ISSN: 2067-3809

ACTA TECHNICA CORVINIENSIS

BULLETIN OF ENGINEERING

fascicule 2
[April-June]

TOME IV
[2011]

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING

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– BULLETIN of ENGINEERING

ISSN: 2067-3809 [CD-Rom, online]

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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering. Fascicule 2 [April-June]

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UNIVERSITY POLITEHNICA TIMISOARA – FACULTY OF ENGINEERING HUNEDOARA
** * **
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Address:
5, Revolutiei,
331128, HUNEDOARA,
ROMANIA
*phones: **+4 0254 20 75 22***
*fax: **+4 0254 20 75 01; +4 0254 20 75 79***
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ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

CONTENT

Abstract:
In the light of the growing concern about climate change, an important part of resource exploitation from industrial society is connected to energy use. Integration of companies through material and energy exchanges lead to a more efficient use of resources as well as financial, social and environmental benefits for the local entities involved, as Systemic Design approach proves.
In order to make current industrial and energy systems more innovative and adapted to changes, Systemic Design theory should be applied. The analysis of seven case studies developed in Sweden, in the field of bio-energy system, helps to review this theory and define a framework with drivers and barriers to the development of self-organizing businesses.
Systemic Design generates Local Economic Development to establish the conceptual base and the analytical skills that are needed to harness local and regional economic change. Looking ahead the development of a multidisciplinary vision becomes crucial, in that way various skills are brought together, towards the emergence of a new culture of sustainable economic and technological innovation and process inspired by the dynamic operation of Nature that is the system for excellence.
This research analyzes seven best-practices in Sweden, which since the Eighties realizes green energy plants, to understand key-drivers and barriers. Research coordinators can facilitate the creation of self-sustaining network of companies.

Abstract:
Use of Information Technologies in product design allows to improve it's efficiency. Application of different IT tools allows reducing the time of preparation of the product for production as well as to reduce the manufacturing costs and improve the quality of the product. When work stand is considered as product, the design process of that product is even more important. Besides of capabilities of work stand manufacturing cost limitations it also effects reduction of costs of products which are manufactured at this work stand.
Sometimes design process of the work stand can have some weakness which cause low level of the ergonomic quality and can be the source of farther economical loses like low production capacity of the work stand, high level of lack, rapid wear of machines and tools, accidents, employee's exhaustion and other professional diseases. All loses which have been described above are incurred through many years of work stand exploitation.
Author of this paper proposed the innovatory approach for work stand environment design by using virtual reality techniques. Elaborated IT tools for design with the use of VR techniques enable to work stand design at the different branches of industries. With the consideration of mass production the development of ergonomic, convenient work stands becomes more and more important. That is why author's research investigations concerned at testing of new tools at the work stand design process for automotive industry. The results of these investigations will be presented as well.

Abstract:
This study outlines the application of electrolytic waste water treatment use for mine works out flowing water. It describes history and circumstances in the 5 mine works (tunnels) in Spišská Nová Ves region. Finally the article provides results of the experimental treatment of the mine out flowing water with high percentage removal of Cr, As, Cu and Hg.
Electro-coagulation method is very suitable for removal of heavy metals. Stated method is very suitable for removal of Cr, As, Cu and Hg from mine waters. By optimization of the process for every type of mining water would be the efficiency higher.

Abstract:
In order to meet the sustainability challenge, industry must include not only the eco-efficiency but also the product's environmental justification and the company policy in a production in order to become sustainable. Achieving sustainable development will require changes in industrial processes, in the type and quantity of resources used, in the treatment of waste, in the control of emissions, and in the products produced.
In order to achieve sustainable production, many efforts are invested in efficient production. Significant part of these efforts is made in the field of increasing energy efficiency. Particularly, in this paper attention is paid to increasing energy efficiency in pneumatic systems. Certain investigation and improvements are done in one beverage company in Serbia. In this paper is given an investigation of packaging and pallet machines, which had an inefficient work regime, inappropriately defined pressure, and position of suction cups. After investigation and applied corrections, significant results are obtained in the field of energy efficiency and sustainable production.

Abstract:
The geotechnical problems could be investigated with different methods, in this research work authors made an investigation on kaolinite modified under the thermal for 6 hours from 100 °C to 500 °C in increment of 100 °C for studying morphology, chemical composites and mechanical properties behavior of soil using SEM, XRF and triaxial tests. The result revealed that the thermal not changing kaolinite unit weight and cohesion up to application of 500 °C it could be expected of well resisting of this material under fire and also the thermal modified kaolinite angle of friction and it is resulted in the improvement of safe bearing capacity. And this is observed that the improvement of kaolinite mechanical characteristics under heat is not due to changing chemical composite and morphology this is may be due to modification of structural atomic of kaolinite minerals. It could be suggested that thermal could modified construction material and using that without shaping in the factory, and could be used as an unformed material and use as per requirements in the site for solving geotechnical problem like settlement, deformation, stability and failure of subsoil and structures.

Abstract:
Robots, specially self-controlled robots are part and parcels of flexible manufacturing system. Most robots are designed for special purpose automated task in manufacturing processes. Robot building blocks, such as controls, motors, drives etc. are standardized to a high degree that keeps the costs down on a competitive level for special made machines. The objective of this project was to design, construct, and to test hardware and software to create a micro-controller based robot platform for flexible movement of a robot. This paper demonstrates the implementation of Pulse Width Modulation technique and usage of Infrared signal in robots using microcontroller. Initially an obstacle detecting device was made using infrared signal. Depending upon the responses of the obstacle detector the robot is able to change its direction in such a way that the obstacle is avoided. After that Remote Control feature was added for easy controlling of the robot base. This designed base will be coupled with robot body for automated guided functions within a manufacturing system.

Abstract:
Water crisis is a major environmental problem and day by day, this problem is increasing with the rapid growth of industrialization and urbanization in all parts of the world. This paper is an attempt to investigate the water crisis in Gaza strip in Palestine because the water crisis in Gaza continues to worsen as the groundwater becomes increasingly polluted and the political situation delays hope of "resting" the Gaza aquifer and finding solutions for proper disposal of sewage and solid waste. The current situation results in diseases and violates the basic human rights of the people of Gaza. However, this study is proposed few strategies to minimize the risk, one of these strategies are secure Palestinian water rights and to strengthen water institutions to be able to govern water effectively and efficiently.

Abstract:
Lean manufacturing is an applied methodology of scientific, objective techniques that cause work tasks in a process to be performed with a minimum of non-value adding activities resulting in greatly reduced wait time, queue time, move time, administrative time, and other delays. This work addresses the implementation of lean principles in a construction equipment company. The prime objective is to evolve and test several strategies to eliminate waste on the shop floor. This paper describes an application of value stream mapping (VSM). Consequently, the present and future states of value stream maps are constructed to improve the production process by identifying waste and its sources. A noticeable reduction in cycle time and increase in cycle efficiency is confirmed. The production flow was optimized thus minimizing several non-value added activities/times such as bottlenecking time, waiting time, material handling time, etc. This case study can be useful in developing a more generic approach to design lean environment.

Abstract:
This paper presents results of optimal design of seismically loaded thin shelled liquid containing cylindrical vessels. Three support structures are bearing plate anchored to foundations, columns and cylindrical skirt. The goal is maximisation of customer satisfaction on the structure. The goal is defined as product of fuzzy satisfaction functions for decision variables like cost and limit states like buckling and overload. Discrete design variables are used. The FE method and standards are used to verify the optimum design. The results agree satisfactorily.

Abstract:
In this article, the temperature distribution in the unit cell for various inclusion shapes at different conductivity ratios, contact ratios and concentration were carried out by ANSYS software with suitable boundary conditions. The software validation and mesh size has been carried out.
The importance of two-phase materials such as ceramics, metal foams, emulsion and suspended systems, granular materials lies in many of the applications in microelectronic chip cooling, spacecraft structures, catalytic reactors, heat recovery process, heat exchangers, heat storage systems, petroleum refineries, nuclear reactors, electronic packaging, and food processing.
This problem has importance because of its analogy with the general susceptibility of dispersed media such as dielectric constant, refractive index, magnetic permittivity, electrical conductivity, elastic modulus, and diffusion coefficient.

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- ***THE 4TH INTERNATIONAL CONFERENCE ON MASS CUSTOMIZATION AND PERSONALIZATION IN CENTRAL EUROPE (MCP - CE 2010) -*** *MASS CUSTOMIZATION AND OPEN INNOVATION IN CENTRAL EUROPEAN REGION, organized in NOVI SAD, SERBIA, 22 – 24 SEPTEMBER 2010 [papers #11-14].*

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Rajcho ILARIONOV[1], Nikolai SHOPOV[2], Ivan SIMEONOV[3], Nikolai MADZHAROV[4], Hristo KILIFAREV[5]

ULTRASONIC METHOD FOR METAL RECOGNITION BY MEANS OF FAST WAVELET TRANSFORMATION

ABSTRACT:
A method for classification of metals is proposed in this paper. An ultrasound non-contact echo-location method is used for gathering information from tested metal samples, made of Aluminum, Chrome-Nickel, Brass, Copper, Cast-iron and Steel. The reflected signal is received and processed using methods for recognition of images. For forming of attributes for classification an apparatus of the discrete wavelet transformations with orthogonal wavelet basis functions is applied. The classification is realized by the method of "k-nearest neighbors" (kNN). The received data are shown and an evaluation of errors in the classification is done.

KEYWORDS:
metal recognition, wavelet, ultrasonic non-contact method, ultrasonic sensors

INTRODUCTION

Nowadays because of their advantages the ultrasound acoustic methods find applications in different areas of the contemporary science and engineering: metallographic, flaw detection, medical diagnostics, assessment of geometrical sizes of objects, investigation of physical properties of materials, etc. After the interaction with the tested objects the acoustic vibrations carry information, which can be easily processed in the computer system. For example, in the area of machine-building not always good qualification and practical experience of the staff are enough for identification of metals in different cases of the production process. The identification is necessary also when we need to choose a metal for using in the production or in the determination of its welding. Identification of steel, cast-iron and other metal scraps is especially important in the choice of the regime of their heat treatment in the blast-furnace.

These and many other cases in the practice impose a necessity for identification of metals. A method for non-contact ultrasound identification of metals is proposed in this paper.

Working out a system for identification of materials and particular of metals is a difficult task, requiring a complex theory, fast algorithms for data conversion and good technical facilities. The synthesis of a system for automatic non-destructive recognition is a multi-aspect task. It involves planning and conducting of experiments for collecting information, formation of samples for training and control, selection of classifier, reduction of recognition features, etc. Extracting useful information from the initial amount of data is an important step during every investigation. Analysis and generalization of data with big divergence is a difficult task. Usually the data consist of quantities, corresponding to some set of measured, statistically determined indexes or heuristically sanitized signs. Such set of indexes (signs) can be marked with a vector from numerical values. Every vector is presented with a point in the n-dimensional space. In the cases of two or three dimensions one can build up two or three-dimensional graphics, but when the dimension of data is bigger (n>3), presenting the vectors and their reciprocal connections is practically impossible. Because of that other methods for presenting the data are necessary. One of the main methods of approach is by reducing the dimension of the data. In this aspect a great variety of methods exist, which carry out the initial system of data to a space with a smaller dimension. These methods can be divided into two groups: methods of clusterization and projection methods. From geometrical point of view the main difference between them consists of the possibility the presentation of the input data to develop in a direction, which best recognizes their most essential particularities.

DESCRIPTION

Sequence of the recognition process

The steps that make up this approach are presented in Fig. 1.

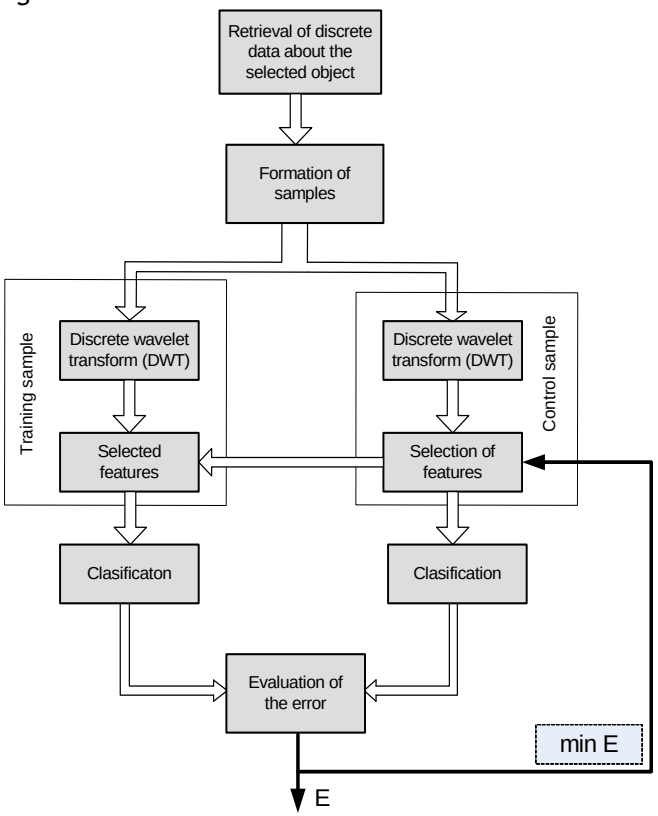

Figure 1 - General structure of the process "synthesis of a classificatory for recognition of metals" with an application of wavelets methods

Retrieval of discrete data about the selected object

The most commonly used method for retrieval of discrete data about the specific object is the pulse-code modulation [MM&WEB]. It expands the information about the object (the received analogue signal) by means of a discretization grid with coordinates along X - discretization frequency and along Y - the binary values of the numbers determined by the conversion digit capacity. The general solution is a binary sequence, which defines the discrete values of the signal. The number of solutions is determined by the discretization frequency and the duration of the analogue signal.

Formation of samples

The discrete data about a certain object are used for the formation of the so-called training sample and control sample. One of the ways for practical realization is by using a random-number generator for choosing samples out of the overall data set about the objects. After that the data are subject to further processing. The training sample is used to synthesize the classifiers, and their efficiency is tested by means of the control sample.

Wavelets methods for forming of features for recognition

Using of the method of wavelet transformation gives the possibility to form a complex of features for recognition (classification) of objects by strictly mathematical way. Its advantage in relation to spectral methods (Fourier transformation, discrete cosine transformation, transformation of Wolsh-Hadamard, etc.) for forming features for classification consists of the possibility for localization of different particularities of the analyzed signal, not only in the frequency range, but also in the time scale. The wavelet transformation is intermediate between the completely spectral (frequency) and completely time representation. By its localization in the time scale and in the frequency range the wavelets take a place between well localized in the frequency range sinusoidal functions and the function of Dirac - well localized in the time range. The wavelet transformation discretizes the signal into different frequency components, which gives a possibility for studying every component with good dividing ability, corresponding to its scale, and in such way good frequency-time localization can be achieved. Because of this characteristic the wavelets permit revealing of sharp "break-downs" and "peaks".

The continuous wavelet transform (CWT) is based on the use of two continuous functions that are integrable along the independent variable axis (figure 1):

- $\psi(x)$ - wavelet function showing the signal details and forming the detailizing coefficients;

- $\varphi(x)$ - scaling function determining the signal approximation and forming the approximation coefficients. The scaling functions are only inherent to orthogonal wavelets - Haar wavelets, Daubechies wavelets, Coiflets, etc.

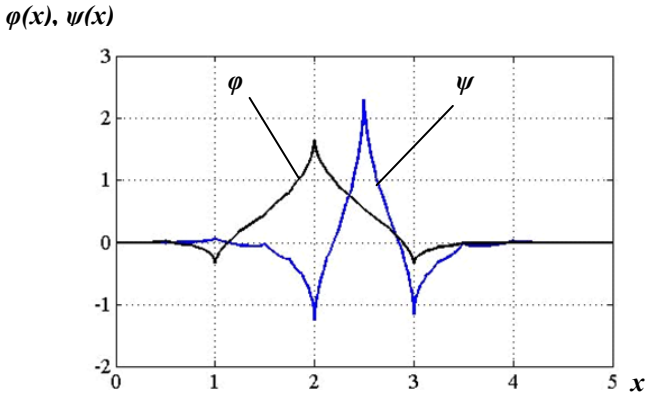

Figure 2 - The basic functions of wavelet Coiflet 1 'coif1'

The choice of the concrete wavelet is determined from the practical application and the type of the signal (smoothness, necessary level of discretization, ever growing time for transformation with growing dimension of the wavelet, etc.).

Despite of comparatively short time of development of the wavelet analysis the variety of wavelet functions is enormous. For example, only the family of orthogonal functions of Daubechies has more than ten representatives with different forms and range of existence. Up to the present moment great number of wavelet functions are well known - functions of Haar, Daubechies, Morlet, etc. [1,2,3,4].

In our investigation we used orthogonal wavelets, because for them a fast wavelet transformation exists, known yet as a pyramidal Mallat algorithm [5,6]. It is realized on the basis of an iteration algorithm following the diagram shown in Fig. 3. Signal U is passed to a low-frequency filter H and a high-frequency filter G with transfer functions, respectively [2,3]:

$$H(\omega) = \sum_{n \in Z} h_n e^{-in\omega} \quad (1)$$

$$G(\omega) = \sum_{n \in Z} g_n e^{-in\omega} , \quad (2)$$

corresponding to wavelet functions $\psi(x)$ and $\varphi(x)$. The filter coefficients h_n and g_n are calculated depending on the applied wavelet, and n is an integer. After reducing the number of the frequency components in half (binary decimation operation ($\downarrow 2$)), the approximation coefficients are obtained on level m = 1 - $a_{1,k}$ from filter H, while detailizing coefficients $d_{1,k}$ are obtained from filter G. In case of a higher level expansion, the approximation coefficients on level m = 1 ($a_{1,k}$) undergo analogous operations according to the diagram in Fig. 3.

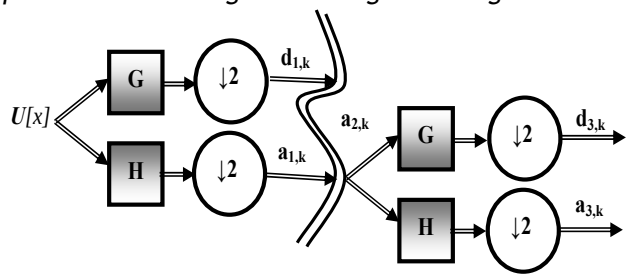

Figure 3 - Diagram of fast wavelet transformation m=3 levels

The approximation coefficients of the forward discrete wavelet transform on level m are calculated according to the dependence [7,8]:

$$A(m,k) = \int_{-\infty}^{\infty} 2^{-m/2} \varphi_0\left(2^{-m} x - k\right) U(x) dx , \quad (3)$$

but the detailizing coefficients are calculated after substitution of $\psi_0(x)$ by $\varphi_0(x)$:

$$D(m,k) = \int_{-\infty}^{\infty} 2^{-m/2} \psi_0\left(2^{-m} x - k\right) U(x) dx \quad (4)$$

In the general form the output signal on level m is represented by the expression:

$$U(x) = \sum_{k=-\infty}^{\infty} A_{m,k} \varphi_{m,k}(x) + \sum_{j=1}^{m} \sum_{k=-\infty}^{\infty} D_{j,k} \psi_k(x) \quad (5)$$

The proposed algorithm can be quickly executed in Matlab software environment.

Experimental Setup Scheme For Recognition Of Aluminum, Chrome-Nickel, Brass, Copper, Cast-Iron And Steel

The experiments conducted for collecting information have been realized using ultrasonic sensors of the type UST40T/UST40R [9].

The analysis of the ultrasonic signal returned upon reflection makes it possible to recognize various physical media. The block diagram of the experimental setup is shown in Fig. 4.

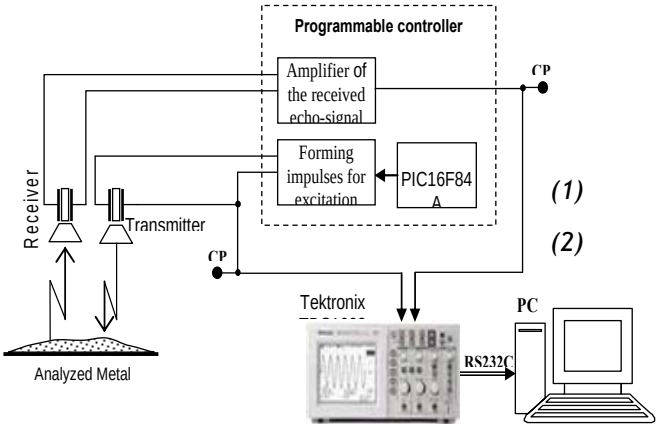

Figure 4 - Experimental setup scheme

The single-chip microcontroller excites the pulse former and a series of six pulses, each having a duration of 12,5 μs (40 kHz), is passed to the ultrasonic transducer, followed by a pause of interval 12 ms (Fig. 5). As a result, a short sequence of ultrasonic waves generated by a piezoelectric transducer is propagated in the working medium near to the analyzed object.

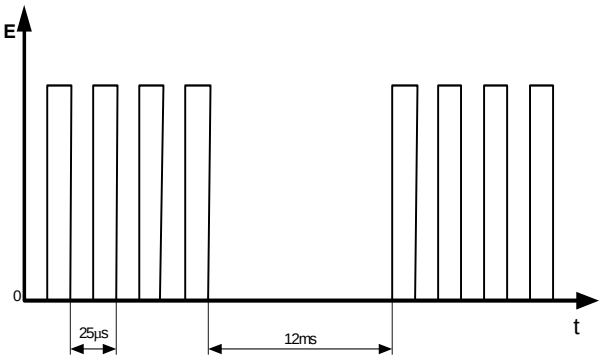

Figure 5 - Packets of square pulses for excitation of the transducer

The returned signal is amplified by the receiver and is then sent to the oscilloscope input. The discretization of the reflected signal is performed using the analogue-to-digital converter built in the oscilloscope with discretization frequency 500 kHz. Each measurement yields 2500 discrete values (records). The data are converted in an ASCII text file.

For the investigation of the above-mentioned materials (aluminum, chrome-nickel, brass, copper, cast-iron and steel) 60 measurements for each of them are performed with an equal distance (which is 50 cm) between the transducer and the analyzed medium.

The choice of these metals is based on their close similarity as a structure, the fact that they are different as substances and their wide use in industry.
By means of simulation using the Matlab software product [3], the approximation and detailizing coefficients of the occurrences in the training sample have been obtained (100 occurrences) on levels m =1 through m =9, applying DWT with orthogonal Haar, Daubechies, Coiflets and Symlet wavelets. During this processing, after reaching level m=8, the feature parts are reduced to 10 coefficients as a result (obtained upon dividing 2500 discretes by 2^8). Fig. 6, 7, 8, 9, 10 and Fig. 11 present the results after the continuous wavelet transformation (continuous wavelet spectrum), compared to the reflected signal for the respective material.

