eliminates misunderstandings in the communication on relation designer client. Thru the ever expanding World Wide Web and development of graphical user interfaces even the personal customization is possible. End user is enabled do build their own personalized products based on the individual needs, e.g. modular buildings, software etc.

## **3. Modular concept of PET bottle design process**

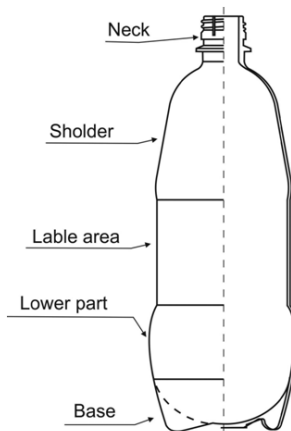
Usual practice in complex process of designing PET bottles is to approach the tasks of defining a shape and overall design as one monolith structure, respecting technological limitations. That approach offers opportunities for the designer to express himself and convey design idea and lift the design on a higher level. It is time consuming and has design has a narrow application usually to a specific product. By this approach design of a PET bottle has almost artistic value e.g. the PET bottle, designed by Ross Lovegrove. On the other hand there is wide need for other approach do the design process that offers highly responsive replay to a clients demands in short time, producing large number of solutions for

client to select form. Short time dictates some cutbacks, communication with the client is limited and does not offer much needed input and iterative revisions of the design. Modular approach to the design process meets the demands for quick solutions and minimal client input in the design process time wise, but information wise input is greater. Client could be enabled to participate in the design process by choosing modules to his liking and assembling bottle as a final design or as a guide for further design process. Communication with client can be done by graphical user interface over the internet, providing quick preview of final product. This is achieved by decomposing PET bottle in five parts and designing each part separately in advance as shown in Figure 2.



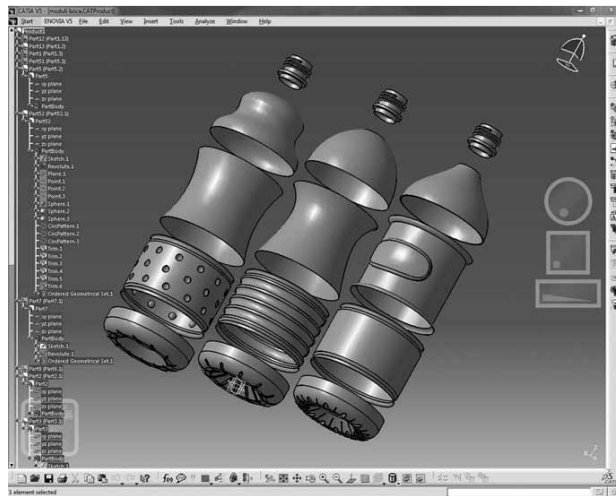
**Figure 2. PET bottle designed divided into modules (CATIA software)**

Usually PET bottle can be segmented into five distinct parts: neck, shoulder, label area (panel), lower part and base Figure 3.



**Figure 3. Decomposition of PET bottle**

Neck area and base area are highly dependable on a type of fluid that is going to be packaged dictating the type of the neck and base used. When packaging carbonated drinks design of the bottle must follow standards and recommendations. Neck if defined in perform design process according to type of fluid that bottle is going to be field with, base too should not be a subject of design in case of carbonated fluids, the use of a petaloid shape for the base design for carbonated PET bottles is widespread, while packaging of non-carbonated fluids leaves some room for designers intervention. The modules of the bottle that offer most room for creativity are shoulder area, label area (panel), lower part of the bottle. Having in mind constraints, three parts of the PET bottle with addition of base design for non-carbonated fluids can be designed independently to each other and offered as modules to clients to choose from Figure 4. For example designing only 3 variants of each module and considering there is 4 modules built in each bottle it is possible to make 81 combination. Not all of combinations are applicable and aesthetically pleasing.



**Figure 4. Decomposition of PET bottle**

In case of modular PET bottle design module interfaces are the places where two modules join. To ensure correct assembly defining fixed diameter in the joining part is crucial. Other thing to consider is overall volume of the bottle. To ensure constant overall volume of the bottle the constant volume of each module must be defined. CAD/CAM software such as DessaultSystems CATIA offer automatic calculation of volume and possibility of dimensional constraints which is useful in interface definition. CATIA software was used for production of experimental modules.

#### **4. Conclusion**

Modular approach to design is adopted by wide range of industries as a good practice in achieving agile manufacturing. Aircraft design, furniture design, circuit design and software design are deeply evolved in modular approach to design process. Designing a PET bottle can also benefit from adoption of modular approach. Up-to-date software and WWW technologies are perfect tools for implementation of modular design, making possible virtual models and interactive design process involving clients from the beginning.

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## APPROACH TOWARDS THE DIGITISATION OF THE CROATIAN CULTURAL HERITAGE

S. Bjelovučić Kopilović, P. Marković, K. Štih and S. Pul

*Keywords: Cultural heritage, cathedral of St. Jacob in Sibenik, visual modelling*

### 1. Introduction

Preserving the cultural heritage means, among other things, that data about archival, librarian and museum items, which are essential parts of that heritage and regions from where they come, are publicly accessible. Cataloguing is essential prerequisite of realizing of the preparing of data about certain contents of cultural heritage.

Though the part of cultural heritage which is about the documents, pictures, books and the like, is catalogued in a custom way, so it is possible to make it publicly accessible, certain elements of cultural heritage which are about large sculptures and architectural objects are accessible in relatively limited data bases and only partially accessible just for some segments.

Main reason of archiving the data comes from the request that data should be accessible to all who are interested in it, but also to present them in order to raise cultural awarness among the wider population. Because of that, the archive should be adjusted to be open and accessible without the potential danger for its contents and materials.

Program of the Ministry of Culture of the Republic of Croatia by the name "National Program of Digitisation the Archival, Librarian and Museum Material" brings the foundations for development of programs and projects of digitalization of the items and materials mentioned as a part of national cultural heritage and for making and improving information society regarding the activities mentioned. Task of the program is to make a frame which will enable and encourage wide scope of accessibility, use and exchange of cultural contents, to make accessibility easier, to present national cultural heritage and will lead to designing the contents and services founded on contemporary information technologies.

Contemporary technologies will use the digitalization after which any further reproduction is possible. Printed form is exceptionally suitable for use in public presentations but also as an elementary information material which is aimed to be accessible to all parties which may show interest. On the other hand, digital database containing detailed descriptions as parameters of certain elements of data in the database, has an essential role for generating the data needed but also for upgrading with new data which are gathered or generated during the activities regarding a concrete example.

The usual making of the foundations of architectural buildings often requires essential afterward analyses. Indentedness and richness of forms, even regardless of especially pointed parts of buildings like sculptures or reliefs as decorative elements, almost without an exception require separate archival storage because of the elements which are to be supplemented afterwards or because of constructional enlargement works or incorporating entirely new segments due to reconstructions and restorations because of usual works done generally in urban areas. Methods of digitisation of such objects, which are known today, include modelling of visible outer contours of an object; at the same time, more complex parts, about which there is a need for making details, have to be build afterwards and their building should be led by professional art historians and not rarely by architects and civil engineers also, who have good knowledge about the static structures of a building.

One of the typical study examples of art historians is representing the building phases of a building. Inconsistencies of the building style caused by various influences under which the primary parts are altered can be illustrated by three-dimensional modelling making virtual objects which are reconstructed according to available documentation; elements which are altered also can be illustrated; and the like. In some cases it is especially useful to have original constructional elements which make afterward restoration, according to original data, possible. The best proof that need for such a model is really appearing is the example of the damage done to the dome of the St Jacob cathedral in Šibenik during the homeland war.

It is evident that triangulation methods of digitisation can contribute to making highly faithful models. But, as for now, neither of these methods can penetrate to the very constructional structure of a building without a use of expensive equipment and expensive procedures for application of such an equipment. Though, triangulation method can be of exceptional usefulness when minimal tectonic and geological shifts of the building are to be registered through time, causing slight dynamical alterations in structure and form. Such kind of digitalization helps in monitoring them. Additional analysis and processing is exceptionally useful in this segment as well, because during it, detailed analysis of constructional elements can be done. Contemporary computational applications use modules for static and dynamical computations. Because of that, when the structural elements are being defined, beside the very archive, soil shift simulations, natural disaster simulations, like earthquakes, can be done, as well as the expected damages can be predicted, about which prevention can be undertaken in the construction of the object or in a strengthening the structure of the foundations or environmental soil in a basis of an object. Beside archival material, approach to designing of the models opens various possibilities to make physical models in diminished scale using contemporary 3D print methods. There is a possibility to commercialise part of the material and through such programs, resources for launching pilot projects of the implementing of digitalized archival systems can be ensured.

## **2. St Jacob Cathedral in Šibenik**

St Jacob cathedral in Šibenik is the most significant civil engineering enterprise in 15th and 16th century Croatia. The cathedral is enlisted in UNESCO list of world cultural heritage in 2001 and it is permanent target of the historians and tourists from all over the world. The position of the cathedral and other buildings around it limits significantly the possibilities of approaching and photographing so that majority of the materials used in press is quite similar or even identical. This difficulty can be solved by three-dimensional photorealistic computational model which enables a representation of the cathedral from any angle, without buildings around it and with a simulation of the light intensity as is wished, including its spatial opening.

The work described is a result of experiences gained in collaboration of a series of overlapping activities of the Department for Art History of the Zagreb Philosophical Faculty and Informatics Department of the Polytechnic in Zagreb. Cooperation focused on St Jacob cathedral in Šibenik, namely on one segment which will result in templates of the rendered model for the needs of printing in a professional book.

Informatics Department of the Polytechnic in Zagreb has a potential needed for making the 3D model. It is possible, by a suitable guidance, to use it for generating the pilot project which can present interdisciplinarity in connecting these two, at first sight, quite disparate studies.

Realization of the the project has been launched with two aims: beside working out of minimal number of the details needed, computational 3D model of St Jacob cathedral in Šibenik will be made and will be used for illustration templates for a professional book which, among other things, describes phases in the building development of the cathedral. Results obtained, together with a structural definition of the archived data, are completely compatible with requirements of the National Program of Digitisation of the Archival, Librarian and Museum Holdings under the guidance of the Ministry of Culture of the Republic of Croatia.

Though the cathedral in Šibenik contains a large collection of archival material, relatively precise data exist from the seventies of the past century and are based on photogrammetric drawings. Drawings are unrelated, exclusively of two-dimensional projection nature. It is very hard to extract certain details

from them which would define space relations more precisely, especially ones which are not visible from some other kind of projection. Access to details, views and even to overview of past restoration activities and to usual archival materials from such a database would give a fourth, time dimension, and it could be simply transferred to appropriate printed edition adjusted for intended audience. Requirements are completely satisfied by 3D digital model of high quality, designed in vector graphics by assigning attributes to certain elements describing parameters needed (material, area of restoration, period of building, alterations etc.) enabling interactive access to data for the user.