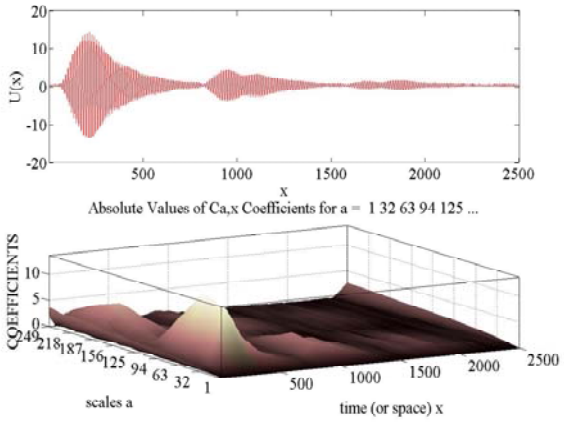

Figure 6 – Aluminum

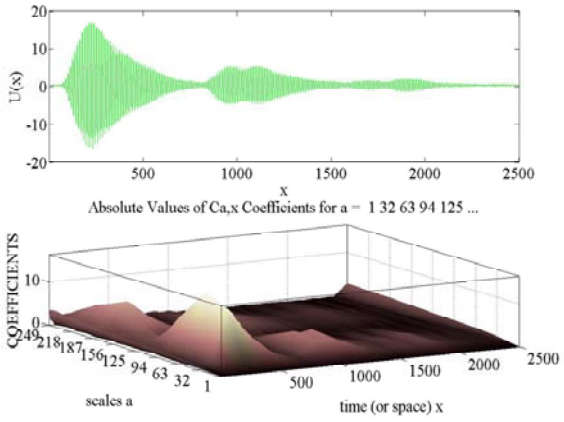

Figure 7 – Chrome-nickel

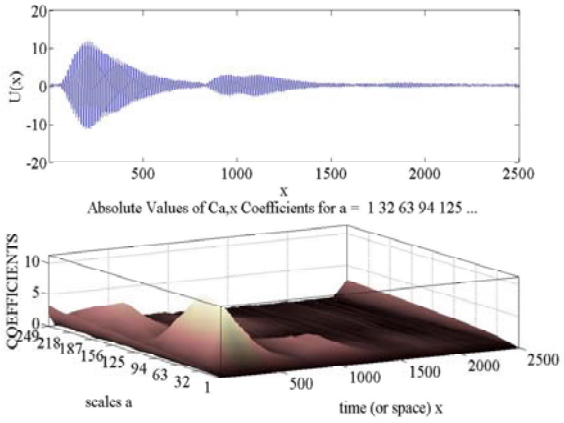

Figure 8 - Brass

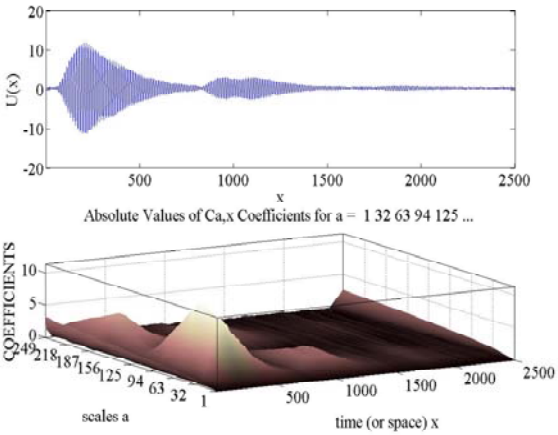

Figure 9 - Copper

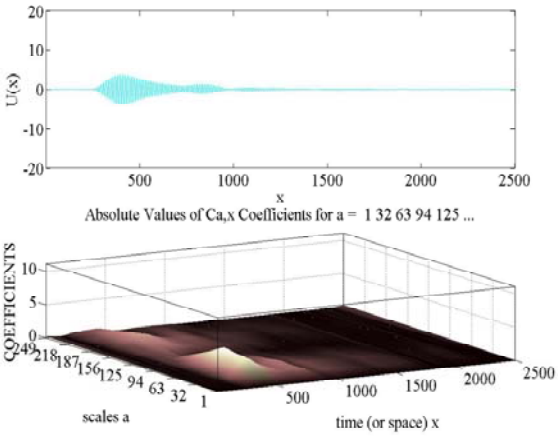

Figure 10 - Steel

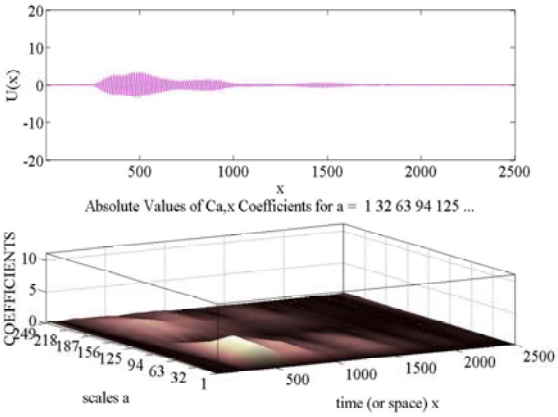

Figure 11 - Cast-iron

The obtained coefficients have been studied in the capacity of recognition (classification) features. Fig. 12 and Fig. 13 present the approximation and detailizing coefficients after discrete wavelet transform (DWT) on level m=8, which yields the best results. As can be seen from the obtained 10 features (coefficients), the greatest distinction is achieved for number one and number four.
On the basis of the obtained features, six clusters have been defined, corresponding to the materials to be identified. These are presented in Fig. 14 and Fig. 15.

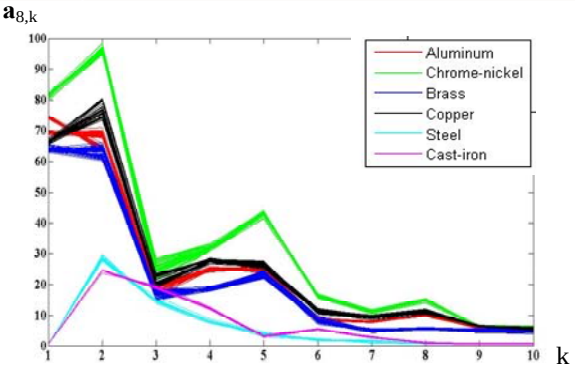

Figure 12 - Approximation coefficients at level m=8

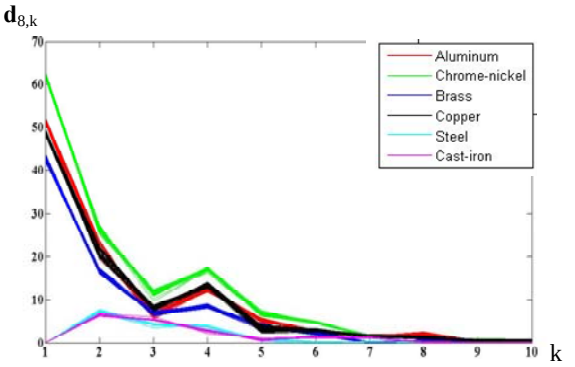

Figure 13 - Detailizing coefficients at level m=8

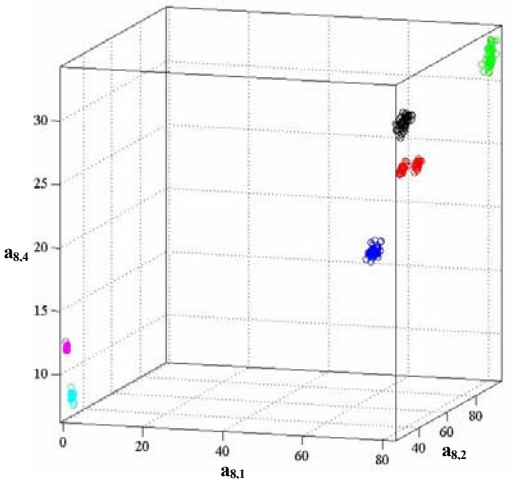

Figure 14 - Clusters with approximation coefficients $a_{8,k}$ k=1,2 and 4

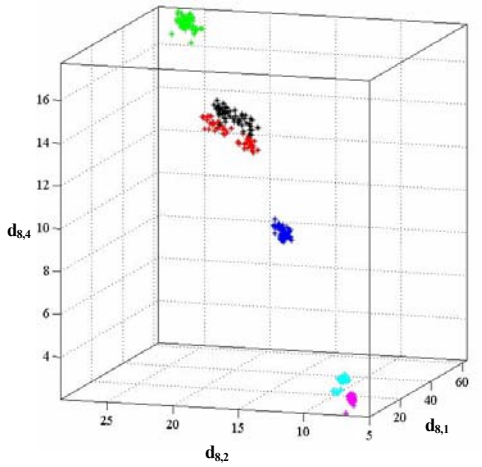

Figure 15 - Clusters with detail coefficients $d_{8,k}$ k=1,2 and 4

It can be seen in Fig. 14 and Fig. 15 that there is no overlapping, instead there is a clear distinction between the cluster zones, which is, in practice, a prerequisite for error-free operation. The selected classifier that operates using the k-nearest neighbor (KNN) method [10] takes into account the Euclidean distance to the three nearest neighbors - figure 16.

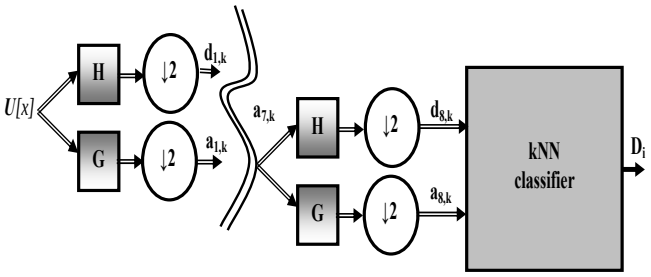

Figure 16 - Block-diagram of kNN classifier with wavelet forming of features

Table 1 - Results obtained for the classification of the validation set (197 measurements) with wavelet "Haar", level m=8 of features $a_{8,k}$ k=4

Metals for identification		Classified by the classifier, number							Errors	
		Al	CrNi	CuZn	Cu	Steel	Cast-iron	Total	Real	Main
Class	m_{ik}	m_{i1}	m_{i2}	m_{i3}	m_{i4}	m_{i5}	m_{i6}	бр.	g_i,%	e_i,%
Al	m_{1k}	27	0	0	0	0	0	27	0	0
CrNi	m_{2k}	0	34	0	0	0	0	34	0	0
CuZn	m_{3k}	0	0	38	0	0	0	38	0	0
Cu	m_{4k}	0	0	0	36	0	0	36	0	0
Steel	m_{5k}	0	0	0	0	28	0	28	0	0
Cast-iron	m_{6k}	0	0	0	0	0	34	34	0	0
Total	бр.	27	34	38	36	28	34	197	General error E=0%	

Table 1 summarizes the results obtained for the classification of the validation set of 197 measurements (other than those included in the training sample). As can be seen in the used classifier working with one feature only, the error is equal to zero and all measurements taken of the materials have been related to 100% of the respective clusters. On this basis one can train a system for recognition of different materials.

CONCLUSION

The main advantage of the applied method is in the possibility for receiving the features for classification by strictly mathematical procedure, so avoiding the subjectivity during heuristically forming of features. That makes a classificatory practically applicable.

ACKNOWLEDGMENT

This study was carried out in the framework of the DRNF 02/9 project titled "Design and development of a device for non-contact ultrasonic investigation of materials aimed at embedding in automated

manufacture systems ", financed by the National Science Fund of the Bulgarian Ministry of Education, Youth and Science.

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AUTHORS & AFFILIATION

Rajcho ILARIONOV[1],
Nikolai SHOPOV[2],
Ivan SIMEONOV[3],
Nikolai MADZHAROV[4],
Hristo KILIFAREV[5]

[1,3] TECHNICAL UNIVERSITY OF GABROVO, DEPARTMENT OF COMPUTER SYSTEMS AND TECHNOLOGIES, H. Dimitar 4, GABROVO, BULGARIA
[2] UNIVERSITY OF FOOD TECHNOLOGY – PLOVDIV, DEPARTMENT OF COMPUTER SYSTEMS AND TECHNOLOGIES, Bul. Maritza 26, PLOVDIV, BULGARIA
[4] TECHNICAL UNIVERSITY OF GABROVO, DEPARTMENT OF ELECTRONICS, H. Dimitar 4, GABROVO, BULGARIA
[5] TECHNICAL UNIVERSITY OF GABROVO, DEPARTMENT OF AUTOMATION, INFORMATION AND CONTROL SYSTEMS, H. Dimitar 4, GABROVO, BULGARIA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Viera POPPEOVÁ[1], Juraj URÍČEK[2], Peter ŠINDLER[3], Vladimír BULEJ[4]

THE CONCEPT OF HSC MILLING MACHINE WITH HYBRID KINEMATIC STRUCTURE APPLICATION

ABSTRACT:
This paper describes the concept of high speed cutting (HSC) milling machine based on hybrid kinematic structure. Hybrid machines are characterized by connecting advantages of both type mechanisms together – high dynamics of parallel mechanisms for positioning and high flexibility and high mobility range of serial mechanisms for orientation. For the application for HSC milling operation we select the mechanism called trivariant. This mechanism is similar to the well known and top-selling concept represented by various realization of tricept. At our department were designed few alternatives and selected the best one, there was built the first small-scale mechanism prototype used for testing, functional verification but also for education and training. Designed was also the simulation software and control system based on standard PC for this prototype. Our prototype is designed like small CNC milling machine but it is possible to modify it also for the manipulation with objects like robot device. According to the application (milling machine or robot) mechanism can work with 5 or 6 degrees of freedom.

KEYWORDS:
machine tools, parallel kinematic structure, hybrid structure, milling, high speed cutting

INTRODUCTION

For the past few years extensive research activities have been conducted in the area of machines with parallel kinematic structure for application as machine tools. Many of these new machines are intended for high speed milling.

Serial milling machines may one day find their limits in high-speed milling due to their limited dynamic characteristics. Indeed, the major drawback of a serial structure is that it consists of a pile of actuated joints; hence the mass on board for the axis underneath can be huge. This is mainly the reason why parallel structures are of interest in milling: in order to go faster.

Such structures have been developed since 1980 for robotic tasks, while the first parallel kinematics machine tool appeared only 14 years later. Since then, a lot of papers have been published that deal with the potential of these structures in milling. The objective of this study is to show the potentialities of parallel structures in milling and especially in high-speed milling of free form surfaces, in comparison to serial structures.

Parallel kinematics structures have been used with success for robotic tasks since the early 1980s. Since the first presentation of parallel kinematics machines (PKM) in 1994, very few are used nowadays in industry, and when it is the case, they mainly achieve drilling operations. However, the dynamics of these structures could be of great interest for high-speed milling as their acceleration potential is much higher than that of serial structures.

PARALLEL KINEMATICS STRUCTURES AND MACHINES

A parallel mechanism is a closed-loop mechanism in which the end-effector is connected to the base by at least two independent kinematics chains [1, 2].

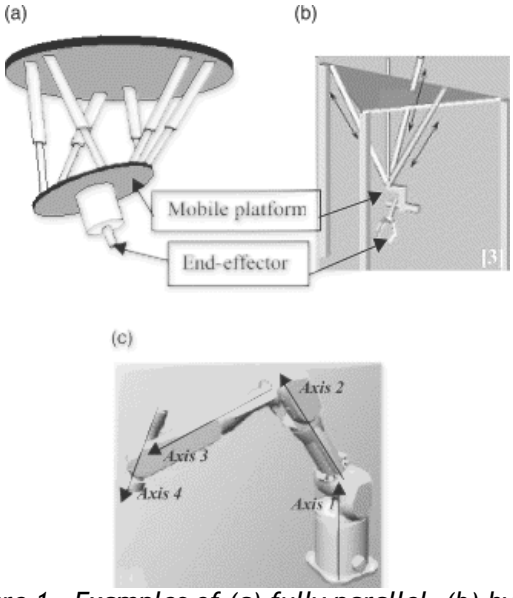

Figure 1 - Examples of (a) fully parallel, (b) hybrid parallel and (c) serial (anthropomorphic) mechanisms

One can classify these parallel mechanisms into two main families:

- *Fully parallel mechanism: a mechanism with an n-degrees-of-freedom (DOF) end-effector connected to the base by n independent kinematics chains, each having a single actuated joint (Fig. 1(a)).*
- *Hybrid parallel mechanism: a mechanism with an n-DOF end-effector connected to the base by m (m<n) independent kinematics chains, each having one or more actuated joints (Fig. 1(b)).*

Parallel manipulators are in "contrast with" serial manipulators, which are just a pile of actuated joints. The story of parallel structures is not simple; however, here are the main dates:

1813: Cauchy works on the first parallel mechanism called the Octahedral.

1947: McGough builds a mechanism similar to the Octahedral that he uses to test tires in different positions.

1965: Stewart develops this mechanism for flight simulators; here arises a well-known structure: the Stewart platform or Gough-Stewart platform (hexapod family). At this time, he imagines the possibility to develop this structure for machine tools or platform drilling.

1979: MacCallion designs the first mechanism that allows fine positioning, of interest in assembly tasks. It marks the beginning of the use of parallel structures for robotic tasks like pick and place [3].

Late 1980s, early 1990s: Numerous papers try to solve the different problems caused by these new architectures (calibration, accuracy, etc.]).

1994: The Variax (by Giddings and Lewis) is the first parallel kinematics machine tool, which is presented at the IMTS of Chicago.

Late 1990s, early 2000s: Many prototypes of PKM have been developed, but very few papers have been published dealing with their suitability in milling [1].

PKS APPLICATIONS

Parallel kinematics structures are particularly interesting as they can offer, in theory, great dynamics characteristics (i.e. high accuracy, high rigidity and high speed) while allowing a great load carrying capability. Hence, they are quite interesting to use in different domains like positioning devices, motion generators, and ultra-fast pick and place robots [2].

Depending on the task to be carried out, a structure will be more adequate than another. Indeed, for assembly tasks, the Delta is one of the most common robots encountered, as it is an ultra-light structure allowing great accelerations [3]. This parallel structure is composed of three parallelograms, which entirely constrain the orientation of the mobile platform in order to allow it only to translate (3 DOF) as shown in Fig. 2(a). In the same manner, hexapod structures are often used for flight simulators (Fig. 2(b)).

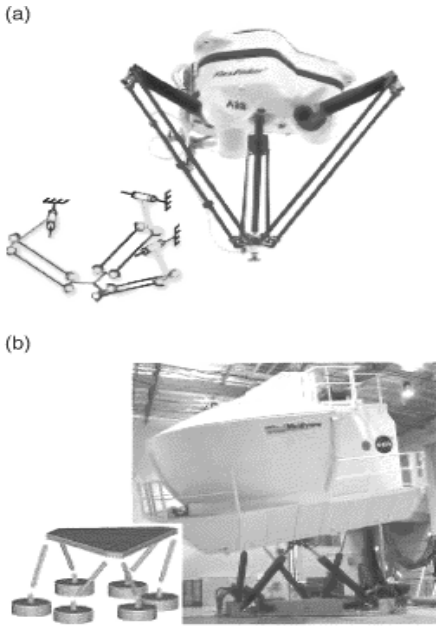

Figure 2 – (a) ABB's FlexPicker (Delta robot); (b) NASA's flight simulator (Hexapod)

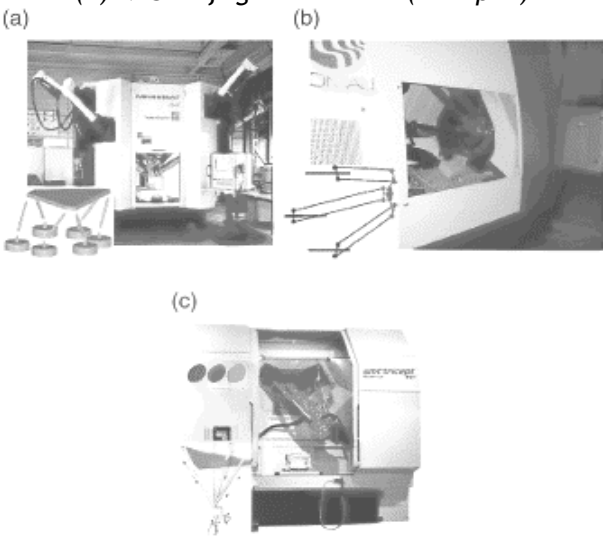

Figure 3 - Examples of PKM: (a) 6X; (b) Urane SX; (c) Tricept

In milling, the development of such structures is of great interest, especially for high-speed milling, as all the axes support the tool. Hence, the mass supported by each axis is less important with a parallel structure than with a serial structure for which the axis underneath supports the mass of the other axes plus that of the tool. Moreover, serial structures find their limits in terms of acceleration; hence, the great dynamics performances of parallel structures (high accelerations) will help in going faster.

PARALLEL KINEMATICS MACHINE TOOLS

Since 1994, many prototypes based on all kinds of structures have been developed (hexapods like the 6X developed by Mikromat, linear Delta robots like the Urane SX developed by Renault Automation), hybrids like the Tricept developed by SMT Tricept and etc. - Fig. 3).

Different studies and point of views, based on theoretical criteria (workspace volume, stiffness, etc.), have been given on the weakness of each parallel structure [4, 5]. However, as Merlet pointed out [2], the major problem encountered with the use of parallel structures in milling is due to the fact that all the advantages are only potentials. Any real parallel robot will present, in practice, impressive performances only if all its components (either hardware or software) present a high level of performance.

Hence, not all the prototypes of PKM developed are nowadays able to mill pieces in materials like aluminum alloy or steel. Among those that can, we can quote mainly Tricept of SMT Tricept (Sweden), Sprint Z3 of DS Technologies and Cincinnati (Germany and USA), 6X of Mikromat (Germany), CMW300 of CMW (France), Hermes of Fatronik (Spain), and P800 of Metrom (Germany).

In the same way, among the prototypes quoted before, only very few are nowadays used in industry. The most commercialized parallel kinematics machine tool is the Tricept from SMT Tricept. This CNC machine tool is used in automotive (e.g. General Motors, Renault, Volkswagen) and aerospace industries (e.g. Boeing) for milling, drilling, laser welding, and assembly. According to SMT Tricept, its strength, stability, and flexibility make it well suited for machining applications, especially in aluminum alloy [6].

In [7], the authors have done a synthesis of the main PKM that can be encountered in industry and research institutes. Thanks to a survey, they have been able to collect information on 46 PKMs; however, very few manufacturers gave the repeatability and accuracy of their machines. All this leads to a certain difficulty in estimating the potential of such machine tools. A recent study has been done in the UK, within the context of the EU CRAFT project RAMOULDIE, in order to compare the machining performance of the Variax (hexapod structure) with conventional 3- and 5-axis machine tools [8]. The authors have shown the difficulty in comparing machine tools which have different structures and different numerical controllers (NC).

So far, their conclusion is that for the test-piece and the criteria chosen, the hexapod has a similar level of accuracy but no better, which is already a great leap forward. However, more studies need to be done on other PKM in order to make a generalization if possible, or at least show the interest, or not, in such structures in milling.

DEVELOPMENT OF HYBRID MECHANISMUS

Hybrid kinematics structure combines together the advantages both types of kinematics - high dynamics of parallel mechanisms for positioning and high flexibility and high mobility range of serial mechanisms for orientation.

During the last decade, the mechanism with hybrid kinematic structure called tricept, has found various commercial applications, such as high-speed milling, welding and component assembling in aeronautical and automotive industry. One of these concepts is also the mechanism called trivariant, which is the main topic of this paper [9].

DESIGN OF MECHANICAL PART OF HYBRID MECHANISMS

From the viewpoint of mechanisms, the trivariant may be decomposed into the one spherical-coordinate parallel mechanism (PM) and the serial extension (SE; or also serial module) based on two or tree rotational joints with orthogonal axes. The subsystem with parallel kinematics represents the positioning of tool centre point (TCP) in mechanism's workspace whilst the serial extension covers the orientation of end-effector. The mechanism architecture is very similar to the classical tricept. The difference lies in PM, where is one active leg aligned with one passive leg. Kinematic scheme of trivariant hybrid structure is in figure 4.

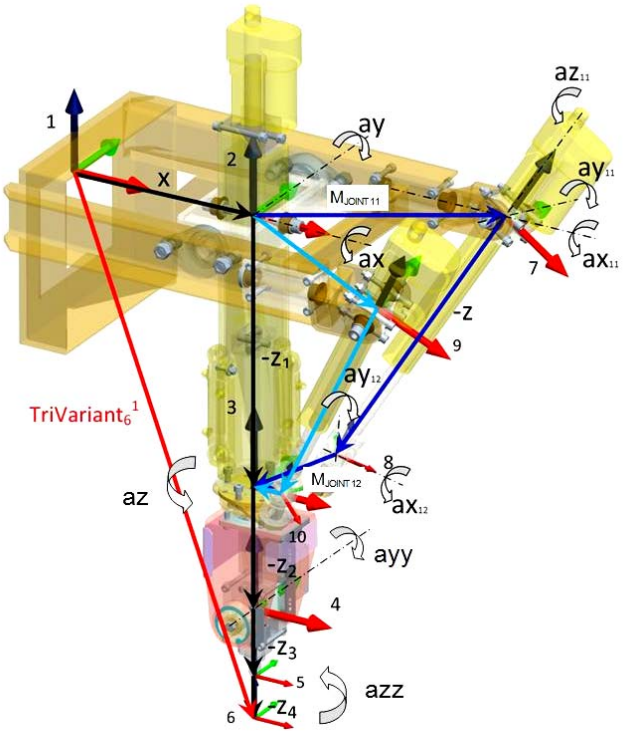

Figure 4 - Kinematic scheme of trivariant hybrid structure with coordinate systems (CS), movements and three kinematic loops: 1 - frame (GCS), 2 - central U joint, 3 - moving platform, 4 - basic part of serial extension, 5 - end-effector, 6 - tool, 7 - top-left U joint, 8 - bottom-left U joint, 9 - top-right U joint, 8 - bottom-right U joint, $M_{JOINT\ 11}$ - linear displacement of top-left U joint, $M_{JOINT\ 12}$ - linear displacement of bottom-left U joint.