### **3. Interconnection of Art History and Multimedia in Contemporary Graphics**

Interdisciplinary is a prerequisite of almost every scientific research today. Though the interdisciplinary is understood at the level of cooperation of two or more similar areas inside a certain field, we witness that it is often necessary to connect humanities with natural or technical sciences. One of the areas in which such a cooperation should happen is in the framework of information sciences, because opportunities it does offer, especially in the area of computational simulation and appropriate visualisation of theoretically founded models, necessarily connect different professions.

One of the areas in which efficiency and purposefulness of such a cooperation may be proved is in designing virtual three-dimensional models of spatially and structurally complex architectonic monuments, especially that ones for which it is not possible to fully enlighten all aspects of complex building structure by traditional research and descriptive methods.

In this sense, designing the appropriate three-dimensional model which faithfully represents all relevant spatial, architectonic and other peculiarities of a certain work is a necessary prerequisite not only of research in which basic hypotheses are verified, and so, in some way, it is a necessary base for producing theses, hypotheses or initial ideas about that what is termed “disegno” by great renaissance architect and theoretician Leon Battista Alberti, but for adequate evaluation and interpretation also. Like any model, this computational model serves not only to satisfy curiosity for more complete representation of a monument which could not be fully perceived in real environment because of the very nature of the object (order of magnitude and existence of “fourth dimension” in architecture), but three-dimensional model is an efficient means of gaining knowledge also.

One of these monuments is St Jacob cathedral in Šibenik for which, despite all efforts until now, there does not exist any known appropriate presentation form in three dimensions which is necessary for the cathedral, and, including the motion in animation, the fourth. Insight in its specific material-technical values (mounting technique for assembling of stone vaults) can be gained only with such a model as well as in the complex spatial structure which appeared due to specific spatial circumstances and stylistic alterations which had come out through a century long building. By the choice of appropriate way of application, it is possible to use the model for designing templates for printing the professional editions of books and journals. In any case, because of its art historical and general cultural and historical significance it is exceptionally important that St Jacob cathedral gets a contemporary presentation model which will grossly help in the understanding of all its specificities and at the same time it will be used for popularizing that unique building monument of our cultural heritage.

### **4. Other Possibilities of Modelling**

Designing 3D models is possible with advanced methods also, e.g. by the use of GIS microgeography - it is 3D digitalization of the building with micronic exactness. In the pilot project of the Ministry of Culture of the Republic of Croatia and regional conservatorial office in Šibenik, St Jacob cathedral in Šibenik is documented by the use of triangulation but optimal results would be obtained by an interaction of this method and manual reworking of details for final application. Unfortunately, previous results were not available to the authors of this article, so the modelling described here is completely made according to available blueprints, and additionally by the insights into certain details of the building directly in the field. Final results fully satisfy realization of the tasks: editing of the book and designing of an animation. It would be interesting to compare the results of both methods as well as financial aspects.

#### 4.1. The Model

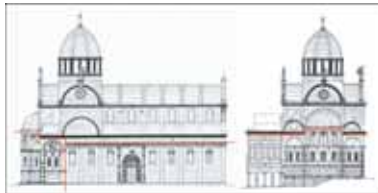
Designing the model is very demanding process which necessarily includes series of elements from professional counselling to direct verification in the field. We shall not tackle the techniques of describing and designing, but we shall present the results obtained, and their comparison with previous documents with which similar areas had been described. Besides designing the model, shorter animated movie is made, and at the end, several frames of it are shown. For the designing of the model, Autodesk 3D Studio Max application has been used, exclusively because of application of the final results regarding rendered models used for the book, and for making the animation for which other advanced applications for obtaining of the desired results were used.

Model is designed in a very detailed manner and rendering of certain elements is determined according to the requirements of singling out of certain details (e.g. structure of the stone unnecessarily draws attention away so it has been excluded, but in some applications, texture of the stone can be posted directly by the use of real photographs of the blocks of the very object). Whole model is illustrated in figure 1.



**Figure 1: Final model without the details of sculptures and reliefs on a façade**

Building phases of the cathedral is one of the items of the project. Final result is a three-dimensional model of each phase clearly represented from a wished perspective. Available documents until now only contained markings on the blueprints in orthogonal projections as is illustrated in figure 2.



**Figure 2: Illustration of the building phase 2 by the usual markings on orthogonal projection.**

For a comparison, figure 3 shows how the same phase looks in three dimensions by designing a model (together with some differences in representation due to different approaches of the scientists in determining periods of building).



**Figure 3: Illustration of the building phase 2 in three-dimensional model**

Details in the model can be designed practically to any depth and constraints are only laid down by the processor power of the computer which will render a result and by memory space which is available for archiving. Figure 4 illustrates a detail of the portal with stylized sculptures because the role of this illustration in the project is to show spatial relations only. If their realistic representation is also wished, then models of the sculptures are designed apart from this representation and they are used as a special object or set of objects, regarding that damaging and fragmentation of the sculptures through time is common. With such an approach, greater scope of possibilities is available to archivists, historians and restaurators.



**Figure 4: Detail of the eastern portal with the stylized sculptures**



**Figure 5: Illustration of the coat of arms scheme**

Specificity of the St Jacob cathedral, among many details, is a coat of arms scheme on the façade. Application of such a methodology is apparent on figure 5 (textual legend is removed from the figure which can be found in the original).

**4.2. Animation of the Building of the Cathedral**

The model is used for designing a short one-minute animation of the building of the cathedral according to phases. Panoramic camera technique has been used, which circles around the object which is being built by adding the wall blocks. Several individual illustrations from the animation are found on figure 6. First frame illustrates a look on the inner space which is closed by eastern portal and southern portal. Camera stops after completion of each time period (frames 2, 3 and 5) with temporary display of the time period and of the main architect who had led building of the cathedral. Animation is of presentational character and its purpose is promotion of the described approach.



**Figure 6: Details from animation of the building phases of the cathedral**

## 5. Conclusion

Application used in the example does not present an obstacle. Though it is relatively demanding application whose capabilities largely overarch needed functionality, the choice is plausible regarding simplicity in generating the final result.

Considering the real needs of designing of archival material, some similar or CAD applications would be very plausible for use, due to the fact that in the human resources market, enough experienced personnel may be found, who would be, with acceptable price, capable to design similar models for other objects. One constraint is a limited potential of human resources in the area of defining the needed parameters for describing digital database.

Capability to use the technique of layers opens a vast array of possibilities of very simple including or excluding the individual elements and with appropriate layouts and additions to program applications (which have to be designed sometimes because they do not exist in original application) it is possible to ensure practically every desired insight into documentation for average computer user.

Setting the appropriate standards for archiving beside using usually available applications is of a great importance for setting up the entire system. Organizing the system allows upgrading in the sense of an opening a database for anyone who has an interest to use it by setting a hierarchy which enables different levels of access; from the lowest in which elementary review is allowed to the highest in which users have permission to add or alter individual elements in the base.

Users of such an organized digital base which is indirectly largely edited by academia, can come from various areas: restorators, local self-government, cadastar offices, tourist association, cultural institutions, educational institutions and the like. It would be logical that the care about preparing and installing of the system is led by the government institutions which take care about the culture so the significant role in activities coordination of the Ministry of Culture of the Republic of Croatia can be presupposed.

The role of the faculties and universities should not be neglected in designig of databases and in choosing parameters, because there lays a great potential, but also a desire for proving themselves in certain segments which make a great synergy and it would be pity not to use it and to launch several similar projects; part of it could be commercialised, and in that way, financial foudation can be made for development and maintenace of the entire system.

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## ANALYSING OF THE SURFACE ROUGHNESS OF NON PRINTING ELEMENTS ON CTP THERMAL OFFSET PLATE

M. Gojo, Ž. Pavlović and D. Novaković

*Keywords: Non-printing surface, surface roughness, thermal CtP plates, print run*

### 1. Introduction

Printing plates used in offset have a flat surface with printing and non-printing elements, which are assumed to be in the same level. The distinctive feature of this printing technique is the fact that the printing and non-printing areas have opponent physical and chemical properties. In order to achieve the ink-repellent effect on the non-printing areas, a water based solution (fountain solution) that contains certain additives is used. A vital factor in offset is to establish the best water-ink balance, since too high or too low water level can badly affect the final product quality. This is one of the reasons why physical and chemical surface properties of the substances used in offset have to be carefully monitored. The most important physical phenomenon which occurs on the surface of the printing plate in both the printing and the non-printing areas is adsorption. Adsorption is an accumulation of particles of one phase on the boundary between two phases. In this case, solid phase is the aluminum-oxide from which non-printing area of the printing plate are built, and the other phase is the liquid water based solution. The next important characteristic of the non-printing areas is surface roughness, which is directly related to the adsorption, and defines it. Roughness of the printing plate's non-printing areas determines its alteration, friction between them and a water based solution, and it also characterizes the sensitivity of a surface, appearance, consumption etc. [Mahovic – Poljacek 2006]. To become rough enough, the printing plate need to be grained. A degree of micro-roughness varies depending on how the graining has been done. The grained non-printing areas have its peaks and recessions, whose features are defined by certain roughness parameters [Hoshino, 2005].

In general, the salient surface points (peaks) of the wrinkles absorb more water based solution due to the higher level of free surface energy in those areas. All the substances tend to minimize their energy state as it is the most stable state. To minimize their energy state, they have to minimize their number of boundary molecules and, therefore, have to minimize their surface area [Novakovic 2009]. To make the fountain solution better wett the non-printing areas, the surface tension of the fountain solution need to be reduced. For this purpose 2-propanol is commonly used graphic industry. The lower the surface tension is, the lower is the contact angle between aluminium-oxide and fountain solution, consequently wetting of the non-printing areas is better. All of these characteristics of non-printing areas on the printing plate can be changed during the printing process. These changes can appear as a result of the pressure on the printing plate. This pressure can be produced by the printing cylinder during printing), rising temperature in the printing press or because of the high print run [Risovic 2008 ].

The aim of this study was to analyze surface topography made with standard stylus profilometric method of non-printing areas of printing plate.

For this purpose we have used one type of lithographic printing plate with the assumption of same surface structures and roughness of the non-image (aluminum oxide) areas. This selection was motivated by two reasons: firstly, as the size and quality of the grained surface microstructure influence the printing performance and durability of the printing plates [Hutchinson 2001] they are manufactured

according to stringent, standardized procedures [ISO 12218:1997] resulting in surfaces of controlled and reproducible roughness suitable for the purpose of this study, and secondly, for the reasons of technological importance of printing plate's surface characterization.