After the end of design phase we have started the building of real mechanism prototype. We would like to apply it for machining operations, concretely milling.

The device has totally 5 degree of freedom (DOF), which is enough for the 5D machining. It is possible also to apply it like robot device for handling operations. But in this case one more rotational axis have to add to the kinematical scheme of SE.
Thereby we obtain mechanism with 6 DOF. In this time building of mechanism is finalized but the testing of all mechanical and also electrical components is still in progress. According to this point and also to the fact, that it is realized like a first prototype for practical verification of designed control system, there is a difference between real and theoretical value of accuracy. In the next period we will try to increase the mechanisms accuracy.

SIMULATION SOFTWARE

Simulation software was created for computer analyses of machine with hybrid kinematic structure. Software allows simulation kinematic properties of Trivariant machine and off-line computer control of tool movements. When the tool is moved from one point to another, software calculates all point of this trajectory and orientation of tool axis which are shown on figure 5.

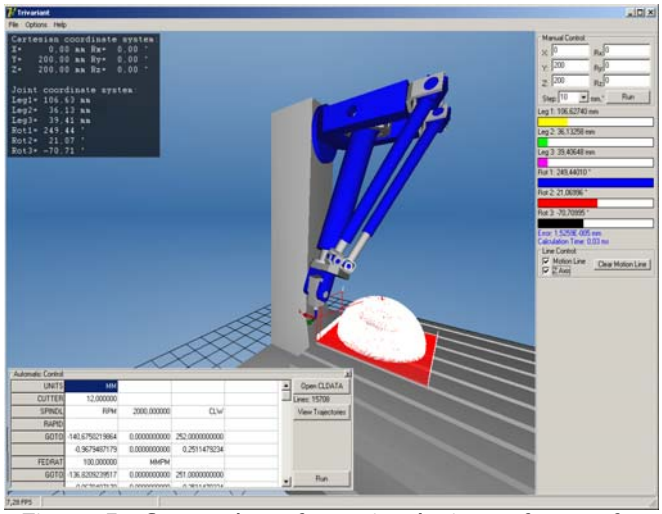

Figure 5 - Screenshots from simulation software for trivariant - main graphic window

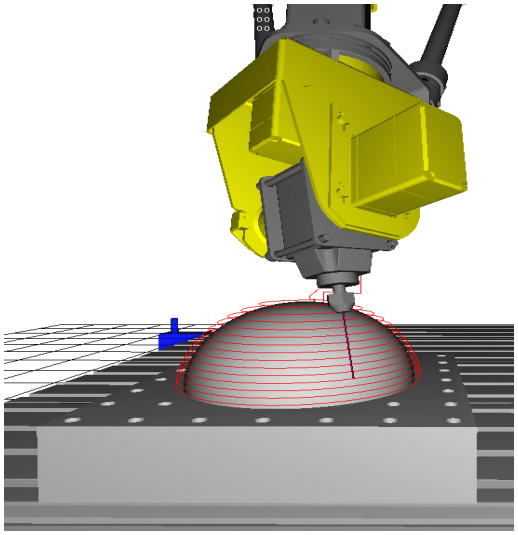

Figure 6 – CL DATA application for 5-axis milling

In each point are calculated important parameters by inversion kinematic of Trivariant machine and computed data are recorded into a graph. Position and orientation of Trivariant base in a simulation space can be changed in dependence on used frame of machine.
In control system is use next parameter: correction of tool length - this parameter is used for tools with a different length with a same control program.
Kinematic visualization is created by importing a STL file of each part of machine to the OpenGL.

CL DATA APPLICATION FOR TRAJECTORY DESCRIPTION

Designed simulation software allows two regimes of work - manual and automatic control of mechanism. Because the manual control is toilsome and time-consuming it seems like more advantage to use the CL DATA generated by appropriate CAM system for trajectory generation.
We can use the CL DATA for describing of the cutting process by application of mechanism like CNC tool machine. If we want to apply the mechanism for manipulation, it is possible to use CL DATA like universal "meta-language" for describing of movement between each position.

CONTROL SYSTEM DESIGN

Control system is built on the base of standard PC with OS Windows and simulation software of Trivariant, which allows off-line programming, simulating activities of this hybrid kinematic structures and consecutive control of machine by data obtained during simulation.
During simulation can by trajectory controlled manually or automatically. In automatic mode are for trajectory planning used CL DATA generated by CAM system (in our case Pro/Engineer).
Trajectory of Trivariant movement is planed with velocity profile which is presented on the figure 5. Classical trapezoidal velocity profile was supplemented by continuous change of velocity for jerk-less movements.
System Architecture - there are two distinctive PC-based control system architectures which are widely being implemented in industries. Firstly, the PC-based control system which the PC itself is the Machine Control Unit (MCU) where is connected to the system. Secondly, a PC-based control system which uses a PC connected a motion controller.

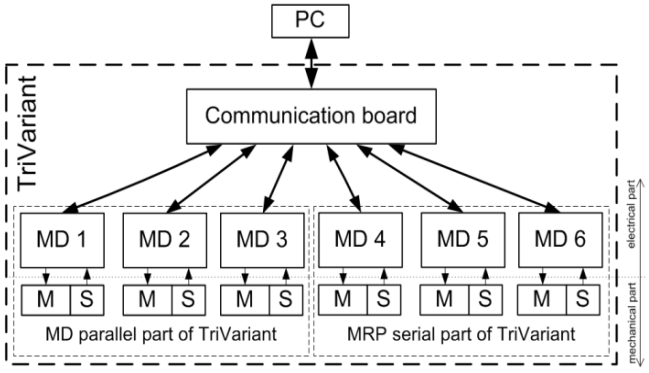

Figure 7 - Block diagram of designed control system

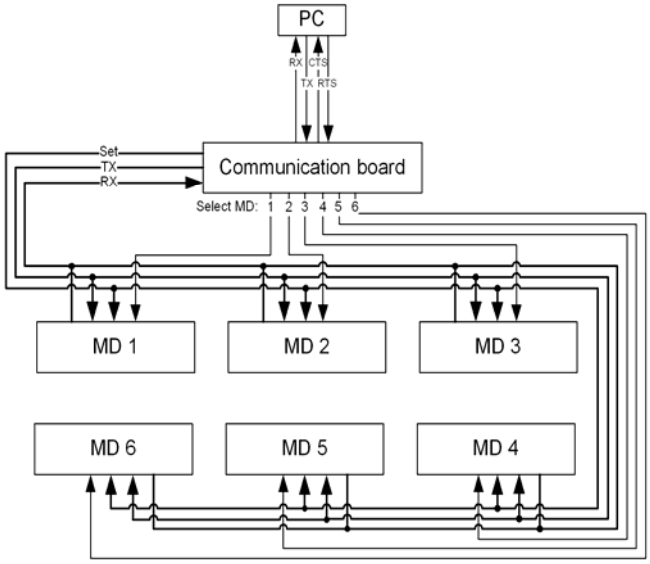

Figure 8 - Communication interfaces in control system

For this kinematic structure we needed design and built a control system. Main request on control system of Trivariant was universality, openness and simplicity of control system.
Base on this request was designed following modular conception of control system (Fig. 7, 8) [9].

CONCLUSION

At the authors workplace was during the last year designed a small-scale prototype of trivariant which can work as a machine tool with 5 DOF as well as a robot with 6 DOF. One of the main purposes for development of it was the possibility to make some functional analysis of simulation software and control system designed for this type of mechanisms. In this time the building of mechanism go to the final phase. Now we would like to start the testing phase. We have to do detailed analysis of trivariant stiffness and accuracy. After the final improvement trivariant can be apply for machining and for object manipulation.
Software designed for simulation and control of trivariant's prototype allows two working modes - triavariant as a machine tool with 5 DOF as well as a robot with 6 DOF. Designed algorithm interpolates a tool trajectory and in each point of trajectory calculates all necessary values for machine control and for visualization by proposed inversion kinematic of trivariant. Trajectory can by controlled manually or automatically during the simulation. CL DATA generated by CAM system (in our case Pro/ENGINEER) are used for trajectory planning in automatic mode. Functionality of simulation SW and control system was verified on prototype developed in author's workplace.
Developed mechanism prototype can be applied like machine tool (figure 9).
The device has totally 5 degree of freedom, which is enough for the 5D milling.

Figure 9 - Small-scale CNC machine tool builds on trivariant hybrid kinematic structure

It is possible to apply it also like robot device for handling operations. In this case one more rotational axis has to be added into the kinematical scheme of SE, the serial extension must have 3 DOF. Thereby we obtain hybrid mechanism with six degree of freedom.

ACKNOWLEDGMENT

This article was created by the solution of project - code ITMS 26220220046: "The Development of Parallel Kinematic Structure Prototypes for Application in the Area of Machine Tools and Robots" supported by operational program Development and research, financed from European foundation for regional progress.

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AUTHORS & AFFILIATION

Viera POPPEOVÁ[1],
Juraj URÍČEK[2],
Peter ŠINDLER[3],
Vladimír BULEJ[4]

[1,2,4] FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF ŽILINA, SLOVAKIA
[3] FACULTY OF ELECTRICAL ENGINEERING, UNIVERSITY OF ŽILINA 010 26 ŽILINA, SLOVAKIA

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Igor FÜRSTNER[1], Zoran ANIŠIĆ[2], Robert FREUND[3]

IMPLEMENTATION OF ADAPTIVE PRODUCT CONFIGURATION AS AN ADDITIONAL TOOL FOR SUSTAINABLE PRODUCT LIFECYCLE

ABSTRACT:
The difficulties in implementing successful mass customization arise mainly due to uncertainty encountered by customers when they intend to customize their products - external and internal complexity - problems faced by the company because of the extensive product variety. This paper presents some results of using a developed methodology for adaptive product configuration in the field of mass customization, which deals with external complexity. The paper introduces the methodology in general and gives an overview of the particular use of the methodology that is implemented in a product configuration system for thermal insulation of buildings.

KEYWORDS:
Adaptive Configuration, Customer Profile, Product Configurator, Thermal Insulation

INTRODUCTION

In the twenty-first century, a company has to organize around the customer in order to be a successful and viable firm. Today, the marketplace is customer driven. Customers expect to get what they would like, with a side order of customization [1]. This approach raises several questions that have to be answered, one of which is that despite nowadays customers are knowledgeable in general, they are still far from being experts that can really co-create a product or a service. The role of the customer is changed, from a consumer of a product, to a partner in a process of adding value [2]. This alteration of traditional organization of a company through the involvement of the customer into the configuration of the final product faces some obvious problems. The fundamental challenge is to avoid the abortion of the configuration process by the customer. In many cases, the customer aborts the configuration process by himself. Major problem areas include the lack of a customer-desired option value regarding a specific attribute within the system as well as the inability of the customer to create definite preferences between certain option values. As a result, the customer aborts the configuration process and does not come up to the sales phase [3]. Also if customers are overwhelmed by the configuration task, there is a chance that they may abort the configuration process. Customers usually only want the product alternatives that exactly meet their requirements. If too much of a choice is offered, customers can feel frustrated or confused, and therefore incapable of making proper decisions. This overload of information is sometimes called external complexity. This external complexity is caused by the limited information processing capacity of humans, the lack of customer knowledge about the product, and customer ignorance about his or her real individual needs [4]. Based on problem analysis regarding customers' involvement in the configuration process, the main areas of investigation to be considered are the minimization of the complexity experienced by the customers [5],[6] and the reduction of the cognitive overhead, considering not only the extent of choice, but also the lack of understanding about which solution meets their needs and also the uncertainties about the behavior of the supplier and the purchasing process [7].

Outer thermal insulation of buildings is becoming more and more important, since energy resource prices have raised extensively in recent years, and environmental issues have become more relevant than ever before. Despite the widespread usage of thermal insulating materials in everyday practice, it can be noted that thermal insulation is often made self-initiated, without proper knowledge about the materials, the technology, and the calculations needed to obtain the best results. This results in inadequate solutions, that can range from high installation costs and high consumption cost to short lifetime and insufficiency of the applied insulation.

The ongoing project defines several goals for the developed configurator that can be stated as follows [8],[9]:

- *The proposed configurator has to offer web based on-line instant results;*
- *The result should be based on the latest results in research and practice;*
- *The proposed configurator should configure customized results, based on the specific characteristics of individual buildings;*
- *The proposed configurator has to minimize the potential complexity experienced by the customer, by reduction of cognitive overhead;*
- *The proposed configurator has to be used by professionals, retailers and end customers without specific technical knowledge about thermal insulation;*
- *The proposed configurator should offer an accurate enough result, which is acceptable in the research field;*
- *The configurator has to raise the awareness about the necessity and the advantages of proper thermal insulation.*

CUSTOMER PROFILE CONFIGURATION

Based on experience, the problem of adapting the process of co-creation to different customers can be solved by identification of different customer profiles that suit each individual customer's needs and limitations. To configure the appropriate customer profile a set of initial questions is asked at the beginning of the co-creation process. There is a need to analyze the answers generated by each customer and to use them to form a customer profile [10]. A number of approaches from the field of data analysis may be used, nevertheless the nature of the questions and the answers refer to the use of a non-crisp logic; therefore fuzzy logic is used to determine the appropriate customer profile [11],[12],[13]. Not only the answers are evaluated, but also the order of answering to questions. Also, during and after the process of co-creation, the customer's feedback considering his satisfaction with a configured profile is analyzed and the profile is adapted according to the feedback.

The previous version of the developed configurator that was meant to be used both by customers with average or no technical knowledge and by professionals with proper technical knowledge in the related field of investigation had some limitations, because some of the previous non-professional customers had found the product configurator too complex to use. On the other hand some of the professional customers have found that the configurator lacked the possibility of defining exact and precise input parameters. Other problems included the need for more or less accurate results, as well as more or less time-consuming configuration. These problems were solved by identification of three different customer profiles:

- *"Dummy" customer;*
- *Intermediate customer;*
- *Professional customer.*

The "Dummy" customer is a customer without proper technical knowledge about thermal insulation, or maybe a customer with no need for highly accurate results, or a customer with a need of a fast enough result, etc. The Intermediate customer is a customer with average technical knowledge about thermal insulation, but can also be a customer without proper technical knowledge about thermal insulation but with more time for completing the configuration process or with a need for more accurate result, etc. The Professional customer is a customer with proper knowledge about the problem of thermal insulation; it may also be a customer with average technical knowledge about thermal insulation but with more time for completing the configuration process or with a need for more accurate result, etc.

To configure the appropriate customer profile, three initial questions are asked before the start of the configuration process:

- *What is your estimate about your knowledge about thermal insulation?*
- *What are your needs considering the accuracy of the configuration results?*
- *How much time do you have for completing the configuration process?*

The answers can range from "I have no knowledge about thermal insulation at all" (Where the value of the answer is 0) to "I am a professional in the field of thermal insulation" (Where the value of the answer is 1) for the first question; from "I need as accurate result as possible" (Where the value of the answer is 0) to "I just want a rough estimate" (Where the value of the answer is 1) for the second question; and from "I have enough time for completing the configuration process" (Where the value of the answer is 0) to "I have limited time for completing the configuration process" (Where the value of the answer is 1) for the third question. Initially, all the answers are set to the value of 0.5. The answers are used as input data for customer profile configuration.

Based on asked questions and answers, three linguistic variables are defined:

- *Knowledge about thermal insulation (k), whose values are: very poor, poor, average, good and very good;*
- *Accuracy of the configuration results (a), whose values are: high, average, low;*
- *Time for the configuration process (t), whose values are: enough, average, not enough.*

The membership functions for the variables $\mu(x)$ are triangular or trapezoidal, and as an example, the membership function for k is shown in Figure 1. They are chosen based on previous testing and experience [14],[15], where the variables are described on the operating domain of $x=[0,1]$.

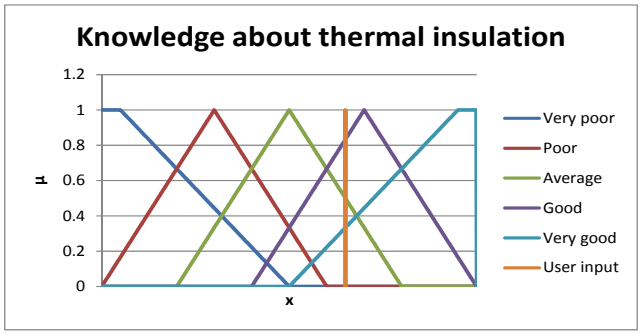

Figure 1 - Membership functions for the linguistic variable "Knowledge about thermal insulation"

Beside the values of the input variables, during the process of customer profile configuration, the order of answering the questions is also taken into consideration. The reason for doing so is that customers usually, based on their belief, sooner answer questions that are of higher importance to them than questions that are not. There is also a possibility that customers do not answer unimportant questions at all; then the value of the answer is 0.5 [16].

For the same answer values (customer input), the membership functions change, based on the answering order. If the answer to the question is the first one, the membership functions taper (1,2,3). It results in a more unique response. As an example, the membership function for k is shown in Figure 2.

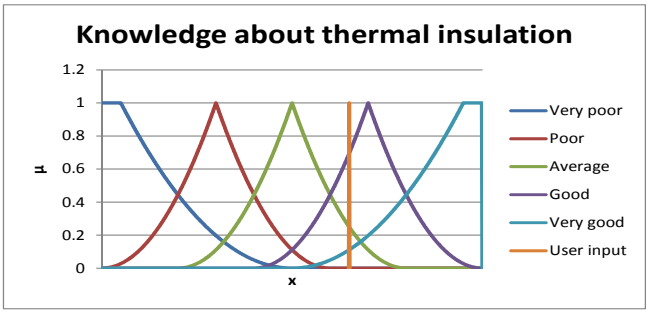

Figure 2 - Membership functions for the linguistic variable "Knowledge about thermal insulation" if it was the first answer

If the answer to the question is the last one, the membership functions expand (4,5,6). It results in a more vague response. As an example, the membership function for k is shown in Figure 3.

$$\mu_{k=very\_poor}^{1st}(x)=\left[\mu_{k=very\_poor}(x)\right]^2$$
$$\mu_{k=poor}^{1st}(x)=\left[\mu_{k=poor}(x)\right]^2$$
$$\mu_{k=average}^{1st}(x)=\left[\mu_{k=average}(x)\right]^2 \quad (1)$$
$$\mu_{k=good}^{1st}(x)=\left[\mu_{k=good}(x)\right]^2$$
$$\mu_{k=very\_good}^{1st}(x)=\left[\mu_{k=very\_good}\right]^2$$
$$\mu_{a=high}^{1st}(x)=\left[\mu_{a=high}(x)\right]^2$$
$$\mu_{a=average}^{1st}(x)=\left[\mu_{a=average}(x)\right]^2 \quad (2)$$
$$\mu_{a=poor}^{1st}(x)=\left[\mu_{a=poor}(x)\right]^2$$
$$\mu_{t=enough}^{1st}(x)=\left[\mu_{t=enough}(x)\right]^2$$
$$\mu_{t=average}^{1st}(x)=\left[\mu_{t=average}(x)\right]^2 \quad (3)$$
$$\mu_{t=not\_enough}^{1st}(x)=\left[\mu_{t=not\_enough}(x)\right]^2$$
$$\mu_{k=very\_poor}^{1st}(x)=\left[\mu_{k=very\_poor}(x)\right]^{0.9}$$
$$\mu_{k=poor}^{1st}(x)=\left[\mu_{k=poor}(x)\right]^{0.75}$$
$$\mu_{k=average}^{1st}(x)=\left[\mu_{k=average}(x)\right]^{0.25} \quad (4)$$
$$\mu_{k=good}^{1st}(x)=\left[\mu_{k=good}(x)\right]^{0.75}$$
$$\mu_{k=very\_good}^{1st}(x)=\left[\mu_{k=very\_good}\right]^{0.9}$$
$$\mu_{a=high}^{last}(x)=\left[\mu_{a=high}(x)\right]^{0.25}$$
$$\mu_{a=average}^{last}(x)=\left[\mu_{a=average}(x)\right]^{0.75} \quad (5)$$
$$\mu_{a=poor}^{last}(x)=\left[\mu_{a=poor}(x)\right]^{0.25}$$
$$\mu_{t=enough}^{last}(x)=\left[\mu_{t=enough}(x)\right]^{0.25}$$
$$\mu_{t=average}^{last}(x)=\left[\mu_{t=average}(x)\right]^{0.75} \quad (6)$$
$$\mu_{t=not\_enough}^{last}(x)=\left[\mu_{t=not\_enough}(x)\right]^{0.25}$$

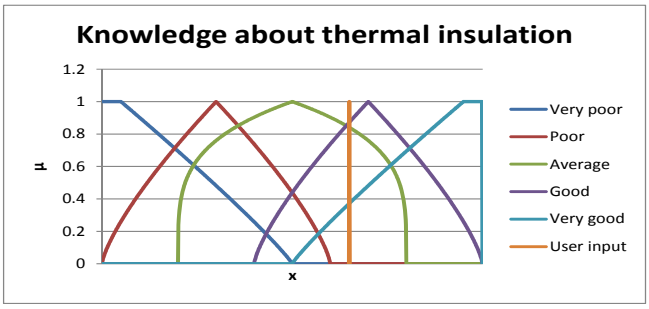

Figure 3 - Membership functions for the linguistic variable "Knowledge about thermal insulation" if it was the last answer

In Figure 1, Figure 2 and Figure 3, for the same customer input (answer) of 0.65, the membership functions are different, i.e. the values of the membership functions are also different, which is shown in Figure 4.

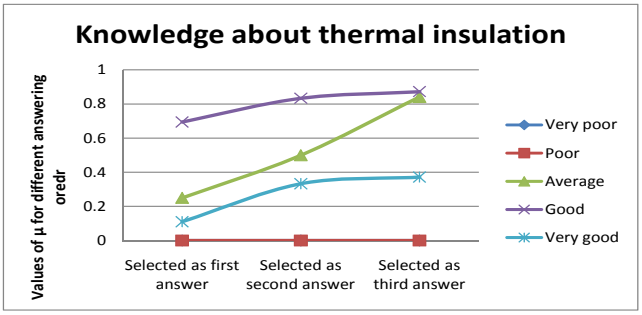

Figure 4 - Different values of the membership functions for different answering order

The fuzzy output from the system, i.e. the decision is made in a manner that 45 if-then rules are defined. The rules are designed to produce three different outputs (o): "dummy", intermediate and professional. The membership functions are triangular or trapezoidal (Figure 5), and are chosen based on previous testing and experience (7,8,9) [14],[15].

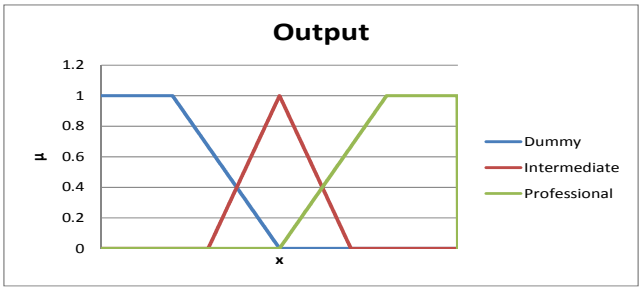

Figure 5 - Membership functions for output

$$\mu_{o=dummy}(x)=\begin{cases}1, & 0\le x\le\alpha_0\\ \dfrac{\beta_0-x}{\beta_0-\alpha_0}, & \alpha_0<x\le\beta_0\\ 0, & \beta_0<x\le 1\end{cases}, \qquad (7)$$

where $\alpha_0=0.2$, $\beta_0=0.5$ are the initial values

$$\mu_{o=intermediate}(x)=\begin{cases}0, & 0\le x\le\chi_0\\ \dfrac{x-\chi_0}{\delta_0-\chi_0}, & \chi_0<x\le\delta_0\\ \dfrac{\varepsilon_0-x}{\varepsilon_0-\delta_0}, & \delta_0<x\le\varepsilon_0\\ 0 & \varepsilon_0<x\le 1\end{cases}, \qquad (8)$$

where $\chi_0=0.3$, $\delta_0=0.5$, $\varepsilon_0=0.7$ are the initial values

$$\mu_{o=professional}(x)=\begin{cases}0, & 0\le x\le\phi_0\\ \dfrac{x-\phi_0}{\phi_0-\varphi_0}, & \phi_0<x\le\varphi_0\\ 1, & \varphi_0<x\le 1\end{cases}, \qquad (9)$$

where $\phi_0=0.5$, $\varphi_0=0.8$ are the initial values

After the evaluation of if-then rules, an aggregated output is generated. Changes in input membership functions influence the customer profile configuration. For the same answers, but for a different answering order, the configured customer profile can be different.