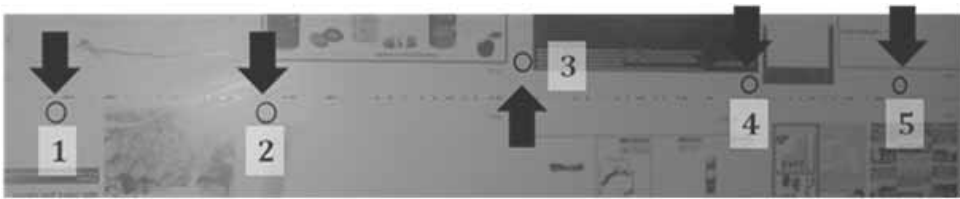
## 2. Materials and Method

The investigations were performed on the Kodak Sword Ultra T98 CtP positive offset plates of 0.3 mm thick with a thermal active layer and the Kodak Goldstar premium developer. The paper used in printing process was the UPM Ultra H web gloss-coated 56 g/m<sup>2</sup> and the Sun Chemical heat-set top gloss colors were used.

The Kodak Sword Ultra is an aluminum-based, electrochemically grained and anodized plate. Due to its polar characteristics, the Al<sub>2</sub>O<sub>3</sub> layer creates the non-printing areas on the printing form. The Kodak Sword Ultra plate is rated for up to 400.000 impressions if unbaked. However, if baked, it can achieve run lengths of 1.500.000. For this experiment, the run length was 300.000 impressions. Consequently, the printing plate was not baked.

The measurements were made at unused sample and on samples taken after a print run of 300.000 impressions. Print runs were done on four color printing machine with a four basic printing colors: cyan, magenta, yellow and black. For each color a single printing plate was used. Two printing plates were analyzed. One processed plate was used to identify the non-printing areas before printing. All separations were developed with a fresh new developer.

The measurements were done on each printing plate, but for this investigation we have used the data obtained from measurements on printing plate for cyan and yellow color. In this study measurements were taken at five distinct points in the non image areas of the printing plate sample, positioned along the line of printing pressure in the printing sets (Figure 1).



**Figure 1. Positions of the taken samples on the printing plate**

The profilometric parameters were measured with the Portable Surface Roughness Tester TR200 [C] provided with a diamond tip with 2 μm radius. The TR200 is capable of evaluating different roughness parameters: *R<sub>a</sub>*, *R<sub>z</sub>*, *R<sub>y</sub>*, *R<sub>q</sub>*, *R<sub>t</sub>*, *R<sub>p</sub>*, *R<sub>max</sub>*, *R<sub>m</sub>*, *R<sub>3z</sub>*, *S*, *S<sub>m</sub>*, *S<sub>k</sub>*, *tp*, and hybrid parameters: primary profile (*P*), roughness profile (*R*), tp curve (material ratio *Mr*) defined according to pertinent ISO standards [ISO 4287:1997, ISO 4288:1996].

The measured surface roughness parameters used in this study are compliant to the geometric product specification standards [ISO 4287:1997, ISO 4288:1996] and listed below:

- *R<sub>a</sub>* - average surface roughness:

$$R_a = \frac{1}{l} \int_0^l |y(x)| dx$$

- *R<sub>q</sub>* - root-mean-square deviation (*R<sub>rms</sub>*):

$$R_q = \sqrt{\frac{1}{l} \int_0^l y^2(x) dx}$$

-  $R_{zDIN}$  – mean value of the single roughness depths  $Z_i$ :

$$R_{zDIN} = \frac{1}{n}(Z_1 + Z_2 + \dots + Z_n)$$

-  $R_p$  - leveling depth, distance between highest peak and the reference line

The SEM micrographs of the samples were made by JEOL JSM 6460 LV scanning electron microscope. To assure the uniform electrical properties and to avoid the charging/discharging of aluminum oxide surfaces, the printing plate samples (radius 1,5 cm) were gold coated by ion sputtering (15.0 nm thick, density 19.32 g/cm<sup>3</sup>). The images were taken at working distance of 15 mm at voltage 20kV and at scanning angle of 35° with magnification of 5000x.

### 3. Result and Discussion

Before measuring the roughness parameters, some visual analyses of the SEM pictures were done. They involved detecting the differences between unused plate and plate used for 300.000 printed sheets. The best roughness can be seen on the plate which was not used in the printing process. SEM micrographs of surface topography of an unused printing plate and cyan and yellow sample after 300.000 impressions are shown in Fig 1, 2, 3, respectively. The changes in surface topography induced by multiple usage of printing plate are clearly seen and manifested as lowering of the peaks and flattening of the valleys. Multiple applications of pressure during printing eventually result in flattening of the surface and smoothening of its features (cf. Fig 3)

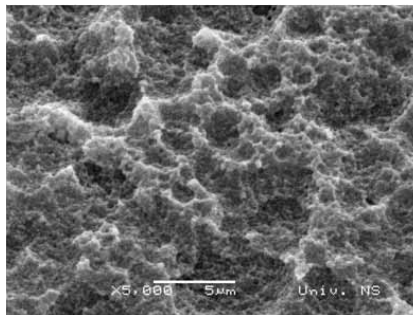


Fig. 2. SEM micrographs of a) unused PP sample

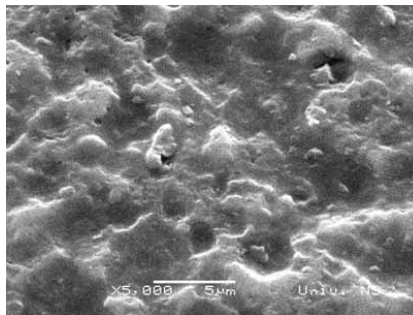
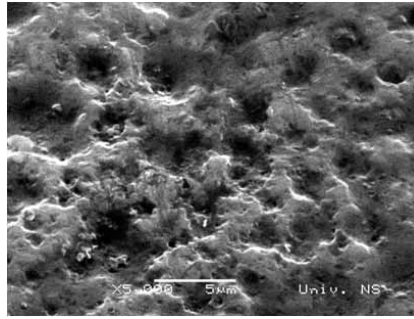
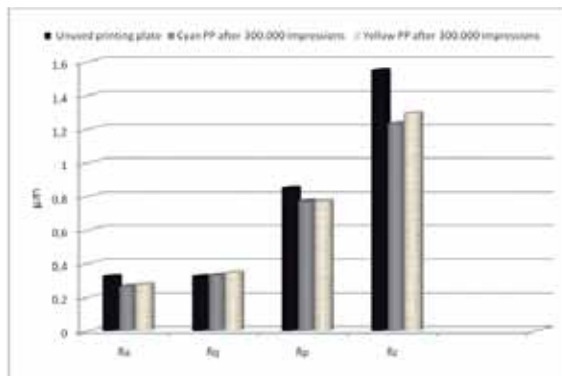


Fig. 3. SEM micrographs of Cyan after 300.000



**Fig. 4. SEM micrographs of Yellow after 300.000 impressions (scanning angle 35o)**

Profilometric values of the analyzed plates shows a similar results of the measured parameters. Unused plate has a small difference compared with the two used printing plates for the print run. Changes in printing plate surface topography result in changes of the corresponding roughness profiles. Compliant with the visual change of surface topography due to multiple use of printing plates noticeable in SEM micrographs (cf. Fig.1) the measured roughness profiles indicate decrease in roughness due to flattening of the printing plate surface induced by applied printing pressure. This is manifested as a decrease in values of all roughness parameters. The changes of measured profilometric parameters for analysed printing plates of unused printing plate and cyan and yellow printing plate after 300.000 impressions are shown on Figure 4.



**Figure 4. Roughness parameters of Unused printing plate and printing plates after 300.000 impressions for Yellow and Cyan color**

Geometrical changes in the microstructure of the non-printing areas of the printing forms caused by the printing conditions were measured by determining of the roughness parameters. The measurement roughness parameters were set up in according with the ISO 4287 standard. The relevant measurement's parameters were: sampling length: 0.25 mm, traversing speed:  $V_t = 0.135$  mm/s, measuring range:  $\pm 20$   $\mu\text{m}$ , and resolution: 0.01  $\mu\text{m}$ .

The surface parameters were measured on the five different spots on the non-printing printing plate samples. Every spot on the samples was measured three times and the corresponding average value is presented in the Table 1.

**Table 1. The average values of the obtained roughness parameters**

Parameters ( $\mu\text{m}$ )	Number of plate print run		
	Unused plate	Cyan 300.000	Yellow 300.000
Ra	0,323	0,2632	0,2758
Rq	0,323	0,3322	0,3488
Rp	0,8512	0,7706	0,7708
Rz	1,5496	1,2334	1,2942

The results shown in Table 1. for non-printing areas on unused plate in comparison with other two printing plates after print run of 300.000 impressions show different values as it was predicted and can be seen from the Figure1. This might have been caused by a higher printing pressure or a weaker influence of the wetting (damping) solution during printing. By decreasing the roughness parameter values and by removing all the active points on the surface topography, adsorption of the wetting solution is weaker.

#### 4. Conclusion

CtP technology is determined by characteristics of continuous development and very emphasized and quick changes. In order to improve productivity, increase quality and simplify operating, manufacturers focus their activity on modifications existing technologies.

Systematization of CtP technologies, studying basic principles and analyzing characteristics of every technology and its components, ensure quality of a final product – print. Since every component is one of the factors that affect results of a printing process, printing plates have a very important role [Hoshino, 2005].

The non-printing surface as well as the printing elements and their geometry have a paramount influence on the correct reproduction and the balance between the ink and the wetting solution. The results obtained show that depending on the length of the print run, considerable changes of the non-printing areas can appear. These changes yield the decrease of the roughness parameters values, which are caused by the  $\text{Al}_2\text{O}_3$  anodic layer dissolving. This results in the decrease of the active surface for adsorption and less quantity of the wetting solution is present. The surface roughness of the non-printing elements can be monitored and controlled by means of establishing standardized conditions during the development and printing, which includes an ink–water balance and an appropriate printing pressure. Further investigation in this area can be carried out by using print runs higher than 300.000 samples and by utilizing different printing plates as well as other materials (inks, wetting solution, papers etc).

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## PIXEL MANIPULATION IN SECURITY GRAPHICS

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*Keywords: pixel deformation, security graphics*

### 1. Introduction

In our research we affect the smallest pictorial element – the pixel in order to enhance security graphics solutions. We created new programming routines that define the appearance of pixels. The general opinion is that pixels are in the shape of squares. Postscript programming language gives us options to affect the shape of pixels so that they become rectangles or parallelograms. The existing picture manipulating programs give no such options for manipulating pixels, so it becomes harder to falsify documents. Postscript defines an image through a sequence of numbers and the postscript interpreter renders it starting from the top left corner, moving horizontally creating line by line and ending with the bottom right corner. Picture display, either on the monitor or printer, seeks data about number of pixels in a row, number of columns, size of the pixel and the position of the image on a page. All these parameters we influenced by stochastic congruence methods. We created new security design solutions that can be applied in security graphics.