The next example shows that for the following input data:

- *1st answer - customer input for knowledge about thermal insulation is 0.65;*
- *2nd answer - customer input for accuracy of the configuration results is 0.8;*
- *3rd answer - customer input for time for the configuration process is 0.5,*

after defuzzification by the "Center of gravity method", the crisp output is 0.387 - and is interpreted as an "Intermediate customer".

For the following input data:

- *1st answer - customer input for accuracy of the configuration results is 0.8;*
- *2nd answer - customer input for knowledge about thermal insulation is 0.65;*
- *3rd answer - customer input for time for the configuration process is 0.5,*

after defuzzification by the same method, the crisp output is 0.369 - and is interpreted as a "Dummy customer".

Based on the previous example, one can conclude that for the same input data, but for a different answering order, different customer profiles can be configured.

After the configuration task is finished, a feedback is generated. The customer is asked to answer a set of three questions:

- *Are you satisfied with the complexity of the configurator? (c);*
- *Is the result satisfactory? (s);*
- *Are you satisfied with the time spent for the configuration process? (i).*

The answers can range from "The configurator is too complex" (where the value of the answer is 0) to "The configurator is too easy " (where the value of the answer is 1) for the first question; from "The results should be more detailed and precise " (where the value of the answer is 0) to "The results are too detailed" (where the value of the answer is 1) for the second question; and from "I could have spent more time for the configuration process" (where the value of the answer is 0) to "The configuration process was too long " (where the value of the answer is 1) for the third question. Initially, all the answers are set to the value of 0.5, which means that the customer is satisfied with the configuration process.

Based on the answers to questions, the input values for k,a,t *are modified to* k_{new},a_{new},t_{new} *(10).*

$$k_{new}=k-\frac{c-k}{2}$$
$$a_{new}=a-\frac{s-a}{2} \qquad (10)$$
$$t_{new}=t-\frac{i-t}{2}$$

This is the input for a new fuzzy output from the system, i.e. a new decision. This new output (o_{new}*) takes into consideration whether a customer is satisfied with a configured customer profile. Based on the difference between an original and a new output, the membership functions for* o_{i+1} *are shifted left or right to better articulate the customers' preferences in the future. The amount of shifting (*sa*) is calculated in the following manner (11).*

$$sa=\frac{o_i-o_{new}}{10} \qquad (11)$$

The division by 10 is used to assure that the shift is not too big. The shifted membership functions for o are (12,13,14):

$$\mu_{o=dummy}^{i+1}(x)=\begin{cases}1, & 0\le x\le\alpha_{i+1}=(\alpha_i+sa)\\ \dfrac{\beta_{i+1}-x}{\beta_{i+1}-\alpha_{i+1}}, & \alpha_{i+1}=(\alpha_i+sa)<x\le\beta_{i+1}=(\beta_i+sa)\\ 0, & \beta_{i+1}=(\beta_i+sa)<x\le 1\end{cases} \qquad (12)$$

$$\mu_{o-intermediate}^{i+1}(x)=\begin{cases}0, & 0\le x\le\chi_{i+1}=(\chi_i+sa)\\ \dfrac{x-\chi_{i+1}}{\delta_{i+1}-\chi_{i+1}}, & \chi_{i+1}=(\chi_i+sa)<x\le\delta_{i+1}=(\delta_i+sa)\\ \dfrac{\varepsilon_{i+1}-x}{\varepsilon_{i+1}-\delta_{i+1}}, & \delta_{i+1}=(\delta_i+sa)<x\le\varepsilon_{i+1}=(\varepsilon_i+sa)\\ 0 & \varepsilon_{i+1}=(\varepsilon_i+sa)<x\le 1\end{cases} \quad (13)$$

$$\mu_{o-professional}^{i+1}(x)=\begin{cases}0, & 0\le x\le\phi_{i+1}=(\phi_i+sa)\\ \dfrac{x-\phi_{i+1}}{\phi_{i+1}-\varphi_{i+1}}, & \phi_{i+1}=(\phi_i+sa)<x\le\varphi_{i+1}=(\varphi_i+sa)\\ 1, & \varphi_{i+1}=(\varphi_i+sa)<x\le 1\end{cases} \quad (14)$$

with the following corrections (15):

$$\begin{aligned}&if\ \alpha_{i+1}<0.05\ then\ \alpha_{i+1}=0.05;if\ \alpha_{i+1}>0.35\ then\ \alpha_{i+1}=0.35\\ &if\ \beta_{i+1}<0.35\ then\ \beta_{i+1}=0.35;if\ \beta_{i+1}>0.65\ then\ \beta_{i+1}=0.65\\ &if\ \chi_{i+1}<0.15\ then\ \chi_{i+1}=0.15;if\ \chi_{i+1}>0.45\ then\ \chi_{i+1}=0.45\\ &if\ \delta_{i+1}<0.35\ then\ \delta_{i+1}=0.35;if\ \delta_{i+1}>0.65\ then\ \delta_{i+1}=0.65\\ &if\ \varepsilon_{i+1}<0.55\ then\ \varepsilon_{i+1}=0.55;if\ \varepsilon_{i+1}>0.85\ then\ \varepsilon_{i+1}=0.85\\ &if\ \phi_{i+1}<0.35\ then\ \phi_{i+1}=0.35;if\ \phi_{i+1}>0.65\ then\ \phi_{i+1}=0.65\\ &if\ \varphi_{i+1}<0.65\ then\ \varphi_{i+1}=0.65;if\ \varphi_{i+1}>0.95\ then\ \varphi_{i+1}=0.95\end{aligned} \quad (15)$$

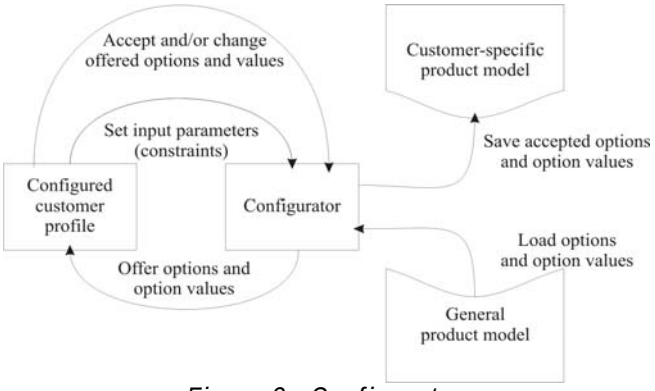

Figure 6 – Configurator

The configured customer profile is used in the configurator (Figure 6).

CASE STUDY

The developed configurator has been tested configuring five existing buildings. The insulation is configured and the results are calculated for each customer profile. Heat loss is calculated for input temperatures [14],[15]. Heat losses without insulation and with the proposed insulation, for different customer profiles are shown in Figure 7 and Figure 8, respectively.

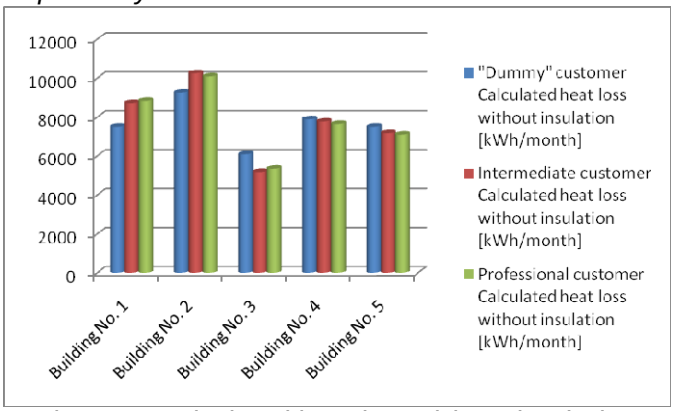

Figure 7 - Calculated heat loss without insulation

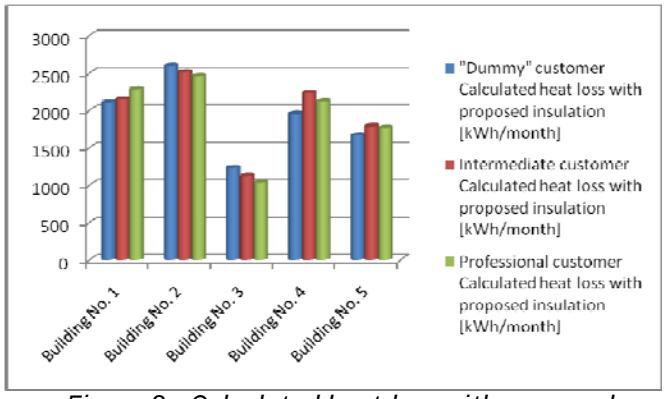

Figure 8 - Calculated heat loss with proposed insulation

CONCLUSION

The process of co-creation during the configuration task faces several problems. If customers are overwhelmed by the configuration task, or there is a lack of a desired option value for a specific attribute, or the customers simply do not understand the configuration process, they may abort the configuration process and do not come up to the sales phase.

Therefore the solution to these problems is to adapt the process of co-creation to different customers by identification of different customer profiles that suit each individual customer's needs and limitations. To configure the appropriate customer profile a set of initial questions is asked at the beginning of the co-creation process. After the answers generated by each customer are analyzed a customer profile is determined using fuzzy logic. Not only the answers are evaluated, but also the order of answering to questions. Also, during and after the process of co-creation, the customer's feedback considering his satisfaction with a configured profile is analyzed and the profile is adapted according to the feedback.

The case study shows that average deviation from the exact calculations for the "dummy" customer range from approximately 9.19% for calculations without thermal insulation to 9.31% for calculations with thermal insulation. Average deviation for the intermediate customer ranges from approximately 1.74% for calculations without thermal insulation to 4.68% for calculations with thermal insulation. Based on these results one can conclude that different customer profiles give different results, but that the differences could be accepted if the nature of the research field is taken into consideration.

The configuration process in the case of the "dummy" customer lasts about 3-4 minutes, for the intermediate customer the required time is about 5-10 minutes, and for the professional customer it takes more. The final solution is given in understandable form, which can be directly used for ordering. These results show that different customer profiles could be necessary for successful completion of the configuration process.

Experiences from retailers suggest that the idea of insulating a building is becoming more appealing and acceptable for the customers, when presented using the configurator, while end users suggest that there is further need to make the configurator more interesting.

The results and the gained experiences point towards several future research directions:

- Making the user interface more interesting by using as many visual and interactive elements as possible with real time multimedia help;
- Definition of rules for taking into account the accepted solutions by previous customers of certain profile and their incorporation into configurator;

Development of an intelligent decision making algorithm that takes into consideration the input parameters and constraints, the customer profile, the previously accepted solutions and that can automatically adjust the solution that can lead to suggested solutions, which correspond to a greater extent to the finally accepted results.

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AUTHORS & AFFILIATION

Igor FÜRSTNER[1],
Zoran ANIŠIĆ[2],
Robert FREUND[3]

[1] SUBOTICA TECH – COLLEGE OF APPLIED SCIENCES, Marka Oreškovića 16, SUBOTICA, SERBIA
[2] FTN, UNIVERSITY OF NOVI SAD, TRG DOSITEJA OBRADOVIĆA 6, NOVI SAD, SERBIA
[3] MAIBIS eG, MANNHEIM INSTITUTE OF BUSINESS INTELLIGENCE AND SECURITY, MANNHEIM, GERMANY

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Tomaž PERME[1], Matjaž NOVAK[2], Rok STRAŠEK[3], Iztok KAVKLER[4], Alen ORBANIĆ[5]

A MODEL FOR TECHNICAL OPTIMISATION OF THE DISTRIBUTION CENTRE

ABSTRACT:
One of the largest companies in Slovenia has been confronted with the dilemma of building a new storage distribution centre (SDC) or to find additional capacity by optimizing the exiting one. The company initiated a project with a goal to describe and analyze operation of the existing SDC and to propose measures for operation improvements. The research methodology and the results are based on a simulation model of SDC that allows more detailed analysis of the system operation, obtaining technical efficiency under different constraints, identifying the potentials for optimization and verifying effectiveness and justification of the proposed improving measures.

KEYWORDS:
logistic system, storage and distribution centre, optimization, efficiency, discrete simulation

INTRODUCTION

Distribution centres represent one of the main subfields of today's logistics and an important part of local or global supply chain. They remain an essential part of goods flow from suppliers to consumers, although, according to lean principles, the supply chain management tends to operate without or with minimal warehousing. Therefore the efficient management and optimization of distribution centres are indispensable tools for operations improvement with the aim of reducing handling and operating costs, increasing distribution accuracy and delivering the goods to customers faster. One of the largest companies in Slovenia that initiated a project for optimisation of the logistic system (L7-0242 – A Model for Technical and Economic Optimization of a Logistics System financed by Slovenian Research Agency ARRS) is aware of this issue.

The presented research work is a part of this project. Its goal is to describe and analyze the logistic processes, technologies, equipment, labour resources and inventory (goods) in the observed storage and distribution centre, and to propose measures for operation improvements.

The project started with an initial analysis aiming to obtain basic data about a structure, processes and also a dynamic behaviour of the system. The data were collected and processed from the available technological documentation, interviews with employees, a snap-shot of the existing processes, equipment and workers in the SDC as well as from the WMS database with recorded transactions of the material flow and order operations. On the basis of the collected data different analyses were accomplished focused on the basic performance indicators of the existent processes, equipment and the warehouse management system. Due to the results and conclusions from the initial analyses a simulation model of the SDC was built, which allows more detailed analysis of the system operation, obtaining technical efficiency under different constraints, identification of the potentials for optimization and verifying effectiveness and justification of the proposed improving measures.

INITIAL CONSIDERATIONS AND THEORETICAL BACKGROUNDS

The main issue of the presented research work can be defined from three different points of view. The first one refers to the development of an appropriate model for simultaneous optimization of the logistic system by technological and economic criteria. Optimization of the two purpose-made functions with different marginal conditions is dealt with. The first purpose-made function is essentially a production function that explains a relation between the actual volume of the realized logistic services on one side and the volume of the used inputs on the other. The second purpose-made function, which is basically derived from the first one with introduction of factor prices, is the cost function. Economic theory clearly proves and explains that there is a systematic inverse relation between production and cost functions. However, production functions are usually written as polynomials of degree two or three, for which an analytical search of inverse function is infeasible. A possible solution in this case is to introduce a discrete analysis instead of the continuous one.

The second point of view of the problem, which is the object of research, is linked to the fact that in the most practical cases analytical mathematical procedures are not enough for sufficiently exact calculation or estimation of consequences caused by a certain decision. For this reason a discrete simulation is used more frequently. From the theoretical point of view realizing this simulation is not a special problem for which science would not have an answer. However, there is a much bigger problem in application of this simulation. A discrete simulation is defined as a general program solution that is designed to form a dynamic computer or digital model of the complex system with a purpose of collecting data of dynamic behaviour of the system and optimization of its operation. For this purpose a user with a lot of special knowledge is needed, who digress the practical use of the discrete simulation. It's important to point out that the described discrete simulation considers only technological optimization of a logistics system.

The third point of view is an interdisciplinary approach. In economic reality there is a strong need to upgrade the technological point of view with the economic point of view. Only an interdisciplinary team of experts with the specific knowledge in mathematics, logistic and economy can take up such tasks.

DISCRETE SIMULATION

Very important aspect of the research project is modelling and simulation of discrete systems, which is a systematic and highly organized method for development of dynamic computer i.e. digital model of a complex system, gathering data of its dynamic behaviour and optimization of its operation. Digital model is a mapping, based on analysis and synthesis of an observed system into a computer form that allows user to perform experiments in digital environment with the aim to verify hypothesis and what-if scenarios, statistically analyze and present structural and dynamic characteristics of the observed system and compare properties, facts and distinctions of different systems without disturbing the real system or on the stage of developing a new one (Fig. 1).

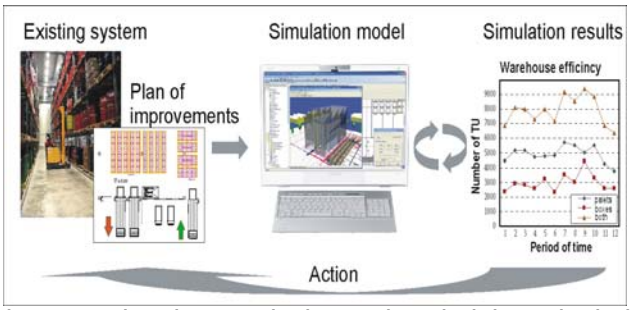

Figure 1- Planning, analyzing and optimizing a logistic system with the discrete simulation

The discrete simulation is designed for planning, analyzing and optimizing logistic systems. In spite of its provable applicability and profitability it is only now pawing the way from basic scientific research projects to real application projects for the industry. The first significant reason for that is a complexity of modern logistic processes and systems that demands an engineer professional knowledge about organizational, technological and technical properties of processes, procedures and equipment in a logistic system as well as an expert knowledge about the discrete simulation. The second reason is usually a detached observation of technological and economical aspects of logistic systems, which doesn't allow the holistic consideration of logistic problems.

THEORETICAL BACKGROUNDS

The scientific field of the discrete simulation for planning, analyzing, and optimizing logistic systems' operation and can be divided into two parts. The fist part is dealing with the discrete simulation [1] for production logistics with the emphasis on material flow simulation and layout optimization of manufacturing and assembly systems, lines and cells. The goal of the research studies of such systems is to obtain the key performance indicators, for example productivity, throughput, availability and reliability, and more complex indicators like overall equipment effectiveness and overall factory efficiency [2]. Beside estimation of the technological effectiveness of the observed system, from the first applications with the discrete simulation onwards there has been a demand for cost estimation. Unfortunately evaluation of costs cannot give applicable results, unless the holistic approach is used in production or a logistic system consideration. In the development phase an estimation of a certain production system effectiveness using a method of total costs of ownership is also possible, but only on the basis of a complete model of the observed system and the discrete simulation [3]. the second part of the simulation for the merchandise logistic systems is dealing with the internal logistic that ranges from a store and warehouse systems, distribution centres and the transportation to material and information flow between companies in a supply chain [4][5]. In spite of that the research studies using the discrete simulation are here more focused on the management and a control view of logistic systems [6] and they have usually not surpassed an estimation of technological properties of the observed systems.

DESCRIPTION OF THE SDC

In the particular case the logistic system is composed of a storage and distribution centre (SDC). SDC is a warehouse which is stocked with bulk products (goods) that need to be re-distributed to the internal (approximately 400 own shops) and external customers (retailers).

The SDC has been set up with the aim of properly organizing the supply network and cutting down the supply costs for the internal customers. The company has gradually becoming a wholesaler, as well, and so it also distributes goods to the other retailers. The processes for fulfilment of internal or external customers' orders are identical. The difference between them is more or less in predictability of the content, in the quantity of merchandise orders and in

time of delivery. The main challenge is to manage the influence of variation in type and quantity of goods (seasonal, monthly, weekly, daily) on operation efficiency of the SDC. The operation of the SDC is supported by the warehouse management system (WMS) with the primarily aim to control the movement and storage of goods within the warehouse and process the associated transactions including shipping, receiving, replenishment and picking to order.

The distribution centre consist of space, equipment, labour resources and inventory (goods). It has three main areas: the receiving dock, the storage area and the shipping dock (Fig. 2). Goods (products) arrive and are stored in the distribution centre in various types of storage locations and containers suitable for the product characteristics and the amount of a product to be transported or stored. The pallets are the basic means (transport unit TU) for transportation and storage of the goods. Pallets are stored in a pallet rack and some of them also on the floor (block location). a particular pallet contains just one stock-keeping unit (SKU). Smaller goods are stored on shelves, in cartons (boxes).

The material flow processes in the distribution centre are supported by the warehouse management system (WMS). The primarily aim of the WMS is to control movement and storage of goods within the warehouse and process the associated transactions, including shipping, receiving, replenishment and picking to order. The WMS also directs and optimizes a stock put away based on real-time information about the status of the bin utilization.

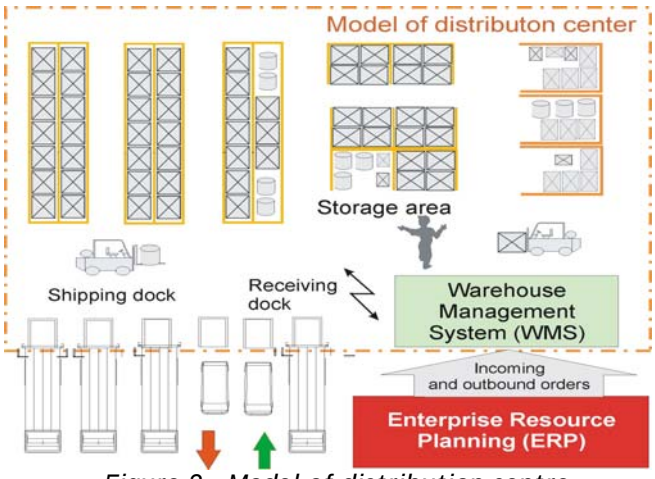

Figure 2 - Model of distribution centre

The WMS provides a set of the computerized procedures for handling the receipt of the stock and the returns into the warehouse facility, modelling and managing the logical representation of the physical storage facilities (racks and shelves), managing the stock within the facility and for enabling a link to order's processing in order to pick, packing and shipping goods from the facility according to the customers' demands and organizing deliveries of goods to customers.

Figure 3 - Information flow in the supply network

The warehouse management system is a stand alone program application that communicates with the enterprise resource planning system (ERP). Orders from external as well as internal customers are always inputted in the ERP system and then sent to the WMS system in the distribution centre for processing (Fig. 3.). After the order is accomplished, the WMS sends a confirmation to the ERP system. The same is with the incoming goods. Without receiving order from the ERP no goods from the incoming shipment can be properly received (tagged and stored) into the distribution centre.

INITIAL ANALYSIS AND OBSERVATIONS

The aim of the initial analyses was to obtain the basic data of a structure, processes and also a dynamic behaviour of the system. The data for the initial analyses were collected and processed from available technological documentation of the logistic system, interviews with employees in the distribution centre and from a snap-shot of the existing processes, equipment and workers in the distribution centre. Very important and useful source of information about operations and inventory in the distribution centre is the warehouse management system. The database in the WMS contains data of the inventory in the distribution centre at the moment of storing the database and a complete history of processing the shipping and receiving orders in a certain period.

Different analyses were accomplished on the basis of the collected data and they focused on the basic performance indicators of existent processes, equipment and warehouse management system. Some significant observations can be summarized from the results of the initial analyses, as follows:

- *The WMS provides the necessary IT support for more organized operation of the SDC including the automated storage allocation, automated replenishment, optimisation of the picking to order procedure, and automated data collection.*
- *The implementation of the WMS along with the automated data collection significantly increases accuracy of the fulfilled orders (more than 99 % of the orders are fulfilled correctly).*
- *Expectations of the inventory reduction and the increased storage capacity are not less likely, because the predominant factors that control the inventory levels are lot sizing, lead times and demand variability. The WMS has no significant impact on any of these factors.*

- *In spite of the WMS decisions about grouping orders to shipments, a delivery schedule, transportation paths and a pattern for the storage allocations of goods are still in the domain of human operators (dispatchers, supervisors and warehouse managers).*
- *The WMS tracks and logs a location of goods and notes also the transactions of processes and events (except when picking to order)*
- *The WMS is a foundation for further improvements of a operational performance of the SDC (even more accurate data and tracking of all operational events).*
- *The WMS needs to provide more key performance indicators then just a stock turnover.*

Digital Model Of The SDC

Due to the results and conclusions from the initial analyses a simulation model of the SDC was built, which allows more detailed analysis of the system operation, obtaining a technical efficiency under different constraints, identifying the potentials for optimization, and verifying effectiveness and justification of the proposed improving measures. The aim of the simulation model is to obtain and compare the key performance indicators of the observed system under different organizational changes, control algorithms, operational decisions and business models without disturbing the operation of the real SDC.

The formal description of the SDC is mostly based upon data from the available technological documentation supplemented with interviews with employees and the snap-shot of the existing processes, equipment and workers in the SDC. The recorded transactions of the material flow in the WMS database helped us to complete the detailed description with the specific data of duration of handling operations. The digital model considers different aspects of the SDC as a detailed layout with a spatial relationship of locations and transport paths, size and type of locations (receiving and shipping platforms, selective pallet storage racks, bulk locations, locations on shelves), transport equipment (number, type and velocity of forklifts, detailed operation procedure), work procedure for receiving, put away, replenishment, order picking and shipping, informational support (the warehouse management system, RF terminals, barcodes, data acquisition and record, data capture), human resources (work procedures, number and skills of workers), transport units (size and SSCC of pallets, content of pallets) and logistic data of the articles (code of SKU, weight and size, packing).