### 2. Experimental work



**Figure 1. Stochastic generation of grays, frequency and angle of rasterization applied on text**

Experiments of applying stochastic screens in typographic examples show how easily random parameters for color, frequency, angle of rasterization can be defined for each glyph separately. Various types of screen elements, angle and frequency are particularly highlighted in Figure 1 because it is designed as a complete example of black and white solution. Figure 2. shows the same screen usage for pictogram shapes in the RGB system. The algorithm created chose alternatively screen elements from a data base and applied different parameters after each glyph. Our examples used four different screen elements that have randomly altered frequency and the angle of rasterization in each glyph.



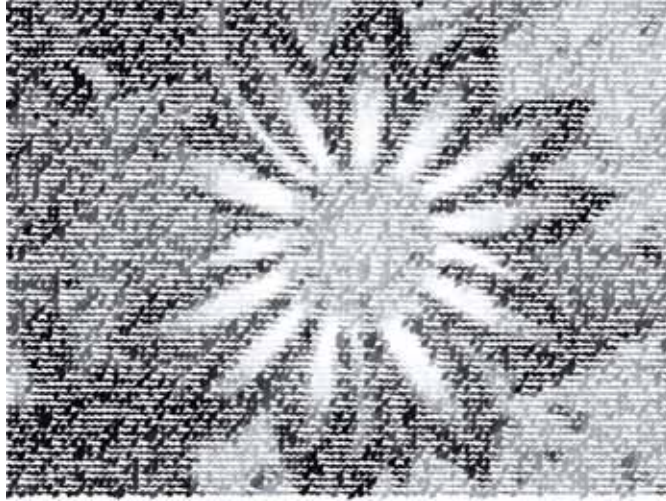
**Figure 2. Stochastic generation of frequency, angle and color applied on pictogram shapes**

However, pixel shape deformation is not possible when rasterizing text. Inside the shape of glyph the screen cell has a rigidly defined square shape which cannot be altered. Adversely, in bitmap images, pixels can be isolated as individual units and deformed at will in their own coordinate system. Figure 3. shows an uniform pixel deformation inside an image. All the pixels inside the image have the same deformation value, with parameters that create a parallelogram. Magenta channel has been inserted into a black and white image who's color values are defined randomly.



**Figure 3.**

In the attempt to minimize the possibility of image reproduction, each pixel has its own stochastic deformation value. Figure 4. shows this way of image construction where pixels have different shape and position definition. Each pixel has a different value of deformation, that can be controlled only through the interval set.



**Figure 4. Pixel deformation in a black and white image**

Pixel deformation is programmed by horizontal and vertical axis, and is achieved by implementing different formula for each axis :

$$\begin{array}{ll} -(a*rn-b) & \text{for horizontal deformation} \\ rn-c & \text{for vertical deformation} \end{array} \quad (1)$$

where a, b and c represent parameters defined by programmer, while rn represents the number generated stochastically in the interval between 0 and 1.

These formulas are implemented in transformational matrix of the pixel in PostScript language:

$$a \ rn \ mul \ b \ sub \ neg \ rn \ c \ sub \quad (2)$$

In Figure 4. example transformation of pixels is performed on black and white photograph for which in PostScript language the command “image” is required. Providing a random number and a programmers choice of parameters, each pixel is rendered and transformed with new and different parameters.

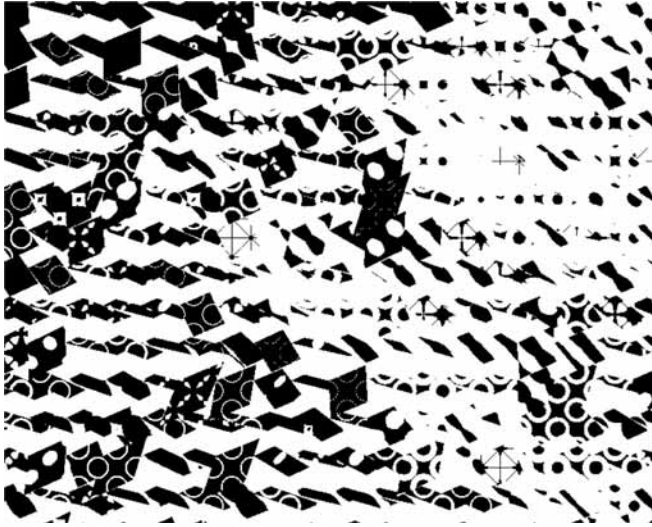
In addition to pixel transformation we applied four different screen elements. Stochastic formula is applied for rendering those screen elements, which gives additional security feature to the image. Here is presented the PostScript interpretation for those screening elements:

```
/r22 {dup 2 index dup dup mul mul mul abs sqrt 3 1 roll dup dup mul mul mul
abs sqrt exch sub abs 1 exch sub} bind def
```

```
/r21 { dup mul exch dup mul add 1 mul sqrt 120 mul sin abs 1 exch sub} bind
def % prsten neg
```

```
/r66 {kory mul dup mul exch 4 exp 2.71828 exch exp exch sub 2 div abs 5 div
} bind def
```

```
/r68 {kory mul dup mul exch 2 exp 0.25 exch exp exch sub 2 div abs 90 mul sin
abs 3 div } bind def
```



**Figure 5. Under magnification deformed pixels and random change of screen shapes can be observed**

In the example of black and white image a stochastic election of screen elements has been added (Figure 5.). Under magnification, we can see the structure of each pixel randomly selected screen element in order to better see the structure of raster elements, the stochastic distribution and strain. Under this kind of magnification, it is clear that the possibility of counterfeiting thus derived images are impossible. This method provides the programmer / designer great opportunities in creating a security graphics and design unique and valuable solutions.

Figure 6. is the same image but in color with different deformation values. The motif of the image is clearly recognizable, but also the image structure, therefore the smallest units of the image – pixels, that now effect the overall experience of the image. These kinds of possibilities, unavailable through the conventional tools for image manipulation give security graphic designers more freedom in security creation, but also different, more individual design solutions. Now the pixel, formerly known just as the carrier of color information, takes part in shape definition of graphics, through the variety of more extreme solutions where the motif is unrecognizable to subtle solutions, depending on the security demand for certain graphics.

Programming in PostScript, pixel transformation is defined by these formulas for horizontal and vertical transformation:

$$\begin{array}{ll} -d * rn & \text{for horizontal deformation} \\ f * rn & \text{for vertical deformation} \end{array} \quad (3)$$

where d and f, again, represent parameters defined by programmer, while rn represents the number generated stochastically in the interval between 0 and 1.

Transformational matrix of the pixel translated into PostScript language:

$$d \ rn \ mul \ neg \ f \ rn \ mul \quad (4)$$

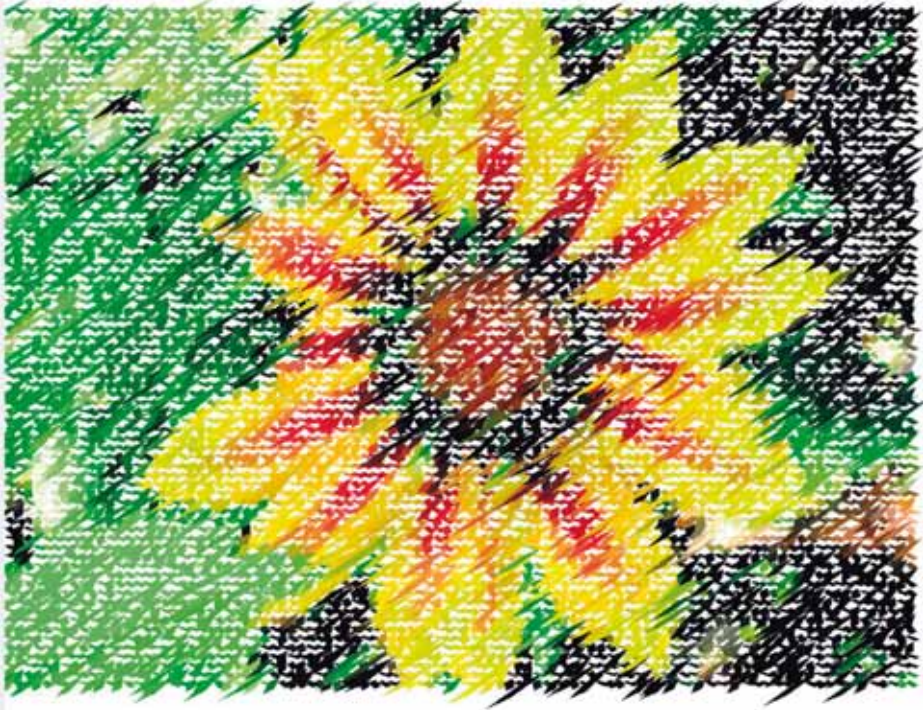


Figure 6. Pixel deformation in color images



Figure 7. Magnification shows stochastic deformation and screen element selection

Performed experiments are just a small part, with which we wanted to show the variety of possibilities in pixel manipulation and the security solutions that can be achieved. We experimented with changing the shape of screen element, its liliature and screening angle, which is programmed specifically for each RGB or CMYK channel, and merging those channels into one image. Figure 7. shows enlarged detail from Figure 6. to display the CMYK channels and their varying screen shapes, liliatures and screening angles. By adding the stochastic calculation for each element, as the example shows, such solutions are not reproducible without knowing specific parameters. By implementing stochastic calculation, we can assure the uniqueness of such graphical solutions.

### 3. Conclusion

Introducing the new security elements into security graphics expands the possibilities of creating quality and unique design solutions. Pixel deformation is achieved by simple programming solutions that completely control the elements of safety graphics. The programs are made in a way that each pixel is approached individually inside an image, which enables its complete shape autonomy. Stochastic methods are controlled by the programmer/designer that defines the change of type, frequency and screen angle, color and shape of pixels. In the experimental part different safety solutions applied in typography and bitmap images are presented. Almost unlimited possibilities of creating new screen elements with the use of stochastic definition of liliature and angle can guarantee the production of variety of individualized solutions which can find their use in every aspect of graphic design for products that require implementation of security features.

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## HUE AND SATURATION SHIFTS IN SOFT PROOF AND NON IMPACT IMAGES

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*Keywords: colorimetric measurement, tertiar colors, achromatic reproduction*

### 1. Introduction

The aim of any reproduction process is to present or reproduce desired color, it means as possible information of aimed color, to the destination product. In this occurrence target colors were on the printed sheet, meaning they served as original, and the goal was to reproduce them as well as a print and for the screen (web) purposes. Like in that case, only colorimetric values as a starting point could be used, a workflow for such a process had to be established. As a general illuminant conditions D65 illuminant was chosen as for viewing and measuring purposes. For workflow and color management [Heidelberg 2006, Fraser 2005, Green 1999] starting point was the screen, calibrated with paths leading to standard RGB space, and if needed with appropriate profile that can serve for soft proof purposes, and to destination calibrated cmyk spaces for coated and uncoated substrate reproduction system. For other screen purposes adequate screen profile should be applied. The proposed reproduction way-workflow for color management is rearranged, so target values through defined profiles were presented on the screen and then recalculated. Finding the “pure” cmy values was important for avoiding possible interference of achromatic actions [Hunt 1995], as achromatic reproduction is interesting in various aspects of reproduction.