For example, the forklift operation in the digital model is a detailed emulation of the forklift operation in the real system. The real forklifts are equipped with the RF terminals and the drivers communicate over terminals with the WMS. The drivers can select a job and a task and have to confirm the accomplishment of a job or task. In the model, the driver can select one of the tree basic jobs (putaway, replenishment and pick to order), then he gets the task, executes the task and has to confirm it's accomplishment (Fig. 4) like the real drivers do in everyday work in the SDC.

The forklift's operation on the location is also modelled in detail. For example, the movements of a forklift (lifts the fork on a level of a particular rack, loads and unloads the pallet) and operation of a driver (scans a code of the location or a SSCC code, types the data in the RF terminal, confirms the task) are modelled with all particular movements (velocity of moving forks up and down), spatial characteristics (elevation of the rack) and operational data (time for scanning and confirming the task).

The digital model of the SDC (Fig. 4) offers a good platform for experimenting with a different number of forklifts to optimize the equipment efficiency and throughput, experimenting with different allocations of goods in racks for minimisation of path and time for picking to order, studying the possibility of shipping dock enlargement with the aim to increase the throughput, studying the possibility of storing different SKUs on the same location (rack) with the aim to enlarge the capacity of the SDC.

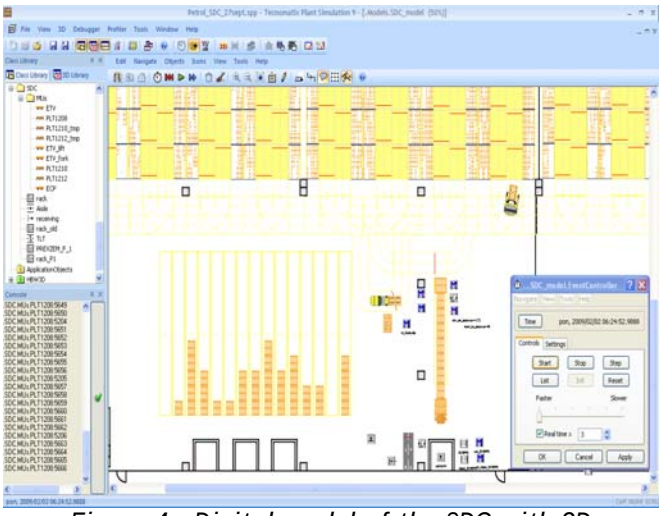

Figure 4 - Digital model of the SDC with 2D representation

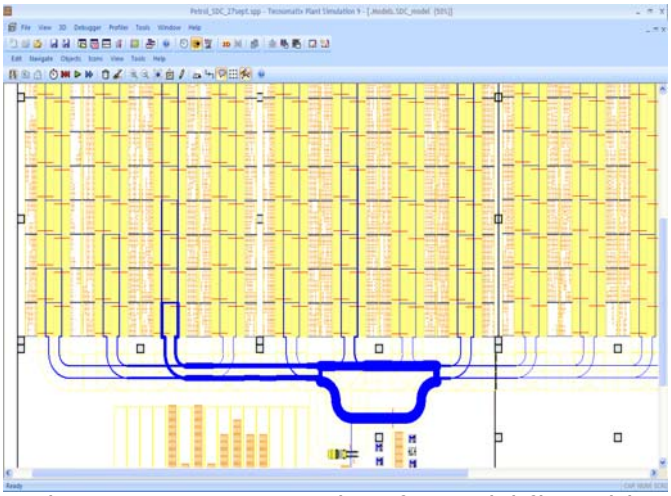

Figure 5 – 2D representation of material flow with Sankey diagram

One of the main advantages of using a digital model for experimentation is the graphical representation of the results. For example the representation of the material flow with Sankey diagram (Fig. 5) can be very useful for optimisation of allocations of goods in racks and for minimisation of path and time for picking to order or for replenishment.

CONCLUSION

Further work of the project goes in tree directions [7]. The first direction is to establish a mathematical model of the logistic system, which will allow a more detailed statistical analysis. The second direction is to complete a digital model of the SDC, to conclude the experiments and to propose a direction of the practical solution. The third direction is optimization of the distribution paths. Given a set of goods, a transportation network with delivery locations and a fleet of transportation vehicles the goal is to carry out deliveries from the SDC to all customers incurring minimal costs and subject to certain additional constraints [8]. In the final stage the digital model of the SDC and the model for optimisation of distribution paths will work together in an integrated and complete digital environment that will offer an efficient platform for overall operation optimisation of storage and distribution centres.

The research work on the project pointed the reasons why there are not more practical examples of modelling and simulation in the practise. The first reasons are the skills and great effort needed to build an adequate digital model. The second and also very important reason is the recognition of the benefits of testing and experimenting in digital environment instead of using findings from successful case studies.

It is also very important to understand that for the effective implementation of simulation of the well defined goals and the specified key performance indicators are of great importance.

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AUTHORS & AFFILIATION

Tomaž PERME[1],
Matjaž NOVAK[2],
Rok STRAŠEK[3],
Iztok KAVKLER[4],
Alen ORBANIČ[5]

[1,2,3] FACULTY OF MANAGEMENT, UNIVERSITY OF PRIMORSKA, Cankarjeva 5, SI-6104 KOPER, SLOVENIJA

[4,5] INSTITUTE OF MATHEMATICS, PHYSICS AND MECHANICS, UNIVERSITY OF LJUBLJANA, Jadranska 19, SI-1000 LJUBLJANA, SLOVENIJA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

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5, Revolutiei,
331128, Hunedoara,
ROMANIA
http://acta.fih.upt.ro

UNIVERSITY POLITEHNICA TIMISOARA,
FACULTY OF ENGINEERING HUNEDOARA,
5, Revolutiei,
331128, Hunedoara,
ROMANIA
http://annals.fih.upt.ro

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Silvia BARBERO[1]

SYSTEMIC DESIGN IN ENERGY SECTOR: THEORY AND CASE STUDIES

ABSTRACT:
In the light of the growing concern about climate change, an important part of resource exploitation from industrial society is connected to energy use. Integration of companies through material and energy exchanges lead to a more efficient use of resources as well as financial, social and environmental benefits for the local entities involved, as Systemic Design approach proves.
This research analyzes seven best-practices in Sweden, which since the Eighties realizes green energy plants, to understand key-drivers and barriers. Research coordinators can facilitate the creation of self-sustaining network of companies.

KEYWORDS:
Systemic Design, Green-Energy, Zero Emissions, Local Economic Development, Multidisciplinarity

OVERVIEW

We live in an age that has achieved an extraordinary degree of sophistication in terms of products and production systems, and yet at the same time we find ourselves damaging our environment. Moreover, there is a widespread crisis currently afflicting the economic system, and the steady impoverishment of social relationships caused by exasperating goal of economic growth. Our industrial world follows a straightforward logic of gaining at the expense of social and environmental aspects: a linear industrial model characterized by cause/event phenomena, technical problems solved and spot strategies studied. [1]
The theories of Industrial Ecology and thereafter Systemic Design propose a complex industrial system, similar to web, where the material and energy flows are better used, in order to model our production and energy systems after nature. Material and energy loops are open because what is considered waste by one enterprise becomes resource to another; in that way the environmental impacts and the resource depletion decrease. Many industrial ecosystems have come naturally for better business, while others have been facilitated through external actors [2-3]. However, as these theories and ventures may be innovative and useful for industries, they are still no more than solving spot problems that arisen from environmental pressure and economical revisions. In order to provide further strength to an industrial ecosystem, broader vision and longer strategies must be design, involving new players and stimulating innovations. The theories of Systemic Design offer a scientific method to design a complex industrial system with environmental, economical and social benefits [4]. The development of industrial ecosystems leads to a multidisciplinary vision inspired by the dynamic operation of Nature.

METHODS

In order to make current industrial and energy systems more innovative and adapted to changes, Systemic Design theory should be applied [5]. The analysis of seven case studies developed in Sweden, in the field of bio-energy system, helps to review this theory and define a framework with drivers and barriers to the development of self-organizing businesses. The bio-energy sector is chosen because the access to a secure and affordable supply is crucial for socio-economic growth and poverty alleviation; and because the emissions associated with its generation and use is also central in many environmental issues. A key challenge for energy sector is that the provision needs to be achieved without unacceptable or inequitable loss of environmental quality. In that area, Sweden is one of the Countries in all World that has been taken in that and since Eighties practices innovations and experiences.
The best practices are chosen from a series of different cases as the best actually in Sweden for they complexity in solving problems not only technical, towards efficiency and sustainability, but also economical, social and environmental, further more they follow some of the Systemic Design principles. Current case studies are examined and compared each other to review the theory of Systemic Design.

The basic concept of this theory is that industrial processes should learn from natural world. The systemic approach is based on five principles that serve as guidelines of design processes and of analysis for the seven cases:

1- *Output>Input. As in nature what is not used by a system becomes a raw material for the development and survival of someone/something else, in industrial production the waste (output) of a system become an opportunity (input) for another one, creating new economic opportunities and new jobs. For example, the exhausted coffee powder resulted by the beverage production can be an excellent substrate for mushroom farming [6].*
2- *Relationship. The parties that compose the complex system are themselves the system. All over the world living systems can be found nested in other systems or as part of the community or organizations. The properties of it, whether living or not, are born from interactions and relationships between constituent parts. The study of the relationship affects not only the relationship between the system components, but also those that exist between the system and larger systems that surround it. For example in industrial model the competition disappears in behalf of cooperation, the boundaries of enterprises become more flexible and adaptable to the context.*
3- *Act locally. As an eco-system is deeply influenced and shaped by its habitat, so the same happens for any other kind of systems where it is extremely important the context that let it be "local".*
The background enhances the resources typical of the area, not only the material ones but also the non-physical ones, as human and cultural resources. Based on these opportunities provided by the context, designers can create new systems, reducing the problems related to the adaptability of "general" solution. In fact, any systemic projects can be reproduced identically in other part of the world, because it was designed for that context and it works like it is just in its location.
4- *Autopoesis. Self-maintaining systems sustain themselves by reproducing automatically, thus allowing them to define their own paths of action, so a system is naturally led to balance and preserve itself alone. A system designed to live in a context is so strictly connected with it that will mutate together it, changing and adapting itself at new conditions.*
5- *Man at the centre of the project. The human being is inserted into the system in which it lives and activates its own relationship with the environment, the culture and the society. In this model the different activities of living and producing co-exist in balance, so every element have their essential function in the relational system benefit: no precedence over the other, but each exists thanks to all the others. The myth of "other-than-me" has been responsible for wars, the rape of the planet and all forms and expressions of human injustice [7].*

This model is inspired by the foundations of Generative Science, based on the assumption that as a result of any transformation of the resource, all by-products are designed to add generative value and subject to careful evaluation. Systemic Design (SD) provides a framework supporting the evolution of a new economy with different sets of industrial relations, where long-term sustainability and success of a network of interdependent activities are prioritize over maximizing economic growth, development or competitive advantage for individual entities [8].

CASE STUDIES

To understand the results given by the Systemic Design, in that chapter two best practises will be presented and analysed according to the guidelines explained before. The chosen best practises are divided for dimension in macro and micro systems, in the first case the projects involve an entire community or municipality, and in the second one they involve just a building or an industry (Figure 1).

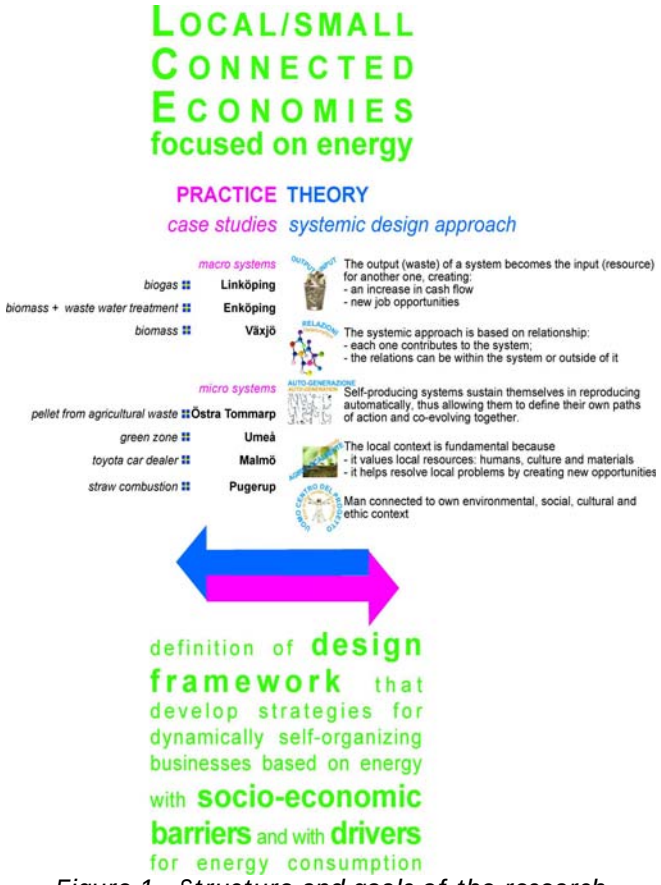

Figure 1 – Structure and goals of the research

Every best practice is analysed in according to a series of variables that include qualitative and quantitative aspects. The report gives the localization, the background and brief description, the environmental benefit, the creation of new jobs, the main actors and the main activities, the funds and financing, and the

future projects related to it. For this paper just two cases are explained in details, one in the first group of macro-system and the other in the second one of micro-system, because they are enough to understand the method that conducts to review the theory and propose a framework to develop strategies for self-organizing businesses. Improvements for further innovation and future progress based on Systemic Design principles will then be produced based on the review of the cases. The goal of this research is to give a review of what could be done to better suit the industries for the future based on current best practices.

MACRO SYSTEM: LINKÖPING

In September 1989, the management of the city of Linköping, the transit authority, Tekniska Verken and KFB was taken to start up the first modern biogas project with modern equipment in the world.

In the town of Linköping, a test of biogas-powered buses began in 1991. In its first phase, 6 busses using converted diesel engines were used, but the whole initial year proved troublesome. 1992 started better and went better. Since 1997, all public transport busses (approximately 60) and some passenger cars run on biogas, and finally in November 1999 were taken the decision to re-write the contracts for bus operations and formally make the pilot. Biogas, has grown considerably since the introduction, there are now over 1200 personal vehicles, 89 biogas busses and 30 heavy vehicles in the Linköping region [9].

The objective of this project is to develop an integrated system for the transformation of difficult waste to useful biogas and to develop a public transport system with city buses fuelled with the biogas. The strategic aim is to connect city and rural areas to each other.

The cities insight in societal values by providing high quality environment was the driver of the initial project: noise and pollution has been reduced dramatically in sensitive areas during the expansion of the biogas project (Table 1).

Table 1 – environmental benefit

Greenhouse gasses	*-80%*
NOx	*-70%*
CO_2	*-90%*
Particulate matters	*-90%*
Noise	*-50%*
Performance in busses	*-10%*

Linköping were successful in providing early improvement in decision making among the staff. After that, the staffs were involved in technical and administrative development early and increasingly. Good timing, sufficient funds, dedicated staff and good portion of good nerves are some of success factors.

The basis of the region's unique expertise in biogas production is, of course, the joint biogas venture by Tekniska Verken, the City of Linköping and Östgöta Trafiken in early 1990s. A further factor underpinning the rapid development of this know-how is the close collaboration between Tekniska Verken and Linköping University. They joined forces to quickly learn what they need to know, the process was stabilised, and production could increase.

The system could not have been developed without external financial support. The lack of industrialization of the total concept made risk too big to carry the whole financial and intellectual burden by them. Attracting money also attracts willingness to contribute with know-how and intellectual capacity. If these type of installations have been more common, standardized and frequent, prices would have been low enough to provide it for lower cost at local risk [10].

The future plans aims for increased biogas production and new public refuelling station, because some of the bottlenecks are comparatively inexpensive to expand.

Biogas firms of the region tend to focus on large scale production plants located near areas of large material flows. Though more should be done to encompass small scale plants into the mix for greater expansion, material flows and coverage. In the future connecting local farms to a biogas grid may ease raw material handling costs, and allow for a larger network of biogas production.

The work of local organizations, researchers and businesses is by far not complete. Biogas research continues to expand as well. Biogas research also is beginning to become a major focus at Linköping University: recently an initiative was started to begin a Biogas Research Center composed of an interdisciplinary team of researchers digestion, methane separation, small vs. large scale developments, biogas to electricity production and biogas in the energy systems perspective.

The first guideline is always present in the selected best practices because it is the key to solve environmental problems, so also in that case there is a transformation from agricultural waste (output) to bio-fuel (input).

Furthermore, in that case study the guidelines that assumed more importance in the success of it is the relationships and the local action.

The cooperation among different partners is a strengthen point and it helps to reach common goal, because often the actors tended to have different views regarding energy, environmental or transportation related subject and had different interests concerning the fuel. The biogas, in this case, had importance for the cooperation between actors. The stakeholders have formed and executive steering committee to deal with mutual and arising issues. Each stakeholder was invited individually, starting with the one that would impact the most on other to join. This is an approach that usually brings the most difficult questions to the table up front. In the Linköping case, this was a successful approach as the critical issue as thereby was debated once and arguments formatted when coming in the next stakeholder or player.

An other important role, related to relationships, has be taken by the staff, that was so involved as decision

makers that we can define the process as co-design or share-in-design.
Furthermore, that kind of approach helps to have a very close relation with the area. Manly staff comes from the region so they well know environmental, social, political and economical aspects of Linköping. The result is a strongly connection between rural area and the city. In relatively short time local farms can be connected with the biogas grid to reach a sort of distributed green energy production spread on the territory.
Finally, the last guideline pointed out is the autopoesis, because the area is naturally growing up in biogas knowledge and a factual event as the emergence of a new Biogas Research Centre is the demonstration of it.

MICRO SYSTEM: ÖSTRA TOMMARP

This project was carried out from 1 January 2006 to 30 November 2009 thanks to EU LIFE Environment Programme.
It was targeted towards developing and implementing an innovative method to reduce greenhouse gas output at the agricultural sector. It resulted in a complete facility for agricultural waste reduction, renewable energy supply, carbon neutral fuel production, as well as a demonstration system. The project involved the seed industry (Skånefrö AB), combustion technology industry (HOTAB) and academia (Lund Technical University).
The objectives of the Bioagro project was to successfully demonstrate an innovative technique that enables seed waste to be converted into energy in an integrated system comprising dose scales, mixer, pellet machine and heating boiler. The ash produced during the combustion to have green energy should be returned as nutrients to the agricultural fields. Carefully selected and tested additives should control the emission of sulphuric, hydrochloric acid, as well as reduce sintering of the ash. Skånefrö´s use of oil and electricity for heating can now be replaced (and only used as a backup security system in case of furnace breakdown) by heat produced out of residues from the company's own seed production operation. At the end of the project the pellet throughput is above three metric tonnes per hour. The pellets are showing the high quality characteristics of a dense structure with a smooth, hard surface for convenient feeding into storage and transport [11].
From the project finalisation, the beneficiary does not longer have to use electricity to heat the office and other buildings at the company premises. In fact the system now has district heating capacity and investigations are in hand to explore the possibility to link the Bioagro system to a new grid for providing heating to the nearby community.
The project set out to demonstrate an innovative method which is transferable to the whole European agriculture sector, constituting a breakthrough in finding an alternative to fossil energy and thus having the potential to assist substantially in reducing the discharges of greenhouse gases in Europe.
The Bioagro action consist in producing and using a high-quality pelletized fuel from grain, waste from grain, seed and grass in a small scale. The pellets will be demonstrated in small units (pelleting machine, heating boilers and burners) easily adapted to different agricultural crops, enabling quick change between different recipes with and without additives. Mixtures of additives together with seed waste will produce a homogenous, cost effective agro fuel (pellet) with low environmental impact. The system can be regarded as more sustainable in comparison with other agro fuel systems, since only non-food biomass is used.
The project implementation faced obstacles that made the process slow and difficult as for instance repeated formal complaints from neighbours delaying the planning and building permissions. Guarantee conditions imposed belatedly by the supplier of the main pellet press caused further constraints. Major technological problems in the material handling systems were faced, with equipment suppliers unable to suggest solutions applicable to the special conditions imposed by the variety of the biomass raw materials. The project management was able to overcome these challenges through a combination of persistence, positive attitude and innovativeness.
The results from the project are (table 2):

1- *Reduction of greenhouse gases*
2- *Reduction of combustible waste from grain production (with 100%) and total waste (with 95%): full utilization and capture of all seed residues from the beneficiary's production.*
3- *Eliminating costs for heating with oil and electricity (by 99%)*
4- *Ash is regained as plant nutrient (100%)*
5- *Less discharge of organic substances (with 20%), sulphur acid (86% in some measurements) and hydrochloric acid (70%) compared to existing techniques*

Table 2 – environmental benefit

Greenhouse gasses	reduction
Waste from grain production	-100%
Oil combustion	-99%
Suphur acid	-86%
Hydrochloric acid	-70%

To enable the Skånefrö's personnel to use and maintain the operation of the boilers, a partner technical company experienced in heating technology for biomass fuels (Hotab) held education sessions for the operators. These mandatory sessions were held during full-day workshops together with practical tutorials on the Bioagro boilers.
The Bioagro system strengthens regional development by generating more jobs in rural areas. The rural focus of it is also in congruence with the employment strategies within the Lisbon Strategy for Growth and Jobs, aiming towards the creation of jobs connected to rural and sustainable development.
The additional employment generated from the Bioagro system at current capacity is on average 9

people working full time. The skill set required ranges from post-graduate engineers to high industrial experience. During the construction phase of the system some workforce as well as companies from outside Sweden has been employed. The number of staff is expected to rise as the capacity increase at the facility.

In order to further promote the commercial development of the Bioagro concept, it was decided to form a new company: Bioagro Energy Österlen AB. It was formally established after the end of the Project, the 1st January 2010. It is a production facility that turns dry agricultural residues into a pelletized fuel and provides district heat supply to the local area. The aim is that the new company shall promote pellet production and pellet sales, as well as the use of the Bioagro development platform and its solution for countries in need of local, environmentally friendly and cost-effective fuel.

A future activity, which is at the planning stage, is to use the Bioagro pellets to produce biochar as a new "Carbon Negative" technology that transform charcoal by pyrolysis of biomass, and it differs from it in the sense that its primary use is for biosequestration. Biochar can be used as a soil amendment to affect plant growth yield (for plants that love high potash and elevate pH), improve water quality, reduce soil emissions of GHGs, reduce leaching of nutrients, reduce soil acidity and reduce irrigation and fertilizer requirements. By adding this production to the system, the whole project can actually remove greenhouse gases from the atmosphere.

In Östra Tommarp case the output taken in consideration is the huge amount of biomass generated by seed production. The agro-residues, no-food biomass, are an untapped potential all around the world, evaluated in 16 billion tons/year and 43 million only in EU-15 (source: European Biomass Industry Association). With that project this kind of waste becomes fuel (pellet) to produce heat and power.

As in the previous case, another important role is taken by local actions, generating development of a rural area and increasing job places and the relation with neighbours was a crucial point, in Bioagro project solved with many problems than in Linköping, because without their agreement the construction of a new building delayed.

An important guideline that stands out in that specific case is the man at the centre of the project, because all people involved in the project were trained and educated to conduce in the right way the boilers and manage the complexity of the system.

CONCLUSION

In the same way was analyzed the other five cases, but the result could be understandable also from these two, because the guideline that is crucial to reach in a systemic project is the transformation of output in input. If the theory and the practical actions don't start from that point, would be not possible to reduce (or avoid) the emissions into the environment and create the relationships named in the second guideline. The relations are so important that can fail the entire project.

Local actions of project and its autopoesis are strictly connected because only a system design in and for a specific context can live through fast changes.

The last guideline about the centrality of human beings in systemic project helps just to remind that social resources are valuable as the other resources (natural and economical).

In particular, in the field of renewable energy, these best practices teach how the creation of sustainable infrastructures and agile energy systems could develop a region. Green energy produced in small plants and distributed in the territory helps the success and the sustainability. Reading in the right way the environment is possible to design the right technology that produce bio-energy and that is connected with other renewable resources. Such agile system can be a new paradigm for both energy efficiency and reliability for any region or country (Figure 2).

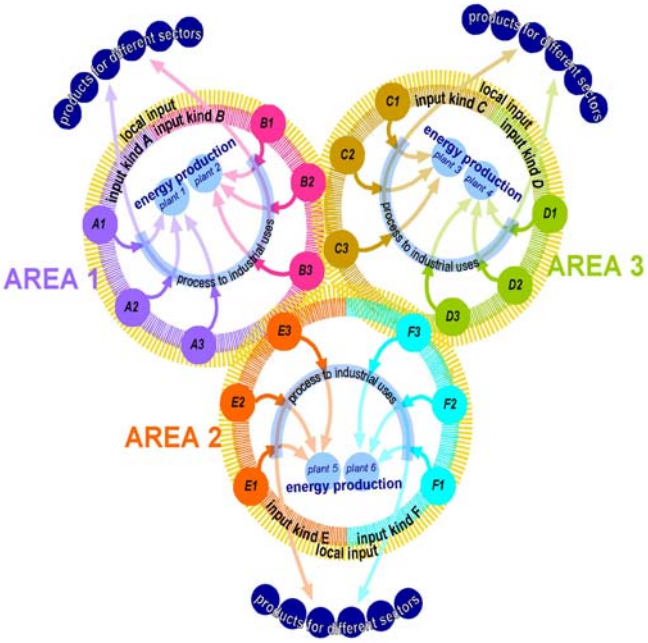

Figure 2 – Agile bioenergy systems

The lessons extracted from these cases are designed to guide the development of other production and product systems aligned with Systemic Design. Networks can bridge the gaps to sustainability and research coordinators can facilitate in the creation of conditions for a self-sustaining network committed to sustainable approaches [12].

Systemic Design generates Local Economic Development to establish the conceptual base and the analytical skills that are needed to harness local and regional economic change. Looking ahead the development of a multidisciplinary vision becomes crucial, in that way various skills are brought together, towards the emergence of a new culture of sustainable economic and technological innovation and process inspired by the dynamic operation of Nature that is the system for excellence.

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AUTHORS & AFFILIATION

Silvia BARBERO[1]

[1] *POLITECNICO DI TORINO, DEPARTMENT OF PRODUCTION SYSTEMS AND BUSINESS ECONOMICS*
corso Duca degli Abruzzi 24, TORINO, ITALY

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

http://acta.fih.upt.ro

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Maciej KOWALSKI[1], Radosław PASZKIEWICZ[2], Przemysław ZAWADZKI[3]

VR TECHNIQUES IN WORK STAND DESIGN

ABSTRACT:
Use of Information Technologies in product design allows to improve it's efficiency. Application of different IT tools allows reducing the time of preparation of the product for production as well as to reduce the manufacturing costs and improve the quality of the product. When work stand is considered as product, the design process of that product is even more important. Besides of capabilities of work stand manufacturing cost limitations it also effects reduction of costs of products which are manufactured at this work stand.
Sometimes design process of the work stand can have some weakness which cause low level of the ergonomic quality and can be the source of farther economical loses like low production capacity of the work stand, high level of lack, rapid wear of machines and tools, accidents, employee's exhaustion and other professional diseases. All loses which have been described above are incurred through many years of work stand exploitation.
Author of this paper proposed the innovatory approach for work stand environment design by using virtual reality techniques. Elaborated IT tools for design with the use of VR techniques enable to work stand design at the different branches of industries. With the consideration of mass production the development of ergonomic, convenient work stands becomes more and more important. That is why author's research investigations concerned at testing of new tools at the work stand design process for automotive industry. The results of these investigations will be presented as well.

KEYWORDS:
virtual reality, ergonomics, work stand

INTRODUCTION

Product design phase affects the cost of its manufacturing. Between 80-90% of all costs of product lifecycle (PLC) depend on realisation of the design stage. All that comes to conclusion is that focusing on the design stage of PLC is important and can improve the overall effectiveness.
The common knowledge is that usage of IT during the design makes the whole process more efficient. By usage of different software and hardware solutions time spent on the design is reduced. Also the costs reduction and quality improvement is noticed with such approach [1]. If designed object is a work stand, the design process generates even more implications on the costs of elements manufactured using the stand. Improperly designed work stand with low level of ergonomic quality creates so-called economic lost such as: low productivity and capacity, high number of production faults, fast tools replacements requirement, increased hazards level, tiredness and work related diseases etc. It has to be mentioned that such costs are cumulated during years of the work stand usage.
If designer decided to use CAD systems he increases the potential to make better decision faster and in earlier stage of whole process. Decision like that have impact on manufacturing costs, work conditions (ergonomic) and effectiveness. The costs of implementing improvements and amends in work stand design when it has been already constructed and used are incomparably higher than the costs of implementing changes in the design phase involving CAD systems.
There are systems which role is to simulate the work stand conditions basing on CAD solutions. Usually such systems are based on so-called CAD Digital Human representation. Usage of CAD Digital Human feature allows visualising the human factors in virtual environment. That leads to include most important element in design process of work stand environment - human influence [2, 3]. Digital dummy or digital human application provides solution of gathering data and design improvements by visualising work place ergonomics, visibility area FOV (field of view) and arm range. It also creates possibility of performing so-called RULA analysis (Rapid Upper Limb Assessment). Thanks to the RULA analysis it is possible to indicate points where the hazard appears. The RULA analysis shows the numerical values (fig. 1) based on data like weight, load and actions frequency. Those numbers are representing a risk of damage for specific parts of

human body. By using the digital human in CAD systems the designer can create safer and ergonomically approved work stands designs. Such approach is time consuming and bases on the following tasks which have to be completed:

- *virtual scene creation,*
- *digital human creation,*
- *placing the digital human within the virtual scene,*
- *assigning the tasks to the digital human,*
- *tasks realisation analysis.*

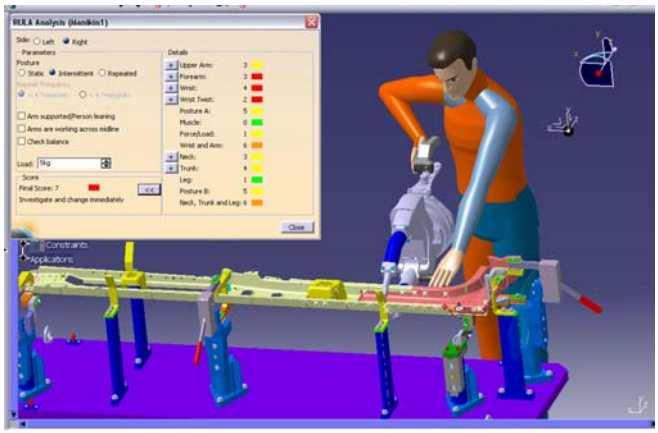

Figure 1 - RULA Analysis with usage of virtual dummy - digital human (CATIA Human module)

The fact that the setup of simulation requires time and specific knowledge is one of the main reasons of rare use of these tools by the designers. The second reason of not using such of tools is lack of knowledge to make adequate and relevant conclusions based on the achieved results and apply them in appropriate way within the designed elements. As a result, work stands designs rarely pass the validation procedures and examination.

The other method used for validation of the work stand design and setup the work standards is MTM (Methods-Time-Measurement). MTM is based on measurements of time of task realisation with regarding to choose method of work. It is using the basic movement analysis. These basic movements are called Trebling and can be combined into modules, for example: reaching, catching, and releasing = gathering.

The method allows estimating main time, time for completion of all activities and main time of preparation. MTM can be performed when the work stand already exists (then the process is called "manufactured analysis") or when it is still in design process (then the process is called "planning analysis").

The Manufactured Analysis is based on observations of existing work flow. The Planning Analysis instead is based on simulation of the work stand. For this second type of analysis the work stand sketches with tools and additional hardware are used to visualise the methods of work. Results of the analysis based solely on simulation are often inadequate in relation to real work results. One of the reasons of such situation is the difficulty of simulating the complex and compound production processes. This is especially evident when process involves complex work stands with huge number of tools used.

Virtual Reality In Design

Simultaneously with development of the CAD systems also the virtual reality (VR) systems evolved becoming more popular and more applicable [1, 4]. The development of the VR techniques starts with simulating presentation of the still images with stereoscopy effect. The next step was creation of the helmets with special monitors build in - HMD (Head Mounted Displays). This leads to give user to percept not only a vision but also a sound via speakers builds into the HMD. By using the sensors the movements of the operators head could be combined with presented image so the visualisation become more immersive and give the observer features of being fully involved within the virtual scene. The next step was to create a whole body tracking systems usually based on exoskeleton mechanical structure (i.e. Gypsy Motion Capture System) but also on optical tracking with using special uniforms with markers. The important development was the ability to use force feedback features and solutions which simulated the human touch sensibility. The increase of calculation power of descent graphic cards gives an ability to render the virtual scene in a real time. All those solutions together are now very commonly used for support the designers in their daily work. The modern CAD and DCC (Digital Content Creation) software already allows to use some of the immersive technology within the regular options of the software such of modelling, texturing, parameterisation etc.

Virtual reality supports such activities like visualisation of CAD models for support the modelling process, comparing solutions and optimising the surface quality in early stages of the design process. By semi-photorealistic and physically correct visualisation of the surface, the designer can evaluate his own solutions even only on visual object without real life prototype [6]. The visualisation solutions are ready to present objects in 1:1 scale which is important to have a right perception of the designed elements.

Virtual reality systems nowadays often substitute real research stands used for visualization of researched physical phenomena as fluid and gas flow, thermodynamics processes or deformation due to forces. Virtual reality systems in this case are responsible for stereoscopic visualization that makes results of analysis more readable and accessible to the user (fig. 2).

Figure 2 - Use of VR in early design phase

Figure 3 - Ergonomical design in Virtual Reality system

VR systems also open up wide possibilities for modeling the ergonomic features of the products (fig.3). They have a number of features including collision analysis, identifying critical areas, animation, and making measurements of objects in the virtual world.

USE OF VIRTUAL REALITY SYSTEMS IN WORK STAND DESIGN

Tools based on the solutions of VR techniques can successfully be used in the design of work stands. In the case of mass production creation of ergonomic, comfortable work stands according to the anthropometric dimensions of man is very important.

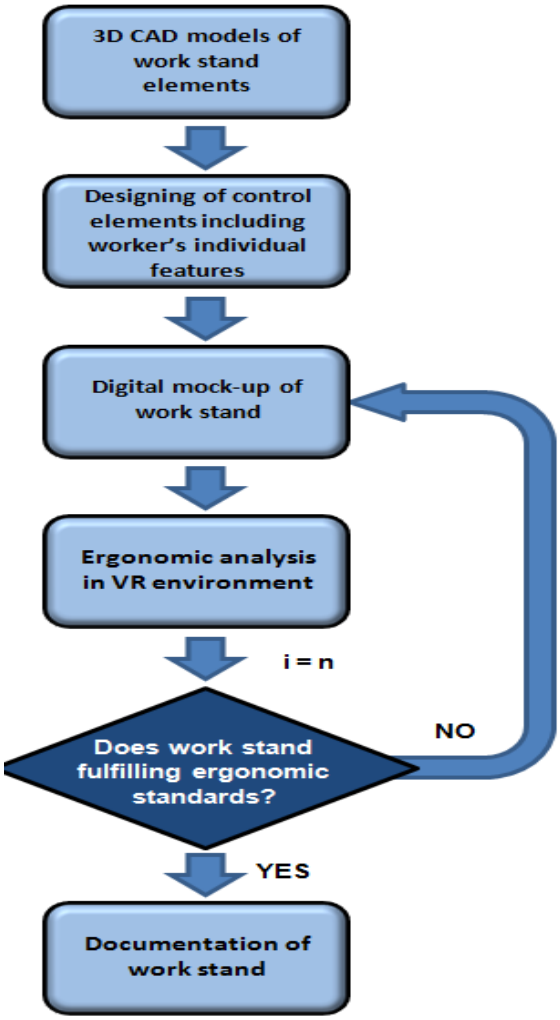

Figure 4 - Work stand design process using VR system

Proper designing of work stand must take into account not only human, but also such elements as equipment of work stand and its environment. The authors proposed a new approach for the design of such facilities using virtual reality systems (fig. 4), taking all the previously mentioned requirements into account.

An example of the implementation of VR techniques in the design process can be a virtual model of spot welding work stand. The authors have developed an interactive simulation of a work stand using a specialized VR programming environment named EON Studio, developed by EON Reality. This simulation allows the user and the designer to verify the functionality of the work stand and helps to learn how to operate it. A detailed geometric model of the work stand has been prepared in CATIA V5, then the model was translated to EON Studio (fig. 5). Virtual spot welding work stand consists of:

- *work table with clamps*
- *spot welding machine*
- *control panel*
- *welded elements*
- *virtual hand*

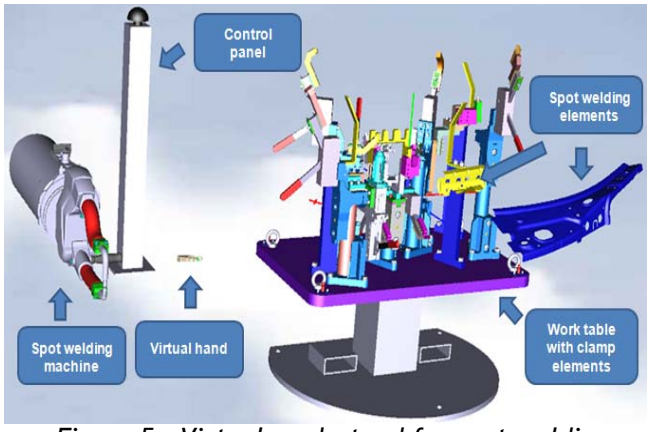

Figure 5 - Virtual work stand for spot welding

To ensure the opportunity of work conditions analysis, work stand simulation was enriched with interaction. A set of relations was created between objects of work stand, to simulate the operation of real welding work stand. The functions allows user to monitor and control elements of the work stand. By use of specialized equipment interaction and immersive effect has been increased. Control and manipulation of objects is realized via magnetic tracker system Polhemus Fastrack ® and the data glove recognizing gestures - 5DT Data Glove. The immersion effect is ensured by stereoscopic projection system - EON ICatcher or HMD helmet.

By using the tracking system user has the ability to control welding machine by hand and arm movement. With the data glove and appropriate gestures user is able to control the closing and opening welding clamps. Simulation enables collision detection of welding machine with elements of work stand and welded elements. Each contact of the welding machine with elements of the station is recorded, and the user is informed by a sound effect. Analysis allows specifying the location of a collision during the operation and allows selecting the optimal setting of welding machine to ensure the correct execution of

welds. Simulation of welding work stand also allows optimizing the welding process by eliminating unnecessary movements, determining the order and positions of welding machine.
Based on the virtual work stand it is also possible to perform MTM analyze, where the time of basic movements can be measured basing on simulated motions. Results of this analysis at the design phase allow detecting and eliminating design errors which with a standard approach could be observed only after construction of the work stand.

MODERNIZATION OF WORK STAND – CASE STUDY

The main aim of works was modernization of work stand for spot welding of elements of a car chassis pillar. These elements are part of the side wall of car chassis and are performed on two work stands AFO 10 and AFO 20 (fig. 6). Standard technological process which was needed for preparation of an element of pillar consisted of two operations - spot welding on first and second work stand. Between these operations gluing of single parts was performed.

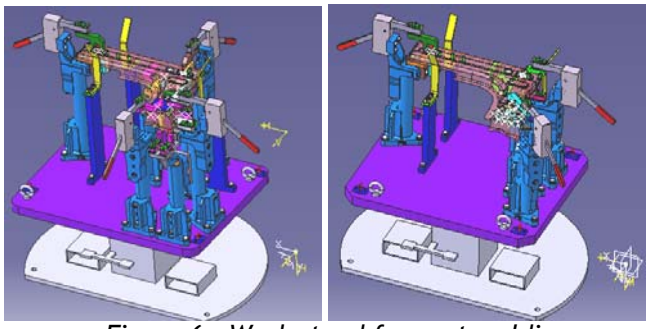

Figure 6 - Work stand for spot welding - Afo 10 i Afo 20

Main and the most important idea for modernization of the work stand was to design one integrated work stand on which all needed operation planned by technological engineer can be made. Such modernization should eliminate transport beetwen work stands, reduce time needed to open and close weld clamps and decrease amount of rotation of work table during spot welding.
To specify work characteristic on work stands MTM analysis was performed (fig. 7).

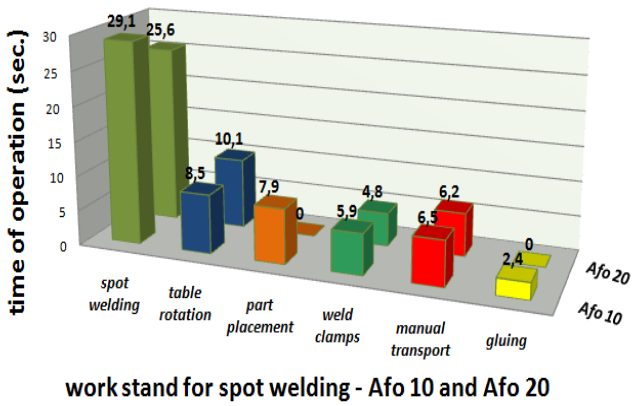

Figure 7 - Time of operations on work stands Afo 10 and Afo 20

As a result of research efficiency of work stand estimate 695 pieces/day assuming 24h work. As the most important factors determining the efficiency of the work stand were transport between them and the process of opening and closing weld clamps. Therefore, when designing a new, modernized work stand the main focus was to minimize the time of these operations.
Design work related to the development of an integrated work stand was carried out using previously described virtual reality system. Construction of digital workstand has been established basing on studies conducted on the basis of the criteria. The integration of two separate workstands allowed eliminating time-consuming transport. Application of pneumatic clamps and reconstruction of the positioning units allowed reducing time needed for process of opening and closing weld clamps (fig. 8).

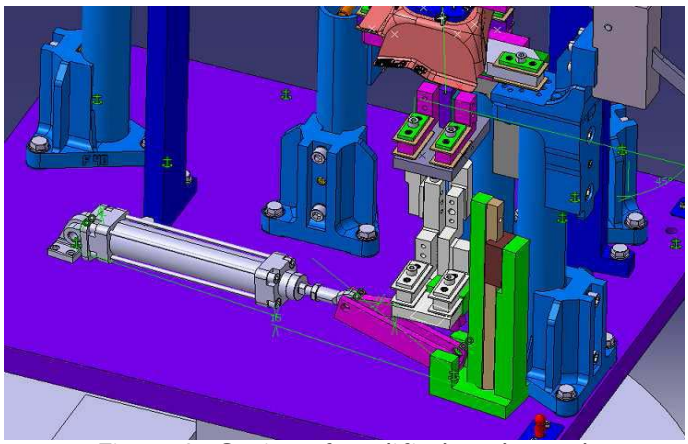

Figure 8 - Design of modified work stand

Use of virtual environment allows preparing interactive model of new designed work stand. Work simulation in virtual environment allows checking and detecting collision of spot welder with elements of work stand. Adequate relation between elements of work stands allows performing MTM analysis (fig.9), which results help to verify the amount of work and compare the rates before and after the modernization. As a result of the research work stand efficiency estimate on 897 pieces/day assuming 24h work, which was confirmed after the construction of modernized work stand.

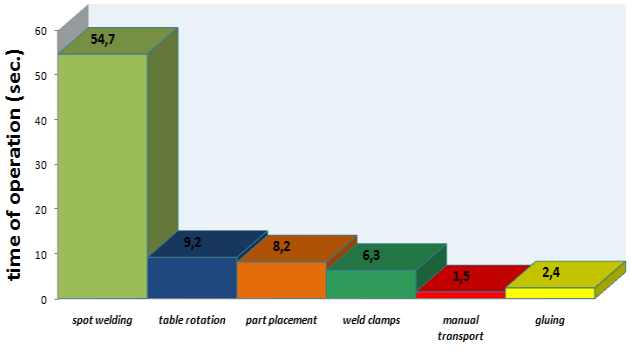

Figure 9 - Time of operations on modified work stand H22

CONCLUSIONS

Design with use of VR allowed us to create a new, integrated work stand. Thanks to merging two separate work stands into one, significant labor and time reduction was possible. Improved functionality of work stand caused reduction of time needed for operations at work stand. Employees perform tasks with natural basic motions, which cause steady work, less fatigue and greater stability of the process. It is important to mention that proper design of such work stand would not be possible using conventional design techniques.

Use of VR technology allows including ergonomic aspects at the design phase of the new work stand, which increases the comfort of future work. Implementation of virtual analysis involving the designer and operator of the work stand allows easily intercepting and eliminating design errors, without need of building a physical prototype.

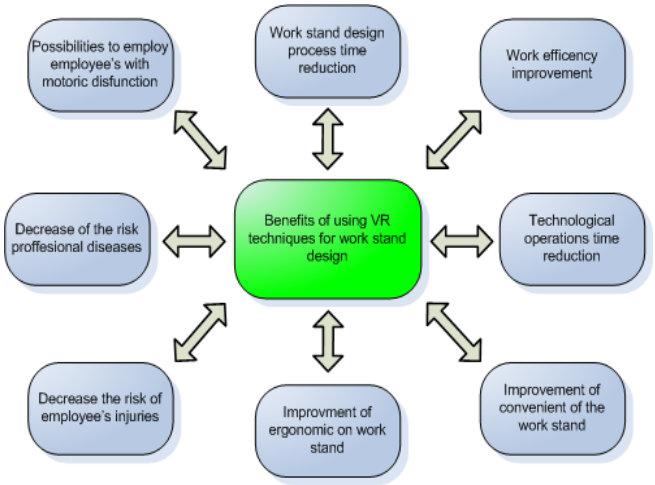

Figure 10 - Scheme of measurable benefits of using VR techniques for work stand design

This reduces the risk of occupational diseases and work accidents. An important advantage of the use of virtual technology in the design process is also the possibility to adapt the work stand for people with motion disabilities (fig. 10).

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AUTHORS & AFFILIATION

Maciej KOWALSKI[1], Radosław PASZKIEWICZ[2], Przemysław ZAWADZKI[3]

[1-3] POZNAN UNIVERSITY OF TECHNOLOGY, FACULTY OF MECHANICAL ENGINEERING AND MANAGEMENT, INSTITUTE OF MECHANICAL TECHNOLOGY, ul. Piotrowo 3, 60-965 POZNAN, POLAND

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

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331128, Hunedoara,
ROMANIA
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Dušan ŠEBO[1], Katarína HALAGOVCOVÁ[2], Henrieta NAKATOVÁ[3]

TECHNOLOGY OF THE MINE WASTE WATER DISPOSAL

ABSTRACT:
This study outlines the application of electrolytic waste water treatment use for mine works out flowing water. It describes history and circumstances in the 5 mine works (tunnels) in Spišská Nová Ves region. Finally the article provides results of the experimental treatment of the mine out flowing water with high percentage removal of Cr, As, Cu and Hg.