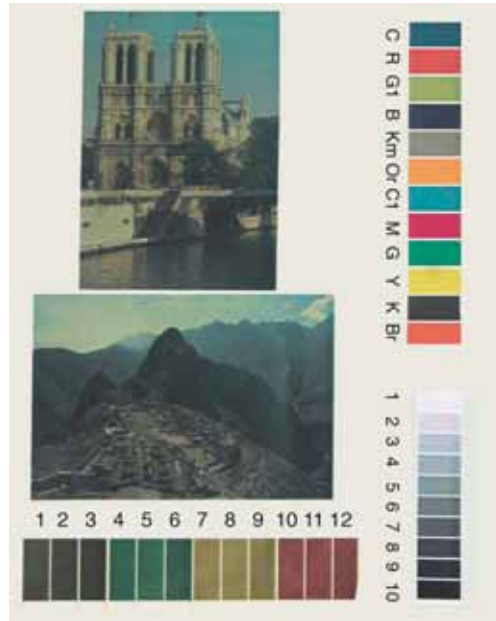
The input information was an image containing some custom patches (1-7), primary and secondary colors and a grey scale (for inspecting, if necessary, gamut and density range), the aim was to prepare color information in a way to be acceptable for various purposes, assuming possibility interchanging information in distinct spaces (systems). Patches 4 and 7 were selected.

As target (custom) colors practically could be treated as tertiar in cmyk space, a suitable achromatic approach [Yule 2000], for reproduction purposes was applied [Agić et al 2009]. as well extended spectrum region purposes reproduction [K. Pap et al 2009] . For demanded observed conditions profiles were made, so compared measurements between systems could be carried out.

### 2. Experimental and discussion

Selected patches on the original image were measured as standard Lab colorimetric values. The original was imaged with a Nikon digital camera with an appropriate embedded camera profile. The screen was calibrated as a standard RGB space, and Epson Stylus pro 3800 proofing printer as a output device, profiles for quality (coated) [ISO 12647] and newsprint reproduction. As the colorimetric values of proposed colors (patches) do not express higher values if saturation and lightness, the absolute rendering intent was involved.

According to Xrite Color Profile Calculator presumed subsequent output values were obtained:



**Figure 1: layout of the predominated image (tertiar color patches denoted 1-7, a grey wedge 1-10, and combination of basic primary and secondary colors)**

**Table 1: colorimetric values of preferred patches**

patch	L	a	b
4	45	-33	27
7	59	-1	46

**Table 2: coverages for coated reproduction (c, m, y, k as % â)**

patch	c	m	y	k
4	82	26	95	10
7	40	34	93	5

**Table 3: coverages for uncoated reproduction (c, m, y, k as % â)**

patch	c	m	y	k
4	94	23	99	21
7	35	29	99	11

According to this calculated output coverages is obvious that they consist all reproduction cmyk (as tertiar colors) a recalculation to cmy values according to equation (1):

$$\hat{a}k = \hat{a}x(1-k)+k \tag{1}$$

where  $\hat{a}x$  denotes primary process color inks coverage and “k” black ink coverage. Recalculated coverages are shown i tables 4 and 5.

**Table 4: c m y coverages (coated, as % â)**

patch	c	m	y
4	83	14	90
7	15	14	80

**Table 5: c m y coverages (uncoated as % â)**

patch	c	m	y
4	90	22	98
7	19	16	98

These coverages correspond to “pure” coverages, where only primary c-m-y values are used in graphic reproduction. Theoretically, in such simple selection reproduction model (including “k” coverage) the total c-m-y-k coverage would be 400 (full coverage) , respectively 360, if the last reproducible primary coverage is 90 percent, and after this value is reproduction as solid (full coverage) . Associate to this problem is the dot gain impact, so such a medium achromatic reduction is also suggested in specifications, customized for specified process. According to ISO specification a lower coverage is preferred for various practical reasons. It is assumed for this purpose, according to gray component reducing system, to use approximate 300 percent coverage what means about 75 % of starting weights. In Table 6 approximate for 300 percent recalculated (reduced) coverages are presented. As an example, for patch 4 coated, maximum reduction coverage weights would be: c-m-y-k: 69-0-76-14.

**Table 6: reduced coverages for coated reproduction (as % â)**

patch	c	m	y	k
4	62	10	67	10
7	11	30	60	11

**Table 7: reduced coverages for uncoated reproduction (as % â)**

patch	c	m	y	k
4	67	16	73	16
7	14	12	61	12

Adopting these (re)calculated weights as starting setting for reproduction respecting preferred profiles, reproduction was acquired. Colorimetric Lab values of input and output images were determined and compared.

**Table 7: h and c values**

	h	c
Predicted patch 4	138	42
Predicted patch 7	92	45
Reproduced coat.4	127	36
Reproduced coat. 7	86	43
Reproduced uncoat 4	131	32
Reproduced uncoat. 7	84	39
Screen patch 4	132	47
Screen patch 7	88	51

As supposed, predicted patches required in reproduction some differences in reproduced values occurred, as shown in table 7. Hue angle (h) in all combinations is lower than the predicted one, chromacity (c) mainly similar with not meaningful deviations. Patch 4 shows lower mutual differences, probably that that patch as a yellowish hue, consist some lower tertiar component (tables 2, 3, 4) than the other. Screen patches Lab values can be converted to another target RGB space. Assumed the reproduction way-workflow was somewhat non standard cause recalculations that leaded from predicted values to “pure” values to obtain conditionally starting point (and values) for a reproduction, and then again recalculate to recommended cmyk. Used rendering intent prefered to mantain chromaticy, as the basic color gamut was not particular wide, in screen gamut what is larger higher value was allowed.

### 3. Conclusions

In graphic reproduction posibility of reproducing some non standard e.g. tertiar colors can be troublesome. Introducing or implementing special (non process) additional colors in graphic reproduction process can be usefull and accomodating in “colorfulness, tone reproduction and overall density range”, but can cause additional separation and various other production problems. From another view, reproduction in standard cmyk subdues to achromatic principles (according tom ISO), so compromise has to be carried out, regardless to theoretical statements. A nonstandard workflow applied, recalculations conduced the differences that occurred in observed systems. Irrespective to this rearranged workflow, for achieving more adoptable results for such non standard purposes, custom procedures have to be involved.

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## THE CONSTRUCTION OF CORRUGATED BOXES AS A KEY PARAMETER OF THEIR STRENGTH

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*Keywords: Corrugated cardboard, transport box, strength construction*

**Abstracts:** This study was directed to examine the strength of RSC type cardboard box depending on height of the box. Boxes with different heights were made from several types of corrugated cardboard. It was investigated whether the influence of height of the box on box strength is linear or not. In theoretical part production of corrugated cardboard and cardboard package is described in detail with many photographs, as well as tests of the corrugated cardboard and cardboard box. Experiment results show flute and linerboard properties, corrugated cardboard properties and cardboard box strength depending on construction and materials of the box.

### 1. Introduction

Corrugated cardboard is the material most often used to create transport packaging and other products such as billboards, toys, furniture. It is also used for product protection. Corrugated cardboard has very good mechanical properties, which means that it is lightweight, strong, and resistant to moisture [Henlon 1998]. Its most important feature is that it is inexpensive, easy to be printed and to recycle. The most important characteristic of transport packaging made of corrugated cardboard is protection of the product that is packed, in order to remain intact during transport, storage and handling, which is in the interest of the producer and the buyer. In order to get such packaging specifications as mentioned previously, quality control of packaging must be performed in order to meet all manufacturer's requirements. For „Holland type“ of boxes, due to their application in the food industry, it is very important to be resistant to moisture, not to contain toxic ingredients, and to have dimensional stability so that they can be stacked when stored. To be able to stack as many of them one on another, the lowest box must bear all the weight, and it is important that the boxes have appropriate strength. Resistance of boxes to crushing is influenced by many factors such as: properties of raw materials, box construction [Mark 1993]., its size and type of wave used. This paper examines the strength of a „Holland type“ box, depending on the material and construction. The basic structures are investigated in this study V1, V2 folding machine box Holand tipe, manual folding box type the same size (600 x 400 x 185 mm), three different quality materials (1917BC2, 12255BC3, 5410BC3). Examined the dependence of different boxes and different construction materials that affect the strength tests show properties boxes corrugated cardboard and a dependence of strength transportation boxes holand type of structure and properties of corrugated cardboard boxes which were made. After the results displayed below analysis and conclusion about the strength of the box depending on design and quality materials.

### 2. Experimental part

Several requirements must be met to apply a „Holland type“ box for packaging of certain types of fruits and vegetables. Storing fruits in refrigerators to save space requires folding boxes with packaged fruit very high one on another. During transport over long distances by ship, train or truck, where

conditions of controlled atmosphere with low temperature and increased relative humidity are present, dynamic load of especially bottom boxes in the stack is also present. The load of the boxes is the highest precisely during transport. Therefore, boxes must be so designed that they can withstand all the loads and changes in the atmosphere. This paper investigates basic box constructions, V1-machine folding „Holland type“ of box, V2-machine folding „Holland type“ of box and manually folding „Holland type“ of box, RS. All three boxes were made of five-layer corrugated cardboard 1917BC2, 12255BC3 and 5410BC3.

### 3. „Holland type“ of boxes observed

#### 3.1. V1 Construction

According to theoretical expectations, V1 construction should be the most resistant to crushing due to the same height of all sides. The weight that presses is distributed to the corners and to the top surface of all sides. This construction is most often produced, since it is the most resistant to crushing.

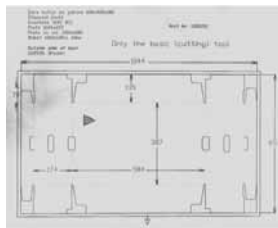


Figure 1. Drawing of a machine folding box V1

#### 3.2. V2 Construction

Since all sides of V2 construction are not of the same height, the results of crushing should be worse than the results of the V1 construction. The weight that presses is distributed, as it is expected, only to the corners of the box, which are the main bearing elements of the box. V2 construction is slightly weaker than V1, but it is more air-permeable because of the additional side openings.

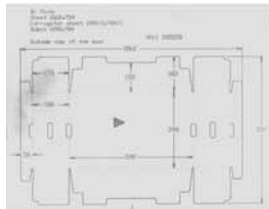


Figure 2. Drawing of a machine folding box S2

#### 3.3. RS Construction (manual folding)

Manual folding construction is just an alternative construction, which is as a rule very rarely produced, because for objective reasons it has the weakest mechanical properties with respect to crushing. It is produced only in cases when the client does not have a machine for folding boxes, and they are folded manually. Their advantage is that a folding machine is not necessary, but the disadvantage is that assembly takes a long time.