KEYWORDS:
electrolytic water treatment, mine out flowing waters

INTRODUCTION

Nature could exist without man much effectively than with the man. Unfortunately it does not apply in reverse because the basis for human existence is the nature and its resources which the man often also wastefully uses to meet their needs. At the same time the trend of use of these resources is increasing disproportionately. From the middle of last century until now has been mined more mineral resources than in the entire previous history. At the same time, from the vast amounts of raw materials that are mined today (about 40 billion tons / year) only a very small portion gets to the final production, which produces waste that is directly or indirectly devastating the environment. Also because of this has U.N.O. adopted the activity entitled "Agenda 21", which should serve for synchronizing the environmental and economic activities at more careful use of natural resources and creation of conditions for sustainable development in all areas, hence also in the major economic sectors such as mining industry. Mining has been developing on the territory of Slovakia from the Bronze Age. The first archaeological evidence of the existence of mining in our country is from around the 6th century AD, when the Celtic settlers mined and processed iron ore. The first evidence of underground mining in Slovakia is from 12 and 13 century AD. At that time, mining of rare metals in Kremnica and Banská Štiavnica acquired the importance in Slovakia. In Slovakia there are currently mined ore, non-metallic, construction and energetic raw materials. Mining as mining industry and preparation of mineral resources, e.g. coal, ores, and non-metals, has also now undeniably great economic importance. From it derives a wide range of other industrial - economic activities, such as metallurgy, machine building, chemical industry, construction, transport and others for which mining provides the substrates or the products of which it uses. However, like any other industrial activity, also mining of mineral resources has except the primary impact (mining itself) also other various secondary effects on the quality of the environment (biosphere, pedosphere, human society, etc.).. Mining industry affects the environment, not only during the period of its operation, but also after termination of mining, after the departure of the last worker from the mines. One of the problems is that it leaves behind the old mining works constituting a burden for the environment. It is important to monitor these. List, location and monitoring of environmental burdens register and continuously update State Geological Institute of Dionýz Štúr in Bratislava. According to current information, there are 16 478 of these environmental burdens on the territory of Slovakia. The problem is also, besides the impact of current issues of mining activities effects, historical persistence and time-consuming dealing of country with this activity. Among the impacts directly related to the mining activity belongs even the existence of mining works, tunnels, shafts, pings, pings fields, heaps, dumps, scrap heaps after ore mining or associated with their processing, slag after ores smelting, and so on. Among the effects associated with the provision of mining activities may be included, in country still well visible water system of mining works, timber harvesting and subsequent inappropriate afforestation, the occurrence of radioactive particles (radon), which get to the surface from weaned unventilated mines, particularly into residential buildings constructed above such mines. Some of the mining works are a source of wastewater. They are

result of spring and following desuinting of extracted raw materials, in underground or in the mine springing water. This water may contain heavy metals, which, after mixing with surface waters disrupt the stability of the ecosystem. The waters are mainly acidic origin, but there is also alkaline waste water. To prevent or reduce the effect of either acidic or alkaline water from old mine works it is needed to adjust them to acceptable levels to avoid damaging the ecosystem. [1]

CHARACTERISTICS OF STUDIED MINE WORKS

Based on the recommendation of the Mining Office Spišská Nova Ves, water samples were taken from the following mining works: Teplička nad Hornádom, Smolnícka Huta, Smolnícka Huta - Shaft Pech, Slovinky – tunnel Alžbeta, Rudňany – tunnel Rochus.
The new tunnel is the lowest exhausted horizontal mine work, tunneled since 1924 in ancient bearing Grétla. Ore was mined here until the end of the 1963. Chalcopyrite was mined there. The problem now is the sudden outflows of water from an abandoned Nová štôlňa (New tunnel), a former opening works on bearing Gétla in Hnilčík that threaten people. Like every phenomenon, triggering a dangerous natural processes, have periodic outflows of mine water from the Nová štôlňa its rational explanation. It is likely that early steps taken at the beginning of the liquidation of the mine within ore mining depression can prevent an existing condition. After the liquidation works, deep parts of the mining system below the level of Nová štôlňa were under water. The bulk of the throughout the centuries forming mining system stayed below the level of groundwater and drained inflows of waters from broad scopes and mining drilling the hill Grétla. Water was collected in the tunnel sewer and flowed to the surface. The mouth of the mine works was by the solvers of attenuation project left in its original state, against the intrusion of unauthorized persons was ensured by the locked bars (probably not strong enough, because it appears that the tunnel has become accessible to anyone). Upon completion of the work monitoring of out flowing water was not carried out, nor a physical inspection of the mine. The original owner (Želba SNV) failed to report to mine and contributed also the legal status - non existence of legislation on fate of mining works after realized securing works or liquidation works of attenuation program and non existing rules for ownership rights to such works. Nowadays it is a period between two torrential waves. Water in the borehole increases about 15 cm during 24 hours and its amount is growing ominously. It is very difficult to predict the effect of new breakage of falling rocks, although built dam is with its dimensions the guarantee of primary catastrophic events elimination. It is not known how much of a mixture of water, mud and rock debris will pass through the dam openings and how much remains behind it and will definitely plug the mine work. The following scenario may result in water overflowing the edge of the incrush funnel what is by part of stakeholders considered as a good final solution (creating a drain channel and diverting the water into the stream). Such a situation would be a potential source of even greater disaster and could lead to the emergence of the constantly growing carst effect in the gypsum horizon and to large callus, threatening the surrounding forest lands. As final and optimal solution, the restoration of drainage function of the mine work Nová štôlňa was adopted. [2]
The first water outlet occurred on the night from 26.9.2008 to 27.9.2008. For that reason was issued a binding order that the organization Rudné bane š.p. B. Bystrica shall [2]:

- immediately ensure the execution of works for the disposal of the situation,
- organizationally provide the necessary staff and equipment,
- canalize the outflow of mine water into the projected channel of the local creek under the developed liquidation plan of the mining work Nová štôlňa,
- technically realizes a liquidation of sudden mine water outflow consequences by restoration of the mouth of mine work so that it prevents the entry into the mining work with leaving a sufficient opening for the discharge of mine water
- will make the local communication functioning by clean up of dirt from mine spoil heaps under Nová štôlňa and from the creek bed of Brusník and its banks.

Despite these measures and realized technical works has come on 7.12.2008 to further outflow of water from the mine work Nová štôlňa. Rudné bane was by binding order imposed [2]:

- to immediately ensure the repair of fault TH - reinforcement and its strengthening to withstand the expected water pressure,
- reduce the hole in the mouth portal of the mine work by installation of tin-plate in its upper half.

Work has been under a mandatory order realized, although there was a third water outflow from the stated mine work on 30.1.2009. Damages were caused to the build portal of mine works; it was destroyed along with two complete TH - reinforcement. Conclusions of the meeting of involved experts were the base for further issue of binding order of the district mining inspector, which imposed [2]:

- to immediately ensure the processing of project documentation with appropriate static calculation for dam construction in the mine work Nová štôlňa,
- to immediately begin with preparation for realization of works according to the project documentation.

In the next procedure was anti breakage dam dimensioned for the water column of height 80 m. 17.2.2009 was fourth outflow of water from mining work Nová štôlňa. Because of that event were suspended works on building an anti breakage dam. At this time is the dam already built. Monitoring borehole was realized. Because less water outflows, water in the borehole increases. [2] Photographic documentation of the site in question is captured on Fig. 1 .

Figure 1 - Water outflow from Nová štôlňa and view on the dirty stream

DESCRIPTION OF LABORATORY EXPERIMENTS

The content of polluting substances in waste water should not overcome the maximum allowable level of pollution (mg/l) before discharging to usually surface waters. [3]

Figure 2 - Sampling scoops

Laboratory experiments were realized in laboratory electrolyzer with capacity 8 l at the following conditions:

- Electrolyzer capacity: 8 l
- Sample capacity: 5 l
- Number of electrodes: 7 pcs
- Distance between electrodes: 4 cm
- Electrodes size: 100x100x2 mm
- Electrodes arrangement: Fe-Al-Al-Fe-Al-Al-Fe
- Current: direct
- Current amount: 10-20 A according to conductivity
- Tension: 42 V
- Electrolysis length: 8 min
- Sedimentation length: 40 min

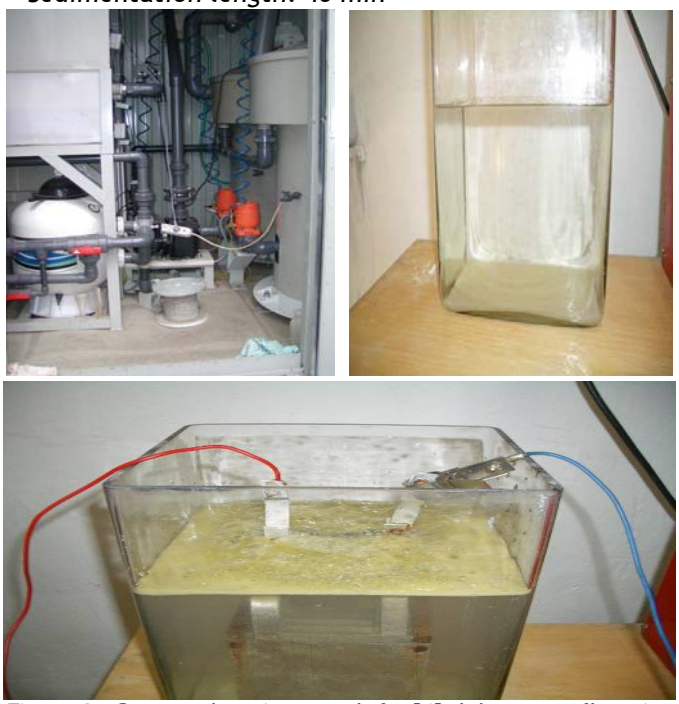

Figure 3 - Patented equipment (left) [4], laboratory flotation on the water sample(middle) and water after electro flotation(right)

Table 1 - Results of electrolytic treatment

Parameter	Alžbeta		Teplička	
	Before Adjust.	After Adjust.	Before Adjust.	After Adjust
Cr^{6+} mg/l	< 0,01	<0,01		
pH	7,93	6,49	7,90	6,62
NL 105 mg/l				
Arsenic mg/l	0,07748	<0,001	0,01385	<0,001
Copper mg/l	0,01031	0,0067	0,0117	0,0063
Mercury ug/l	<0,08	<0,08	<0,08	<0,08
Magnesium mg/l				

Parameter	Smolnická Huta	
	Before Adjust.	After Adjust
Cr^{6+} mg/l		
pH	7,90	6,62
NL 105 mg/l		
Arsenic mg/l	0,01385	<0,001
Copper mg/l	0,0117	0,0063
Mercury ug/l	<0,08	<0,08
Magnesium mg/l		

Parameter	Pech		Rochus	
	Before Adjust.	After Adjust	Before Adjust.	After Adjust
Cr^{6+} mg/l	<0,01	<0,01		
pH	3,30	3,90	7,90	6,62
NL 105 mg/l				
Arsenic mg/l			0,01385	<0,001
Copper mg/l			0,0117	0,0063
Mercury ug/l			<0,08	<0,08
Magnesium mg/l	254,9	157,0		

Electrolyser was filled with 5 litters of mine water and the current was turned on. The electrolysis was interrupted after eight minutes and the content was transferred to the sedimentation barrel. After sullage (25 - 40 min.) was the mud drained and pure solution was transfused to the sampling scoops (fig. 2)
Photo documentation from laboratory measurements is captured on fig. 3.
Results of analysis are stated in table 1.

CONCLUSION

Electrokoagulation method is very suitable for removal of heavy metals [5].Stated method is very suitable for removal of Cr, As, Cu and Hg from mine waters. From the analysis result it is obvious, that efficiency at removal of Cr is 41,18 %, As 97 - 99,9 %, Cu 35 - 91,6 % and Hg 88,57 %. Since the observed waters had various physic-chemical composition and electrolysis conditions for each water were same, process of electrolyses was not optimal. By optimization of the process for every type of mining water would be the efficiency higher.

ACKNOWLEDGMENT

This study was prepared under ITMS 26220220028 Implementácia a modifikácia technológie na znižovanie výskytu siníc v stojatých vodách.

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AUTHORS & AFFILIATION

Dušan ŠEBO[1],
Katarína HALAGOVCOVÁ[2],
Henrieta NAKATOVÁ[3]

[1-3] TECHNICAL UNIVERSITY IN KOŠICE, FACULTY OF MECHANICAL ENGINEERING, DEPARTMENT OF ENVIRONMENTAL STUDIES AND CONTROL PROCESSES, Němcovej 32, KOŠICE, SLOVAKIA

ACTA TECHNICA CORVINIENSIS - BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

http://acta.fih.upt.ro

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Ivana IGNJATOVIĆ[1], Dragan ŠEŠLIJA[2], Slobodan DUDIĆ[3]

INCREASING ENERGY EFFICIENCY OF COMPRESSED AIR USAGE FOR SUSTAINABLE PRODUCTION OF FOOD AND BEVERAGE

ABSTRACT:
In order to achieve sustainable production, many efforts are invested in efficient production. Significant part of these efforts is made in the field of increasing energy efficiency. Particularly, in this paper attention is paid to increasing energy efficiency in pneumatic systems. Certain investigation and improvements are done in one beverage company in Serbia. In this paper is given an investigation of packaging and pallet machines, which had an inefficient work regime, inappropriately defined pressure, and position of suction cups. After investigation and applied corrections, significant results are obtained in the field of energy efficiency and sustainable production.

KEYWORDS:
energy efficiency, sustainable production, food and beverage industry, compressed air

INTRODUCTION

In order to meet the sustainability challenge, industry must include not only the eco-efficiency but also the product's environmental justification and the company policy in a production in order to become sustainable. Achieving sustainable development will require changes in industrial processes, in the type and quantity of resources used, in the treatment of waste, in the control of emissions, and in the products produced.

Using as an example one of the biggest beverage company in Serbia, this paper examines problem related to the efficient use of compressed air in the production. Results indicate that it is possible to identify and improve some points in the production process, in order to increase energy efficiency in the manner of sustainable production. An examination of the two machines into the company provides useful ideas and enables the quantification of saving which could be achieved by applying them. In this paper are presented the main problems on the packaging and pallet machine, some procedures for the improvements are suggested and applied, and, finally, achieved effects are measured and described. Among other facilities, energy consumption has significant impact on sustainable production. This paper describes examples how different factors, such as poor maintenance, inappropriate working regimes and usage of inadequate or less energy efficient components and devices, affect on increased compressed air consumption. These examples are described with real case studies from companies.

PROBLEM DESCRIPTION

One of the biggest beverage factories in Serbia had huge problems with packaging and pallet machines. They had big loses of compressed air, maintenance operations were very frequent and, the most important, they had breakdowns in the production.

After the thorough energy efficiency audit [1], several critical spots are marked, where obvious problems with compressed air were present. Two machines are selected for detailed analysis.

The first one was the machine for inserting glass bottles into the plastic crates [2], so-called packaging machine. The operators on the machine noticed that there are significant pressure drops during the machine operation. In some cases, that led even to the dropping and breaking the glass bottles. This machine has three carriers. One carrier has four rows with seven heads, each head for handling a single bottle. Each row has its own air supply, Figure 1. Each carrier inserts 4 x 7 = 28 glass bottles into the crate, in one cycle.

The main problem was with the rubber, which is placed into the head. During the operation, rubbers are wearing out and causing air leaks. Therefore, it is necessary to change the damaged rubber, what has often been neglected. The problem was in absence of every day inspection of the machine and poorly organised preventive maintenance.

The second problem was related to the pallet machine [3]. The part of this machine, the vacuum gripper, picks paperboard from the stock and places it on the pallet.

One pallet has five paperboards, between each level. Each level of pallet contains packages of the plastic bottles, Figure 2. Vacuum griper has four suction cups, Figure 3, and vacuum is generating on the Venturi principle.

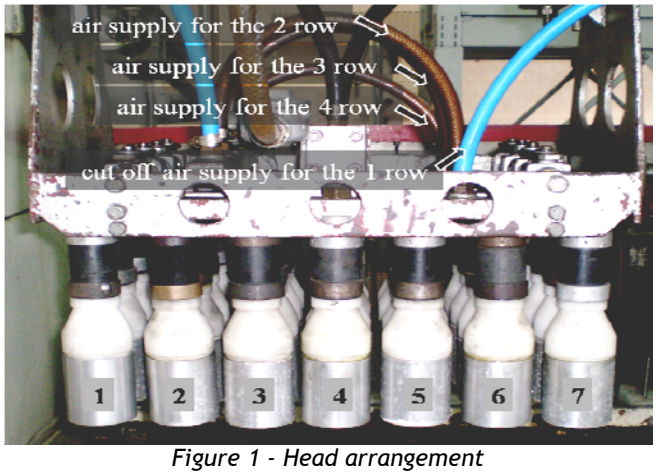


Figure 1 - Head arrangement with the air supply in the carrier

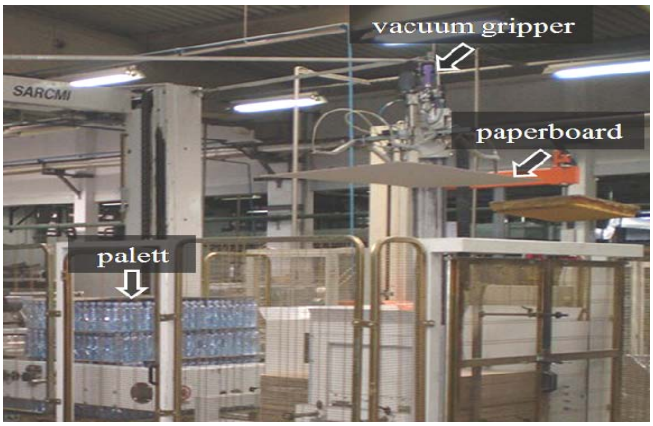


Figure 2 - Picking and placing the paperboard on the pallet

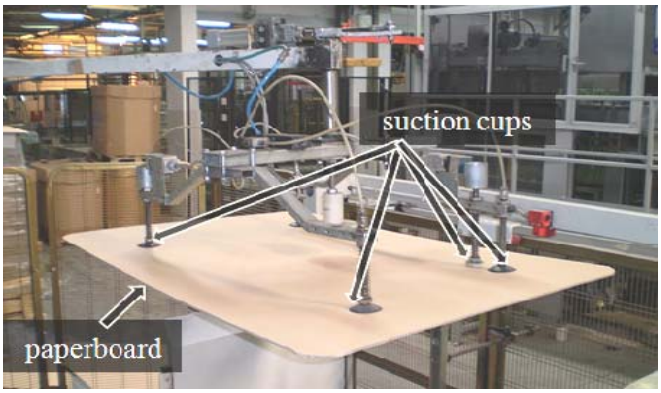


Figure 3 - Picking up the paperboard with suction cups

This machine had energy inefficient work regime and inappropriate usages of compressed air were huge. Besides good maintenance practice, losses were significant. The reason for that is unsuitable determined and set up work regime.

MEASUREMENTS AND METHODOLOGY

Firstly, measurements were conducted on the packaging machine, using the AirBox device, from the manufacturer FESTO.

The device was connected to the air supply of the first row of heads in the first carrier. This row was chosen because there was only one faulty head there. Air consumption was measured in static mode (machine is off), but air supply was enabled. Comparing that result with the air consumption of the faultless row, it was easy to determine loses of compressed air on the single head.

There were two faulty head on average in each row. Hence, it was simple to calculate the annual volume of compressed air that is lost on the packaging machine.

After the measurement, acquired results are presented in Table 1 and Figure 4, a.

Table 1 - Part of the obtained results about air consumption

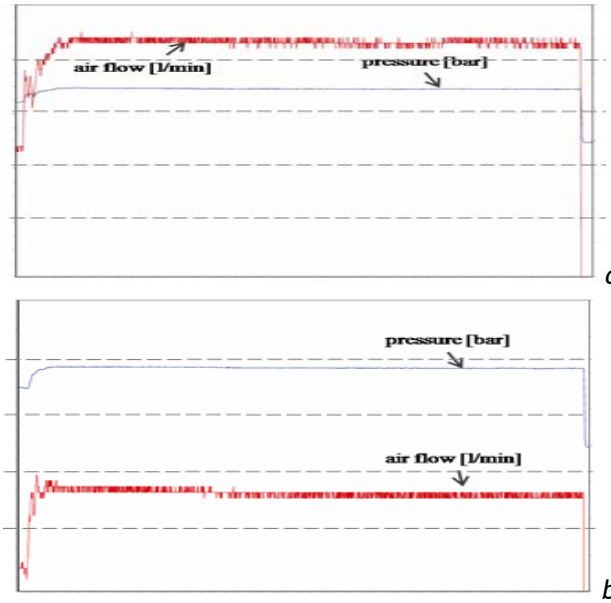
No.	air flow Q [l/min]	pressure p [bar]	interval between two measurements-Δt
1	49,6	1,06	0,049805
2	89,7	1,06	0,049805
3	95	1,19	0,049805
:	:	:	:
2427	107,6	1,38	0,049805
2428	107,6	1,38	0,049805
2429	72,8	1,31	0,049805
n = 2429	$\sum_{i=1}^{n} Q_i = 259759$		

Using the equation:

$$\overline{Q_i} = \frac{\sum_{i=1}^{n} Q_i}{n}\left[\frac{l}{\min}\right] = \frac{259759}{2429} = 106\ ,94\ \frac{l}{\min}$$

it was calculated the average volume of leakage on the one failed head, which amounts 107 l/min.

After the measurement, the bad head was replaced with the new one. After that, measurement was repeated and the better results are obtained, Figure 4, b. Air flow, after the corrections, was 80 l/min. Reduction of air leaks amounts to 27 l/min, which can be noticed on the diagrams, also.



a)

b)

Figure 4 - Obtained air flow on the first row of head: a) before, b) after replacing the head

The second measurement was carried out on the pallet machine, and it is determined that vacuum griper consumes 315 l/min of compressed air. From the energy efficiency point of view, that is huge volume of compressed air for this type of applications.

Big problem with this vacuum gripper is in its work regime. Immediately, after placing one paperboard on the pallet, it picks up the next one and holds it in the upper position until the new row of bottle packages is placed on the pallet. That period lasts 20-30 s, in average. During that time, vacuum is generating constantly. In some unpredictable situations of malfunctions in the line for forming bottle packages, the upper position of vacuum gripper with the paperboard, might last dozens of minutes, or even several hours in the cases of big accidents. Over that time, compressed air is spending for generating vacuum. This is an inefficient way for consuming the compressed air and the costs increase rapidly.

Recommended procedure for optimising the vacuum griper encompasses three steps:

1. Improvement of the work regime with reprogramming the controller, which regulates vacuum gripper.

Vacuum gripper should be reprogrammed in the way that, after placing the last of package bottles on the pallet, it picks up the paperboard from the stock. Current time of 20-30 s would be reduced to 5-6 s for consuming compressed air for generating the vacuum.

2. Replacement of the vacuum generator with the new, efficient one, with integrated air saving circuit.

Vacuum generator with air saving circuit generates the vacuum up to defined level and after that switches of. When the vacuum level falls below the required range, vacuum generation is activated automatically, Figure 5. The main point of this type of vacuum generator is that it does not generate vacuum constantly. There is a tolerance range within the vacuum level. When the vacuum level falls down below the level necessary for picking and placing the paperboard, vacuum starts generating again [4].

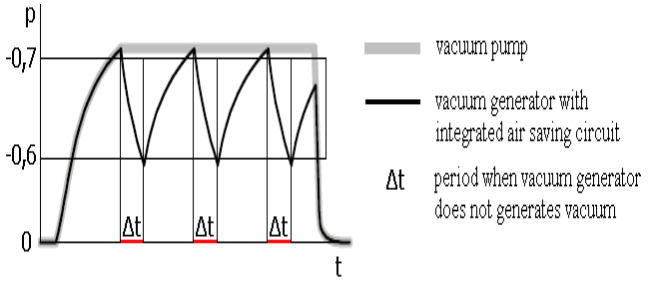


Figure 5 - Working principle of the vacuum generator with integrated air saving circuit

Implementing the vacuum generator with integrated air saving circuit, air consumption would be reduced from 315 l/min to 50 l/min.

3. Reducing the pressure level.

Diagram of the compressed air consumption for generating vacuum, and diagram of vacuum level, for the vacuum generator with integrated air saving circuit, is presented in the figures 6 and 7, respectively.

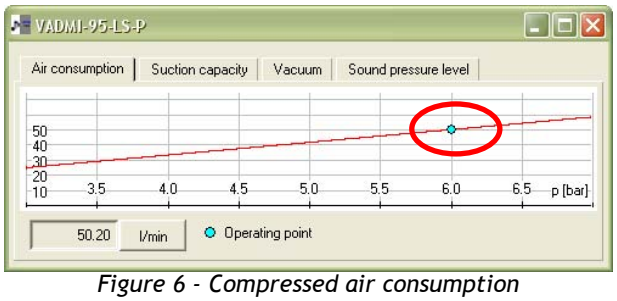


Figure 6 - Compressed air consumption at pressure level 6 bar

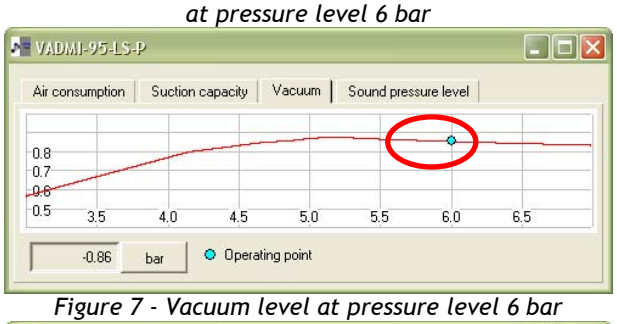


Figure 7 - Vacuum level at pressure level 6 bar

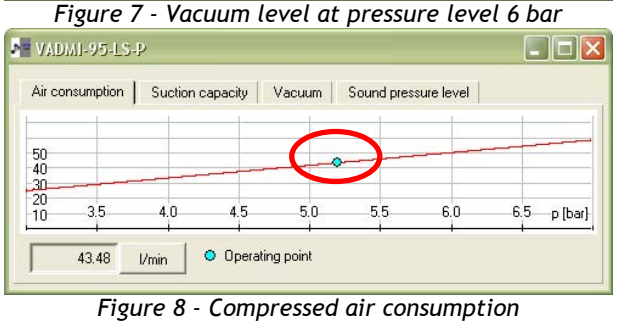


Figure 8 - Compressed air consumption at pressure level 5,2 bar

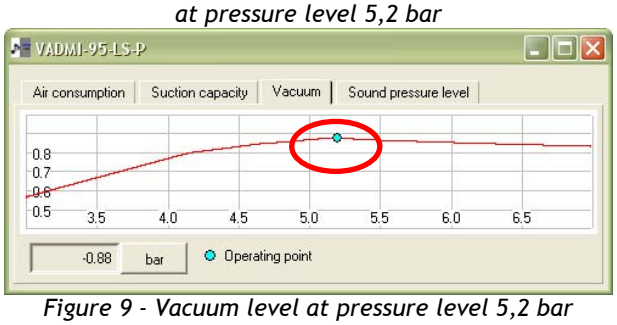


Figure 9 - Vacuum level at pressure level 5,2 bar

As it can be noticed from the figure 7, the highest level of vacuum is at 5,2 bar. If we reduce the initial pressure level of 6 bar to 5,2 bar, savings of 6,7 l/min can be achieved, figures 8 and 9.