Table 3. Material labelled with 5410 BC3

Quality identification	5410 BC <sub>3</sub>
Box code	opened box of fruit and vegetables <i>holand tipe</i>
Dimension of box/board (mm) (l*w*h)	600 x 400 x 185 external dimensions
Quality of corrugated cardboard: number of layers, type of paper, type of wave	kraftliner 175 g/m <sup>2</sup> fluting 150 g/m <sup>2</sup> kraftliner 140 g/m <sup>2</sup> fluting 150 g/m <sup>2</sup> white kraftliner 175 g/m <sup>2</sup> five-layer corrugated cardboard
Surface weight of corrugated cardboard (g/m <sup>2</sup> ) (ISO 536)	960 g/m <sup>2</sup> ± 5%
Thickness of corrugated cardboard (mm) (DIN 53105)	6,45- 6,65 mm
Mullen test, resistance to bursting BST (kPa) (ISO 2759)	min 1780 kPa
ECT test (kN/m) (ISO 3037)	min 11,30 kN/m
Moisture content % (ISO 287)	7% ±1

## 5. Test results

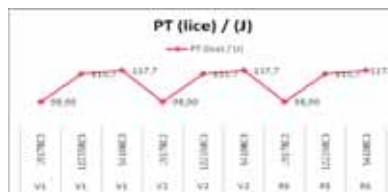
Diagram 1. Results of BCT-(minimum) test for all three constructions and qualities



Diagram 2. Results of BCT-(maximum) test for all three constructions and qualities



Diagram 3. Results of PT-(face) for all three constructions and qualities



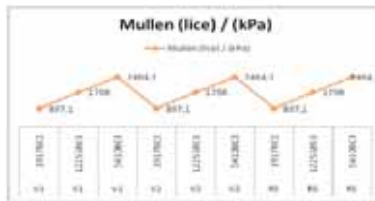
**Diagram 4. Results of PT-(back) test for all three constructions and qualities**



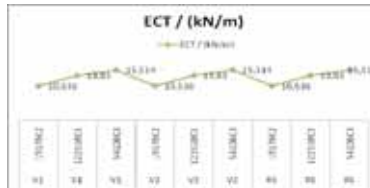
**Diagram 5. Results of Mullen test (back) for all three constructions and qualities**



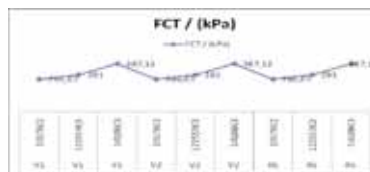
**Diagram 6. Results of Mullen-(face) test for all three constructions and qualities**



**Diagram 7. Results of ECT test for all three constructions and qualities**



**Diagram 8. Results of FCT test for all three constructions and qualities**



## 6. Conclusion

The expected box strength from the beginning of the study were not confirmed. Namely, it was expected for the manually folding box (RS) to be the weakest, however, measurements showed the

opposite, that this box was the strongest. If further surveys confirm the same, it can be claimed with certainty that it is best to fabricate such a box because it is not necessary to buy expensive machinery for folding boxes. Based on the results obtained by testing of corrugated cardboard and corrugated boxes it can be concluded that the properties of raw materials for production of corrugated cardboard, thus the properties of corrugated cardboard, greatly impact box strength in relation to crushing. The better the mechanical properties of paper layers and corrugated cardboard are, the stronger the boxes made of corrugated cardboard will be, and more resistant to vertical pressure. Given the fact that box strength is determined by many factors, it cannot be distinguished which of them would influence box resistance to crushing at the most, and therefore, an increase in the value of ECT does not cause a linear increase in box resistance to crushing, which is otherwise very closely related. The highest values of the properties tested had the corrugated cardboard 5410BC3, whose constituent sheets were stronger and of better quality, while somewhat lower values were established for the corrugated cardboard 12255BC3 quality.

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## INFLUENCE OF THE PAPER COATING ON THE PRINTING PLATE'S PROPERTIES IN WEB OFFSET PRINTING

K. Dragčević, M. Barišić and Z. Sabati

*Key words: paper coating, printing plate, web offset printing*

### 1. Introduction

The main task of the dampening solution in the offset printing is oleofobisation of the free surfaces on the printing plate. Ink which is then applied binds only to the surfaces of the printing plate and with the damping solution, under the influence of pressure, through offset rubber sheet is transferred to the printing surface (paper tape).

In addition to its primary role, damping solutions with the passage through the printing machine also maintains the pH value of the surfaces of the machine parts with which it comes into contact. With the proper emulsifying damping solution gives a proper ink viscosity, stickiness, gloss, drying contributory and allows standardization of colorimetric parameters of the ink on the print.

Passing through the printing machine, surface of the paper and its coatings, because of the friction between the paper and offset cylinder and chemical dissolution, by the rotating machine parts based on the cross from the offset cylinder and comes to the printing plate. Ink and dampening solution with the presence of dissolved paper coatings particulate, fillers, binders, grain of the paper, traces of pigments ... alter the properties required for good performance of the press. This phenomenon is inevitable, but at the optimum temperature of the printing press (30-35 °C) additives in the wetting solution (buffer, softeners, emulsifiers ...), and additives in the ink can compensate for this phenomenon, so it does not significantly affect the quality of the printing. The most important parameter that changes with the interaction of the paper coatings, ink and damping solution is the changes of rheological properties of dyes and stickiness itself. This phenomenon is especially pronounced if the temperature of the printing machine greatly deviates from the optimum (pronounced phenomenon in the summer months due to the increase in temperature of the machine, and much less frequently in winter months due to a lower temperature.) In the web offset printing the change of the appearance of sticking ink becomes more pronounced in systems that do not use iso-propyl alcohol in the damping solution, since the additional supplement do reduce surface tension, but do not cool parts of the printing machine.

If the printing machine is warmed significantly over the optimal temperature ink becomes more viscous and, less saturated with pigment. To maintain the colorimetric parameters the automatic systems for applying ink increase the drift. Because of the larger deposits and changing the chemical composition of ink on the offset rubber canvas and strengthen the cohesion and adhesion forces, which increases the pulling surface coatings. Covered papers incorporated in the ink, of which the most common chemical are calcium carbonate and cellulose fibers, through the offset rubber sheet come into the contact with the printing plate. With the successive influence of pollution from paper into the ink tribological system becomes much more aggressive and leads to increased wasting of the printing plates.

## 2. Experimental

In the real web offset printing system noted the increased spending of printing plates in specific cases is noted. In the most cases, such phenomena are related to the wrong photomechanical process during the printing plate preparation (the change of, exposure energy, concentration or composition of the developers, temperature and time of developing ...). A detailed analysis of all the issues that were printed in this system over a longer period excluded this possibility. All printing plates were processed according to the manufacturer's instructions and, in the most cases, holded the expected circulation (approximately 200,000 to 300,000 prints).

In this paper eight real issues (edition) during whose printing increased spending of printing plates is noticed were analyzed, and compared with the systems where this phenomenon did not occur. Table 1. shows the observed editions, the circulations which printing plate served in the quality limits deviations and papers used as the substrates. In four cases newspaper uncoated papers produced by two different manufacturers were used, and the remaining four on the bright coated paper of the same manufacturer but different grammage.

**Table 1. Overview of the publication, circulation and paper printing plates**

sample	edition	served circulation	paper
1.	EN br.1,1	23 000	newspaper RN 42,5 g/m <sup>2</sup>
2.	EN br.1,2	50 000	newspaper RN 42,5 g/m <sup>2</sup>
3.	GL br.1,1	40 000	coated LC 65 g/m <sup>2</sup>
4.	NEWS 1,1	40 000	newspaper SF 45 g/m <sup>2</sup>
5.	EN br. 2,1	38 000	newspaper RN 42,5 g/m <sup>2</sup>
6.	GL br. 2,1	50 000	coated LC 65 g/m <sup>2</sup>
7.	GL br. 2,2	60 000	coated LC 65 g/m <sup>2</sup>
8.	GL glam	12 000	coated LC 80 g/m <sup>2</sup>

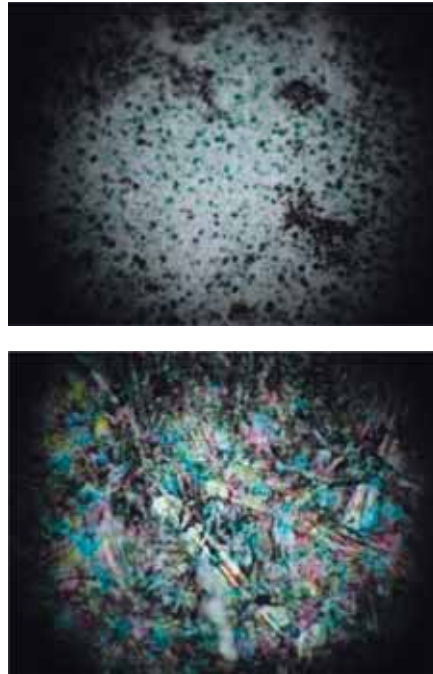
Ten samples of each paper (1x10cm strips) were drown in 100 ml of distilled water and realistic wetting solution for 4 seconds – as long as just melting of compounds on the surface of the paper last (the primary penetration). Prepared solutions were measured by electrical conductivity and pH value before and after treatment. By monitoring of conductivity and pH changes an indirect view to the amount of dissolved compounds from the surface of paper by chemical process and their influence on the composition of the wetting solution is got. By microscopic imaging all areas of printing forms where the damage occurred were observed and compared with the same areas on the print. All available data about factors affecting directly or indirectly on printing and printing quality (printing speed, the chemical composition of the wetting solution, the composition and supplier of the ink, the temperature of machine parts, colorimetric parameters of the image ...) were compared as well.

## 3. Research results

Table 2. presents the results for wetting solution in which surface coating of the papers are dissolved. Distilled water used for the preparation had pH value 6,78 and electrical conductivity 6  $\mu\text{Scm}^{-1}$  and realistic wetting solution pH value 5,12 and electrical conductivity 1425  $\mu\text{Scm}^{-1}$ .

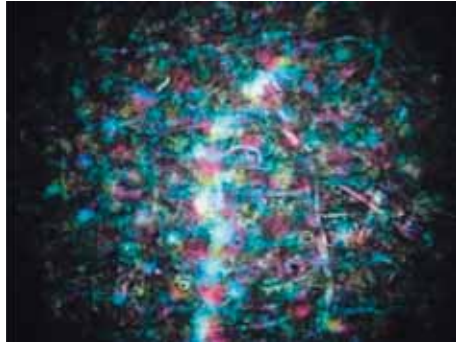
**Table 2. Change of pH and electrical conductivity**

paper	distilled water		realistic wetting solution	
	pH	$\kappa/\mu\text{Scm}^{-1}$	pH	$\kappa/\mu\text{Scm}^{-1}$
newspaper RN 42,5 g/m <sup>2</sup>	7,12	164	5,25	1456
newspaper SF 45 g/m <sup>2</sup>	7,54	428	5,82	1726
coated LC 65 g/m <sup>2</sup>	7,85	328	5,21	1502
coated LC 80 g/m <sup>2</sup>	7,80	334	5,23	1498

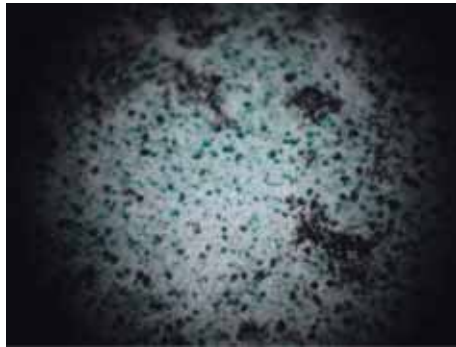


**Figure 1. Microscopic images of printing plate and print damages for edition EN br.1,1 (uncoated paper)**

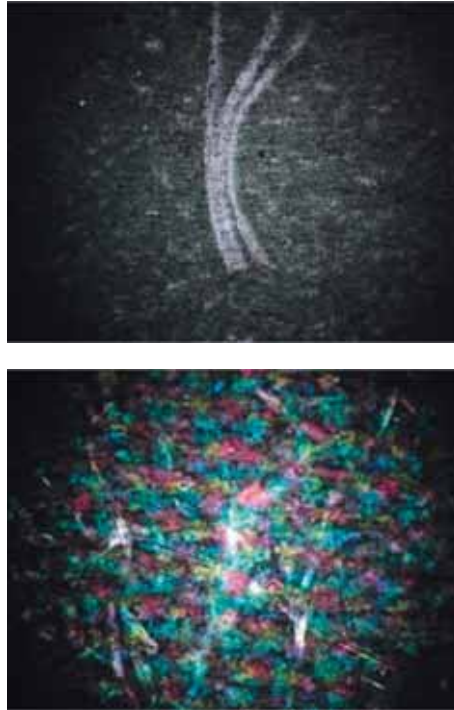




**Figure 2. Microscopic images of printing plate and print damages for edition GL br.1,1 (coated paper)**



**Figure 3. Microscopic images of printing plate and print damages for edition EN br. 2,1 (uncoated paper)**



**Figure 4. Microscopic images of printing plate and print damages for edition GL br. 2,1 (coated paper)**

#### **4. Discussion**

By monitoring the pH and electrical conductivity of paper coatings solutions it is determined that 42.5 g/m<sup>2</sup> Newspaper RN shows the smallest influence of dislocated compounds in wetting solution. The greatest change in pH and electrical conductivity were measured in solutions of newspaper SF 45 g/m<sup>2</sup> which is a lower quality paper.

By analysis of the data and microscopic images it is noted that in the system of printing on uncoated paper deformations on the printing plates, and then on the print come largely due to the crystallization of salts and alkali (mostly CaCO<sub>3</sub>, Ca(OH)<sub>2</sub>, MgCO<sub>3</sub>). All observed damages are coarse grained and crystalline structures, and are particularly pronounced in the full tone fields. The crystallization of salts is result of saturation of inks with dissolved surface compounds (directly or by emulgation with wetting solution), and due to the effect that buffer creates undisociated complexes.

In the system of printing on coated paper damage on the printing platte, and than on the print are more diverse. Besides the already mentioned presence of crystalline clusters observed were filamentous structures that are attributed to tear off the paper fibers are observed. Paper and cellulose fibers are not tribologically aggressive and it is not supposed that they cause spend of printing plates, but in picking in the printing process fibers bind other tribologically aggressive chemicals from the paper coatings. Comparing all the available parameters that affect the printing process in systems where increased spending of printing plates is noticed in systems where the printing plate withstood the intended circulation only parameter that could be correlated with the described deformations is temperature increase of the machine parts. All other observed parameters were within the standard limits for web offset printing system.

## 5. Conclusions

Influence of the paper coating during the printing process on the solution wetting causes the changes in the tribomechanical offset printing system, and this phenomenon is most prevalent in contact of offset and printing plate cylinder which leads to increased spend of the both cylinders.

The standardized conditions for web offset printing compounds added to the wetting solution and ink manage to compensate the influence of all components from the paper surface and maintain the printing quality parameters in the expected values.

Significant changes of printing machine, or some of its parts, temperature indirectly leads to increased sticking dyes, and therefore the usual chemical dissolution comes to mechanical plucking surface of paper. Uprooted compounds (cellulose fibers, china clay, crystal  $\text{CaCO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{MgCO}_3$ ,.... through offset rubber sheet transfer on the printing plate and there are adsorbed and enhancing its spend.

The presence of coarse crystalline structures that can be attributed to  $\text{CaCO}_3$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{MgCO}_3$ , and other hard-soluble compounds that are used as fillers in papers can be equally observed in the monitored system with all kinds of paper. Contrary to expectation, the presence of the cellulose fibers was significantly more observed in the printing on the coated papers.

Exclusively in the system printed on the newspaper SF 45  $\text{g/m}^2$  where the changes on the printing plates were observed in all aggregates, in all other systems the changing on the printing plate was noticed on the black aggregate.

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## OBJECTS DESIGN THAT RELIES ON THE MOTIVATION OF TRADE DOCTRINE

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*Keywords: motivation, graphic technology, simulation*

### 1. Introduction

The world in graphic engineering is turning today towards interdisciplinarity and fast technological changes towards digital techniques. We realize ourselves that the upgrade and knowledge design is a bare necessity in the graphic trade if we wish to remain competent on the labour market. Knowledge gained through a graphic artist's education disuses quickly, and we are already facing a question: How do you efficiently refresh that knowledge in printing? The answers can be found in: planning and lifelong learning. Lifelong learning has a key role in achieving a fast and high quality of specific social skills in learning/teaching graphic technology, which are directly useful in everyday practice and development of graphic artist's career. How to design a base for quality and development of new needs for motivational educational programs and self-learning e-learning in graphic trade?

Planning of learning from the future, or more precisely, planning of the learning from the immediate future is a discipline in printing that allows individuals, groups and organizations the way of learning with which they could change their activities according to making of the future in printing.

That is a kind of addenda to the learnings from the past or past experiences of graphic technology and printing. There is a need for new, designed ways of learning by using new graphic technologies in today's dynamic business situations. New situations that we can no longer learn from the past experiences. That is why we are in a search of answers to challenges that have never been a previous experience. "We do not have time to learn from the experience, making a lot of our most important decisions is direct doing" as it was said by Peter Seng. We must admit that we are leaving the past, people want something else, something innovative that they don't have and what they need in the future of graphic technology and printing. A deeper learning cycle is based on planning the learning on innovations and feeling the future of graphic technology and printing especially with the growth of the Internet, and as school networks they allowed the use of innovative and motivational learning of graphic technology.

Networks in classes for learning and teaching graphic technology are becoming a means of exchange and distribution of resources such as materials and programs, for teachers and students, sources of information of on-line communications as: - emails, - forums, - e-conferences, - collaborative tools.

Networks are an opportunity for both teachers and students as a resource for complementary and for additional planning of new education, research, any help, etc. So, the precondition is a society with mass use of home computers, the Internet and web sites. The emphasis of having a personal computer at home is the beginning of planned electronic learning which changes the educational system, teachers, methodology of teaching the graphic technology and it goes deep into the transformation of the whole educational system.

## **2. How to define the goal of teaching in graphic technology and printing?**

Do we ever realize the importance of full understanding of entire purposes and the goals of teaching graphic technology and printing is? As a young teacher, I started asking myself quite soon what the purpose of me being in the classroom is. The goal is that students master the study matters, the purpose is for them to develop an interest for further education. Can we set up such goal? Yes, that is a specific and poorly set up goal. From the consequences of a poorly set up goal, people can lose their jobs. If our role and goal is bare mastering of curriculum material, we can easily predict numerous influences that will disable us from achieving it. That set goal is not good because it is focused solely on mastering the curriculum material on graphic technology and printing. In our case, the goal should be to motivate our students as much as we can so that they can learn how to use and develop their skills with a help of innovations on the graphic area. We know that it takes hard work to learn how to achieve that goal.

In short, in the process of planning the learning of graphic technology in which, among other things, an important role have processes of thinking, we always find a certain level of independence, from very low to very high. R. E. Hull says: "When a school determines both the goals of learning and the media by which they will be achieved, it is called self-directed learning. In cases where the student determines the goals, and the media is determined by the school, we are talking about personalized learning. If the student determines both what he will learn and the way he will learn, it is called independent study." As we can see, R. E. Hull differentiates learning according to the levels of independence, taking into consideration two elements: goals and means (media) of achieving those goals. Here as well, as in many cases, the name is chosen by negotiation. The atmosphere in class is also important. To use all the possibilities of learning graphic technology and printing and to achieve the goal, students have to feel good and comfortable at school. The environment should be positive and they should accept positive life attitudes. Students at school need an environment that will help them find their identity, go through the adolescence phase and to achieve their own personal quality. If they don't have that, frustrations, insecurity and problems that come from the families are growing bigger or they are pushing them towards aggressivity, delinquency and addiction.

## **3. Teachers' motivation as a precondition to success**

It is obvious that motivation is of essential importance to succeed. How can a teacher successfully motivate? We influence the motivation in different ways: by marking, motivating the class atmosphere and by innovative motivation. Therefore an answer cannot be arid as: "This is according to the program, and they demand from me to teach you that!" The most important motivational reason for learning is natural curiosity, as well as a desire to learn something new. The goal is to intrigue the students with the most recent accomplishments in graphic trade. They have to start dreaming about it because they like it. Students will be happy to accept studying if it is interesting to them. They will not bother to ask if they will need that knowledge later if the designed innovational e-material and the way of learning as New eLearning is interesting to them. It is important that the teacher presents the material in the most interesting way possible. It is good that the classes are dynamic and that as many motivational means for help in class are being used, such as the Internet, photographs, innovations in graphic trade. The class has to be designed in a way that the students complete a certain exercise by themselves or in a group and present it in front of the whole class. What they do themselves is very encouraging and they present something they created themselves with much more love, effort and joy. If the students and the teachers find a certain subject or way of teaching interesting, it is easy to motivate them for studying – if we teach them to make something new because they find it interesting. The teacher has to motivate, give interest for further learning.

By accomplishing our goal, students realise, develop and use their skills to get good marks. If they get them, they get them not because someone gifted them, but because with good motivation they used their abilities to learn graphic technologies broadened via new eLearning admission. Studying is a hard intellectual work. You cannot force anyone to learn something he doesn't want (as it is hard to stop someone from learning something he really wants). Really, if we want to teach our students to study about graphic technology in their own free will, we need to motivate them. Force doesn't give any results. If we can assume for sure to demand for changes, we need to achieve graphic e-literacy for

our students in order for them to successfully function in high-tech society. In a high school syllabus and program, the teacher has to be the motivator focused on the trade. That poses a key question – can we put that in work? The graphic trade teacher needs to design the class by reducing or increasing the complexity of his questions, until he gets the proper answer speed and quality. That method is essential but not sufficient. That is why a student level has been introduced. It is defined in a way that students can use a survey to define wanted problems on a set model. (Žiljak V, Žiljak I, Pap K., 2005).

Based on serious results of modern scientific researches, it appears that in traditional class the teacher is central frustration of many. Every teacher, if creative, will develop his own strategy. Teaching is somewhat like art. Beside knowing the techniques, it demands an intuition as well. How do we successfully know how to motivate the students the best we can for learning graphic technology and printing? The goal should be to create, design such environment for students to use and develop their skills in learning with the new eLearning the best they can. In that way, the syllabus in graphic trade would be realized. While working with students, we need to remove the force as much as we can. By force, you cannot achieve good results with students. The teacher will need to motivate, interest the students for learning with innovations in the graphic trade. It is important to present the matter in an interesting way and suitable for their skills. If we keep encouraging our students and with our way of teaching we motivate them to study, they will achieve great results and that kind of work will bring satisfaction to both the students and the teachers. The teacher can use the new e-material for designing graphic technology and printing as: encouragement for work, additional information that supplement and upgrade the given information in a student or activity book, as a source of innovation, animation, sound, photography and film. The teacher can promote monitoring of other practical activities in the classroom, or outside in the nature. The teacher can plan the road of individualisation and differentiation in the class, relaxation and fun. Dr. Joe Boland said: “Teachers leave the stage of wisdom and become guides that stand aside.”

#### **4. Innovative contribution by using computers**

Using the computers and eLearning gives evidence about motivation and innovation of learning and teaching the graphic trade. Most of the teachers agree with the idea that by introducing computers as a learning tool, motivation is being largely improved. With eLearning the things that have been learned as the means of expansion and implementation are being applied. Introduction of computers helps the teachers to make the teaching subject more interesting and to transfer their enthusiasm to their students. Also, teachers can introduce teaching changes that are connected to technology of integration. They can set up more challenging goals with a high evaluation of suggestions, meaning, to better present more complicated materials in the sphere of graphic technology and printing which are being adjusted to the students and their individual needs. Teachers use the computer as a “dramatical” increase in self-respect and motivation of their students. Teachers in graphic trade also use a spectre of efficiency of development of technical skills. They involve and accomplish a greater number of complicated tasks. The increased use of information outside the source, improved creativity, improved communication skills. Advantages of a computer classroom are being used as the main motivation for innovation in graphic practice. In that way, scholastic tools are being given to expand students’ experiences and improve their performances. They are also used in promoting students’ independence and collaborative work. Projecting and designing the class, by using a combination of the Internet and New eLearning enables a more interesting learning, which is also interactive, integrated and independent. Informational and communicational technologies have created an environment suitable for collaborative motivational learning and for participation between the students [Fong-Ling Fu, et al. 2009]. With this paper we are trying to examine the design and development in the atmosphere of the motivational learning in the web-based learning context on innovations in graphic trade. The experiment will be carried out on the high school level with students that create an atmosphere of competitive and collaborative learning. In that atmosphere there will be changes and differences in learning and enjoying the learning about graphic trade and printing. The results will show that competition (defined as participation in a group, competition between the groups) is the best learning strategy because it encourages competition and collaboration between different types of knowledge. Competitive learning in this atmosphere will

encourage the students to develop greater analytical skills, while the atmosphere of collaborative learning will show the students' synthetic skills. [Fong-Ling Fu, Ya-Ling Wu, Hsi-Chuan Ho 2009]. Since both atmospheres contribute to learning, this research will show that combining in pedagogy in building the atmosphere for learning, does not only contribute to analytical and synthetical skills, but also brings to the general level of knowledge about graphic technology and printing. It is important to emphasize that planning and creation of studying environment which consolidates new motivational informational and communicational technologies, achieves a pedagogical aspect of increase of the level of knowledge on how to learn graphic technology.

## **5. Traditional graphic technology classroom**

In a traditional classroom of graphic technology, graphic preparation, printing and graphic processing put many vocations into one. In graphic preparation those are: text editing, picture scanning, digital cameras, archiving of pre-printed materials, transformation of record format, electronic graphic compression, usage of computers, planning of how the imprint will act in the printing machine and processing, waste planning and planning of printing and cutting, making decisions about relations between process and spot colours, planning of the method of colour separation depending on circulation, type of print, purpose of the graphic product, designing of the inner and outer image of the graphic product and many more. In printing, those are: graphic techniques – conventional and digital, sheet printing and role printing, varnishing, numbering, print for special purposes – packaging, labels, folio print, print on different materials for special occasions. In graphic processing that is: bending, encapsulation, cutting, printing, gluing, binding, sewing, perforation, counting. Special group contains works in which some things are hand made. Printing has in the past twenty years experienced a few unsuccessful pre-qualifications of its employees for the purpose of introducing the digital print and computers into graphic preparation. In the occupation's integrations many skills are not actual any more, many skills will not be needed anywhere anymore and there is a need for new skills. The new learning organization after schooling and life long education is expected in the concept of eLearning. Studies about the printing future are very modest and are mostly dealing with variables that in any case do not have any stronger changes (Žiljak, 2004). In prof. Žiljak's (he comes from the Faculty of Graphics Arts) demonstration, he proposes an organization of a knowledge base for the area of pre-press and printing as well as incubating software and hardware simulators for the area of graphic engineering. Simulation brings a new view on learning processes of graphic technology. Traditional learning and training of graphic production methods are becoming too expensive and inefficient. They developed a digital system of describing printing processes. Program support has been supported by data bases and algorithms that describe a virtual printer. The suggestion was to introduce a hybrid method and learning techniques in typography, reprography, printing by stating it is the best way to successfully train a graphic artist. Even after the mandatory education has been finished, simulation is the most efficient method for the later education. Simulation should be included in the syllabus so that the employee would start learning dedicated, new programs, after his school hours, by himself. With students a system of gaining knowledge through (as possible interactive) web/Internet technology should be developed in a way that students and teachers can create scenarios of simulation models because only then they can pose profound and complex questions and tasks. Simulation development in graphic education will continue. The best way is to direct the development towards the visual, interactive, multimedia programming. Simulators were created more as a part of some scientific or expert project and less as an order for some real printing procedure. Printing house which mostly produces books is completely different from the one that, for example, produces newspaper. Printing office that produces packagings is very much different from the one that, for example, whose graphic products are security papers and protected documents. To this huge diversity only some "new method" can help. The new learning organization after schooling and life long education is expected in the concept of eLearning. (Žiljak, 2004).

**Table 1. News in graphic trade**

<b>TRADITIONAL GRAPHIC TECHNOLOGY</b>	<b>NEWS IN GRAPHIC TRADE</b>
<b>PRE-PRESS</b>	
Hot type	
Photo type	
Computers – simple programs	Computers – newer computer programs (word, indesign, photoshop, corel drew, illustrator) A software tool that uses two pictures has been developed – Irdesign Computers
Typography	Web typography, creating of virtual layouts with new designer solutions, microtypography on securities, table type, programs for aesthetic typesetting of the text
Rephotography – uses expensive materials, prepares the film for DTP systems	Realistic systems combined typography and rephotography New raster elements
Chemistry – printing plates	Chemistry – completely defined by the plate buyers - pigments area
Chemigraphics – manual mounting	Chemigraphics – automatic mounting
	Immediate editing - iteration
<b>PRESS</b>	
Conventional press	More types of digital press
Newspaper production	Hybrid rotation
<b>POSTPRESS</b>	
Djelomična automatizacija: Partial automation: Printing, bending, gluing, cutting, binding, sewing, perforation, counting, binding in different ways, manual postpress	Infiltration of supplements More precise bending Partial automation High automation in newspaper production Specialized printing houses (complete automation) Multiple way of finalizing the product Automated procedures in packaging Manual setting for smaller circulations (holographics)

## **6. Designing a simulated learning of graphic technology**

Simulators have been used in the approach to learning a great number of vocations in prepress, printing and postpress: by physical models and video films, programs and interactive training and exercise modules and systems. However, today in printing it is only a demonstrative level, a unique one. By planning a simulated learning of graphic technology and printing from virtual to physical is a concept of teaching and learning, in which by combining and mixing of different educational styles and by using different classroom aids (computer, IR camera, IR scanner etc.) we are affecting the duration and quality of the graphic artist's education. That plays a key role in the ability of motivations focused on the future. Simulated/virtual style of learning graphic technology and printing is based on many different methods that teachers can use for teaching plans. Mixed learning and simulated style of learning prefers: on the one hand, by integration of a wide spectre of homeworks and activities in the class about teaching graphic technology, and on the other hand, using computer technology, interaction between students and teachers, and between students. (Žiljak V, Žiljak I, Pap K. 2004). New informational and communicational technologies and designing of simulated learning of new models would start a new wave of innovations in the education of graphic artists and eLearning. From

classic classrooms to a simulated learning with a help of innovations in graphic trade, results can be radical between students and teachers. That would lead to a drastic change between technology and design of models of learning graphic technology and printing. For successful designing and using of New eLearning in graphic trade, perspective dynamic performances and a defined agglomerate of basic abilities is needed. The results need to be submitted to the educational establishments in order for them to widen their understanding of the new eLearning on the innovations in the graphic trade. The results need to give guidance to help eLearning collaborators adapted from traditional classrooms with surroundings in the eLearning printing.

## Acknowledgement

A greater agreement between the theory and practice is important, and today's results show that a greater advancement can be achieved. We have to make an effort in designing a concrete choice of a syllabus of graphic technology. Considering the surroundings in the graphic trade, we need to plan the learning schedule: most of all a decision about learning goals, allocation of teachers' and students' roles and motivational and innovational e-material for learning graphic technology and printing. And finally, knowledge should be focused on a change of efforts and beliefs that the teachers need to acquire in order to create motivational surroundings for learning that encourages New eLearning in learning of graphic technology.

The research would show that at least two aspects of planned learning and surroundings are of crucial importance: increased knowledge in the process of learning on innovation as a goal of motivational learning and bigger attention to the students' role. Intelligent systems of e-learning in graphic technology belong to a category of e-learning where the process of learning and teaching are asynchronous. Sometimes this type of learning is called devided learning because the systems built for this kind of learning consist of re-usable components which diminish the price of their implementation. The subject's goal is that a student imagines the future of the development, to experiment with it and makes a research. Students need to develop imagining the future development of the subjects they are learning about. Students that actually develop that will be able to enjoy the confirmation of their development predictments.

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