DISCUSSION

Packaging and palletising machines can save significant volume of compressed air with relatively small investments and better maintenance procedures.

Packaging machine has two failed heads in each row, in average, which is eight head on one carrier, or twenty-four head on the whole machine.

Total time of working cycle, which encompasses time needed for inserting bottles into the crate, is 12 seconds. Compressed air is consumed 5,2 s of that period, and the rest of the time is spent for setting the heads into the position for picking up the bottles. In the other words, compressed air is spent during 45% of working time of packaging machine.

Packaging machine manipulates with the average of 75 600 000 bottles annually. If we consider that the packaging machine places 7 (heads) x 4 (rows) x 3 (carriers) = 84 bottles in one cycle, there are 900 000 cycles per annum.

We have already determined that there are two faulty heads, in average, in each row on the carrier. During the measurement, the air leakage on the one failing head was 27 l/min, Figure 4, or 2 x 27 = 54 l in one row. In just one cycle, that amounts to 54 x 0,45 =24,3 l/row. There are 12 rows on the machine and the total leakage amounts to 24,3 x 12 = 290 l of compressed air in one cycle.

If we take into consideration 900 000 cycles per year, we get 290 x 900 000 = 261 000 m^3 of compressed air. Production costs for one cubic meter of compressed air take € 0,12. That means that annually savings are € 4 000, with maintenance costs, which are relatively minor.

Situation on the pallet machine is little complicated because of three proposed steps of improvements.

In the condition without breakdowns and malfunctions, one cycle of palletizing lasts 2,38 min = 158 s, in average. Vacuum generator operates 136 s, Figure 10. During the one cycle, vacuum gripper places five paperboards onto one pallet, and it operates 86% times of the cycle. There are 23 cycles within one hour, or 69 000 cycles in one year.

Annual consumption of compressed air on the vacuum griper amounts:

$$69000\frac{cycles}{year}\times 125\frac{s}{cycle}=143750\frac{\min}{year}\rightarrow$$

$$143750\frac{\min}{year}\times 315\frac{l}{\min}\approx 45280\frac{m^3}{year}.$$

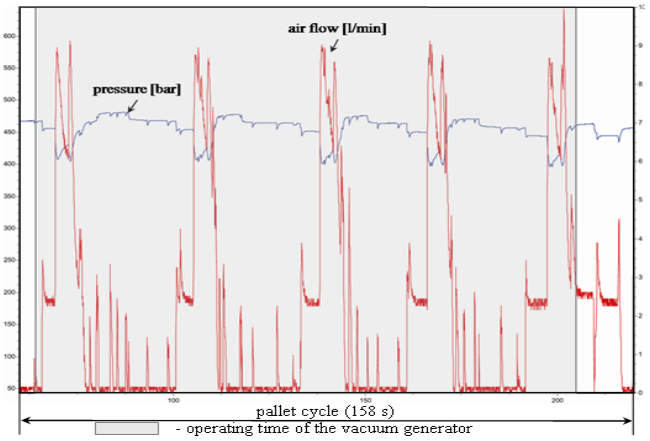


Figure 10 - Consumption of compressed air on the pallet machine in the one cycle

By the reprogramming the controller which regulates the functioning of the vacuum generator, in a way that after placing the last package of bottles on the pallet it picks up the paperboard from the stock, operating time of the vacuum generator would be reduced from average 20 to average of 5 seconds. Air consumption in that case would be:

$$69000\frac{cycles}{year}\times 25\frac{s}{cycle}=28750\frac{\min}{year}\rightarrow$$

$$28750\frac{\min}{year}\times 315\frac{l}{\min}\approx 9056\frac{m^3}{year}.$$

Volume of consumed air per year would be decreased by 45 280 - 9 056 = 36 220 m^3, or 80%. With the calculation of price of compressed air, annual savings, with just this simple reprogramming, would amount to € 550.

Savings would be more significant and apparent in cases of accidents, when appears sudden stoppages. In that cases compressed air would be not used for generating vacuum, like it happens now. Vacuum generator would not be in the operation until the last package of bottles comes on the appropriate pallet level.

With the replacement of the current vacuum generator with the energy efficient one (with integrated air saving circuit), air consumption would decrease from current 315 l/min to 50 l/min (Figure 6). With the average working time of the vacuum generator per year and 69 000 cycles per year, additional savings would be achieved:

$$28750\frac{\min}{year}\times 50\frac{l}{\min}=1437\frac{m^3}{year}$$

of compressed air, or savings of 85%. If we calculate production price of compressed air, € 115 would be saved just on one vacuum generator. Vacuum generator with integrated air saving function costs approximately € 350. Return of investment would be less than three years, but significant saving would be achieved on compressing of air. (2)

Reduction of the working pressure for the vacuum generating by 0,8 bar (from 6 to 5,2 bar), would lead to the reduction in compressed air consumption, from 50 l/min to 43 l/min (figures 6 and 8). In this particular case, this reduction does not bring significant savings. However, our intention was to call attention to this kind of possible actions for increasing energy efficiency and sustainable production.

CONCLUSION

Consumption of compressed air is wide spread, but, at the same time, it does not get enough attention in production companies. Therefore, it is often used in an inappropriate manner. Companies with an increased awareness for environmental protection and the need of sustainable production processes, continuously increase energy efficiency of compressed air systems. In this paper is given a very good example about how significant savings can be achieved with the minimum of investments and other additional costs.

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AUTHORS & AFFILIATION

Ivana IGNJATOVIĆ[1],
Dragan ŠEŠLIJA[2],
Slobodan DUDIĆ[3]

[1-3] FACULTY OF TECHNICAL SCIENCES,
TRG D. OBRADOVIĆA 6, NOVI SAD, REPUBLIC OF SERBIA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

5, Revolutiei,
331128, Hunedoara,
ROMANIA
http://acta.fih.upt.ro

UNIVERSITY POLITEHNICA TIMISOARA,
FACULTY OF ENGINEERING HUNEDOARA,
5, Revolutiei,
331128, Hunedoara,
ROMANIA
http://annals.fih.upt.ro

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Štefan BOJNEC[1], Drago PAPLER[2]

INVESTMENT EFFICIENCY APPRAISAL FOR DIFFERENT SIZES OF THE SOLAR ELECTRICITY PLANTS

ABSTRACT:
Most of the solar electricity plants of different installed power sizes in Slovenia are connected to the electricity supply network. More than one-third of the solar electricity plants are larger than 50 kW. They are often situated on the roofs of different buildings. The sensitivity of the investment economic efficiency appraisals for the solar electricity plants by their four different installed power sizes is investigated. Among important determinants of investment's efficiency are the guaranteed purchase price of electrical energy for micro and small solar electricity plants, investment support measures and technological advancements reducing investment costs for the solar electricity plants.

KEYWORDS:
renewable sources of energy, investment appraisal, solar electricity, purchase price, subsidy, technology management

INTRODUCTION

The development of the solar electricity plants in Slovenia is in an initial, but rapidly growing stage of development [1]. The installed solar electricity plants are often situated on the roofs of business, production, schools, recreation, parking, and larger households' buildings. Similar as water, biomass, biogas and wind energy, also the solar energy is a part of natural renewable sources of energy [2,3]. The European Union (EU) defined within the climatic-energy package support measures for the use of energy from renewable sources of energy. For Slovenia by the year 2020 two objectives are defined: first, 25% share of energy from renewable sources of energy in the final use of energy and second, 10% share of energy from the renewable sources of energy in the final use of energy in transport [4]. To achieve these objectives, EU countries support investments by investment grounds and credit subsidies for the solar electricity plants and with some other measures such as a guaranteed price for the purchase of the electrical energy, which is produced by the solar electricity plants and from the other renewable sources of energy. In a spite of different government support measures to increase energy production from the renewable sources of energy, the results by the EU countries vary. In this respect Slovenia is not any exception.

The paper presents an economic analysis of solar electricity plants of four different power sizes by investment appraisal methods in the case of Slovenia. Economic analysis is conducted on the basis of a plants costs and incomes realized by selling the electricity with subsidized price. We illustrate the dependence of the investment efficiency of the solar electricity plants of four different installed power sizes on the government policy support measures, which are causing the investment costs and revues through electricity prices, and on the technological advancements of the solar electricity plants, which are causing the investment costs. The paper contributes to the literature in three significant directions. First, it provides investment appraisal in the case of the solar electricity plants by using static and dynamic investment appraisal methods and indicators. Second, we conduct the sensitivity analysis of the investment economic efficiency into the solar electricity plants by their four different installed power sizes. Among important determinants of investment's efficiency are the guaranteed purchase prices of electrical energy, which is delivered from the micro and small solar electricity plants on the revenues side, and technological advancements, investment support measures and interest rate subsidy for investments into the solar electricity plants on the investment costs side. Finally, we derive findings for further research and policy relevance, which is important for education, promotion, research and development activities with exchange of good practices from the studied case study for the solar electricity plants' investments.

METHODOLOGY

As the methods of the analysis are used the period of investment return, indicator of economy, indicator of profitability of investment, and indicator of profitability of expenses as the static investment efficiency measures and the net present value and the

internal rate of return as the dynamic measures for economic investment efficiency appraisals [5,6]. The period of the investment return is defined as:

$$t = \frac{N}{ar} = \frac{N}{Rr - \mathrm{Re}} \qquad (1)$$

where t is the expected period of the investment return in the number of years, which are necessary for the return of the initial capital investment; N is the value of investment, ar = Rr – Re is the annual return or annual profit from the investment, where Re means investment and operational costs, and Rr means revenues from the purchased electrical energy, which is sold from the solar electricity plant.

The indicator of economy (E) of investment is defined as a ratio between total business effects (Rr) and costs (Re) of the solar electricity plant in constant prices:

$$E = \frac{Rr}{\mathrm{Re}} \ . \qquad (2)$$

The indicator of profitability (O) of investment is defined as:

$$O = \frac{Rr - \mathrm{Re}}{N} \cdot 100 \ , \qquad (3)$$

which shows the annual profitability (in %) from invested capital into the solar electricity plant.

The indicator of profitability of expenses (Oe) is defined as:

$$Oo = \frac{Rr - \mathrm{Re}}{\mathrm{Re}} \cdot 100 \ , \qquad (4)$$

which shows the annual profitability (in %) from all expenses of the solar electricity plant.

The net present value (NPV) is defined as the difference between the present value of revenues (PRr) and the present value of expenses (PRe):

$$NPV = \sum_{i=1}^{i=n=30} (Rr - \mathrm{Re}) \cdot \frac{1}{(1+r)^i} = \sum_{i=1}^{i=n=30} Rr \cdot \frac{1}{(1+r)^i} - \sum_{i=1}^{i=n=30} \mathrm{Re} \cdot \frac{1}{(1+r)^i} \ , \qquad (5)$$

where NPV should be positive: PRr > PRe, r is a discount rate (derived from the average market interest rate for long-term deposits) and i is the time period of investment.

The internal rate of return (IRR) is defined as:

$$IRR = r_p + (r_n - r_p) \cdot \frac{NPV_p}{NPV_p - NPV_n} \ , \qquad (6)$$

where r_p is a discount rate for a positive NPV_p and r_n is a discount rate for a negative NPV_p.

Iteratively, it should hold:

$$0 = \sum_{t=0}^{n} \frac{(Rr - \mathrm{Re})^i}{(1+r)^i} \ , \qquad (7)$$

where Rr is total revenue of the solar electricity plant project in year i and Re is total expense of the solar electricity plant project in year i, r is a discount rate when holds NPV = 0 and r = IRR, n is the project life time period in years, and i is the current index of time periods i = 1, 2, …, n.

EMPIRICAL RESULTS. SOLAR ELECTRICITY PLANT INSTALLED POWER SIZE AND INVESTMENT COSTS

We present the size of investment costs for four investment alternatives by the size of the installed power of the solar electricity plant (Table 1). Total investment costs for the four investments alternatives are increasing with the size of the installed power of the solar electricity plant from 10 to 100 kW, and vice versa holds for the price per installed power unit, which declines by 21.1%. This decline in per unit of the installed power price by the increased size of the solar electricity plant is caused by the decline in per unit fixed costs as a result of utilisation of economies of the solar electricity plant size. On long-term, the technological advancements and progress in production of photovoltaic modules, which is the most important in the investment structure of the solar electricity plant, also causes declining patterns in investments costs per installed kW. The price per installed power from 2.81 to 3.56 Euro per Wp is for photovoltaic modules, which are produced from monocrystalline or multicrystalline silicon. It is worth mentioning because prices for thin-film cells such as a-Si, CIS, CdTe or similar are much lower, but they require much bigger installing surface on the roofs of the buildings.

Table 1 – Investment costs alternatives by the size of the installed power of the solar electricity plant (in Euro)

Investment cost structure	10 kW	20 kW	50 kW	100 kW
Photovoltaic modules	23,500.00	46,000.00	112,500.00	210,000.00
Network trafficator	5,100.00	8,150.00	16,200.00	31,300.00
Installation material and assembling	4,500.00	8,500.00	20,000.00	35,000.00
Electro projects	500.00	700.00	900.00	1,200.00
Connection on the network	1,200.00	1,200.00	1,500.00	2,000.00
System control	750.00	1,000.00	1,250.00	1,500.00
Total	35,550.00	65,550.00	152,350.00	281,000.00
Price per installed power (Euro per Wp)	3.56	3.28	3.05	2.81

Source: Kon Tiki Solar Kamnik (2010).

SOLAR ELECTRICITY PLANT PRODUCTION AND GUARANTEED PRICE FOR ELECTRICITY

Sunray in Gorenjska region in Slovenia is estimated at 1,050.0 operational hours per installed kWh/kW. We assume that solar electricity production declines by 1% per year during the life period of the solar electricity plant and after 30 years the achieved conversion factor is at 0.71. Moreover, the methodology for the reference costs of electrical energy produced from renewable sources of energy in Slovenia assures the guaranteed price for electrical energy, which is produced and sold by the solar electricity plants for the 15 years since the start of the solar electricity plant operation. This guaranteed subsidized price is set at 0.41546 Euro per kWh for the solar electricity plant of the installed power up to 50 kW and 0.38002 Euro per kWh for the solar electricity plant of the installed power from 50 kW to 1 MW (Table 2).

Table 2 – Electricity production and guaranteed electricity price by the alternative sizes of the installed power of the solar electricity plants

	10 kW	20 kW	50 kW	100 kW
Electricity production in the first year (kWh)	10,500.0	21,000.0	52,500.0	105,000.0
Cumulative electricity production during the life period of the solar electricity plant (30 years)	275,100.0	550,200.0	1,375.500.0	2,751.000.0
Guaranteed price of electricity (Euro per kWh) for the first 15 years of the solar electricity plant operation	0.41546	0.41546	0.41546	0.38002

Source: Compiled by the authors

FINANCIAL FLOWS FOR ALTERNATIVE INVESTMENTS BY THE INSTALLED POWER OF THE SOLAR ELECTRICITY PLANT

We assume that the investment project into the solar electricity plant is financed by own resources. The depreciation period for the network trafficator is taken 15 years, which means 6.67% annual linear depreciation rate, while for the photovoltaic modules and other equipment parts of the solar electricity plant the depreciation period is taken 30 years, which means 3.3% annual linear depreciation rate. Net present value of investment captures all revenues and expenses for own and borrowed sources during the life period of the solar electricity plant investment. The economic analysis is conducted only on the basis of a plants costs and incomes realised by selling the electricity with subsidised price. In our calculations we do not consider some other positive externalities from solar power plants, which on indirect way contribute to environment, economy, and society such as reducing carbon dioxide emissions. The sum of revenues and expenses should be positive or at least equal zero for an acceptable investment project (Figure 1).

Real money flows of investment means all revenues and expenses for the investor during the life period of the investment into the solar electricity plant. The static investment indicators give us approximate investment appraisal, but often they do not give us satisfactory and accurate evidence on economic efficiency of a certain investment project. Among the static investment indicators, we include here the period of the investment return, which tell us the expected number of years, which are necessary for the return of the initial investment capital/expenses. From Figure 2, which presents real money flows and the expected period of the investment return, can be seen that cumulative total revenue changed from the negative to the positive value by 8.32 years for the installed power size of 50 kW per the solar electricity plant, by 8.36 years for the installed power size of 100 kW per the solar electricity plant, by 9.06 for the installed power size of 20kW per the solar electricity plant, and by 10.12 years for the installed power size of 10 kW per the solar electricity plant.

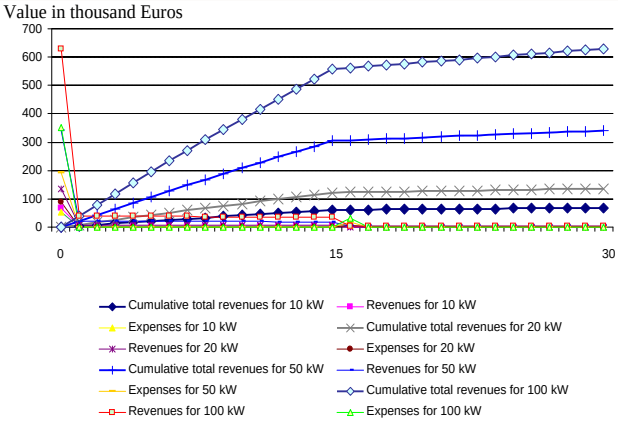

Figure 1 – Total monetary flows for an investment into the solar electricity plant by the installed power 10, 20, 50, and 100 kW

Source: Own calculations.

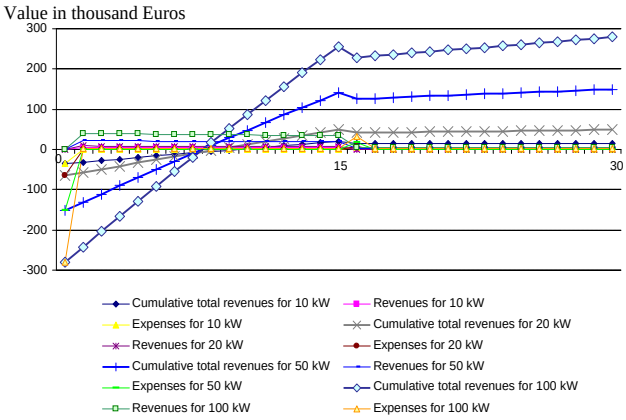

Figure 2 – Real monetary flow and the period of the investment return for the solar electricity plant of the installed power 10, 20, 50, and 100 kW

Source: Own calculations.

STATIC AND DYNAMIC ECONOMIC EFFICIENCY APPRAISAL FOR THE ALTERNATIVE INSTALLED POWER SIZES FOR THE SOLAR ELECTRICITY PLANTS

Our special focus is on the indicators of economic investment efficiency appraisal for the analyzed four sizes of the installed power of the solar electricity plants. As can be seen from Table 3 the static indicators of economic efficiency of investment (indicator of economy, indicator of profitability, and indicator of profitability of expenses) are increasing by the installed power of the solar electricity plant. The greater the installed power of the solar electricity plant from 10 kW to 100 kW, the greater is the static economic efficiency of investment. However, the increase is not linear after the installed power size over 50 kW. The reason in behind are government support measures, particularly lower guaranteed price for sold electricity for the solar electricity plants above the 50 kW. The shortcoming of the static indicators of economic efficiency of investment is that they do not consider investment time dimension in a proper way. This is the reason to consider more in detail the dynamic economic investment efficiency appraisal by the net present value and the internal rate of return by the size of the installed power of the

solar electricity plants. The calculated net present value is found to be negative for the smallest installed power size of the solar electricity plant of less than 10 kW. The calculated internal rate of return is found to be the highest (9.82%) for the size of the installed power 50 kW per solar electricity plant, because only up to this size the government guarantees the highest guaranteed price for the purchased electricity. In a spite of the lower guaranteed price for larger installed power sizes of the solar electricity plants, the relatively high internal rate of return (9.77%) for the largest installed power of 100 kW per solar electricity plant is achieved due to the relatively lower fixed costs per unit of the greater electricity production. Therefore, the investment efficiency appraisal confirms that the investment efficiency for the solar electricity plants up to 50 kW is determined significantly by the guaranteed price for the purchased electricity during the first 15 years of the operational period. On the other hand, the investment efficiency for the solar electricity plants greater than 50 kW in addition to government policy is determined by the technological advancements and the utilization of the economies of scale of the larger installed power of the solar electricity plants, which is likely to reduce fixed operational costs per unit of the electricity production and sale.

Table 3 – Indicators of economic investment efficiency appraisal by the size of the installed power of the solar electricity plant

	10 kW	20 kW	50 kW	100 kW
Indicator of economy (E)	1.31	1.56	1.78	1.79
Indicator of profitability (O)(%)	45.1	74.6	97.9	99.3
Indicator of profitability of expenses (Oe) (%)	30.7	55.9	77.8	79.4
Net present value (NPV) (in Euro)	-1,057.00	7,724.00	36,132.00	66,939.00
Internal rate of return (IRR) (in %)	5.53	8.01	9.82	9.77

Note: Discount rate is taken at 4.375% for profitability of government bonds. Source: Own calculations

CONCLUSION

The development of the solar electricity plants in Slovenia is in an initial, but rapidly growing stage of development. Most of the installed solar electricity plants of different sizes are connected to the electricity supply network. The sensitivity of the economic efficiency of investments for the solar electricity plants by their four different installed power sizes confirms that among the important determinants of investment's efficiency are the government policies, particularly the guaranteed purchase price of electrical energy, which is found to be relatively more significant for the economic efficiency of the solar electricity plants up to 50 kW, as well as other investment supports and interest rate subsidies for investment into the solar electricity plants. The free installing surface on the buildings roofs of different purposes is a limitation factor for the installed power size of the solar electricity plants. The installed power size of the solar electricity plant improves the economic investment efficiency positively due to the reduction of the fixed costs per unit of electricity production and sale. Therefore, the government support measures can encourage new investments for smaller and medium installed power size solar electricity plants, which can be situated on the roofs of different households' buildings.

The paper stresses importance of governmental influence in mitigating the risks in the solar electricity plants development in Slovenia. The reduction in governmental support measures and more free market conditions are likely to increase competition in wider (non-Slovenian) European neighborhood with a greater investment risks into the solar electricity plants development. This can cause possible instabilities on the solar electricity market. On the other hand, the technological advancements and progress in photovoltaic modules production is likely to further strengthen economic efficiency of the largest installed power sizes of the solar electricity plants, which can be situated on the roofs of the largest buildings such as schools, hospitals, factories, stadiums, and similar as a challenging issues for future research with managerial and policy implications. Among issues for future research is also the analysis of the other factors, in addition to a plants costs and incomes realized by selling the electricity with subsidized price, which on indirect way contribute to positive externalities improving the economy of solar power plants, such as reducing carbon dioxide emissions.

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AUTHORS & AFFILIATION

Štefan BOJNEC[1], Drago PAPLER[2]

[1] UNIVERSITY OF PRIMORSKA, FACULTY OF MANAGEMENT, Cankarjeva 5, KOPER, SLOVENIA
[2] ELECTRO GORENISKA, Mirka Vadnova 3a, KRANJ, SLOVENIA

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Claudia DE GIORGI[1], Clara CEPPA[2], Beatrice LERMA[3]

NEW PRODUCTS AND INDUSTRIAL PROCESSES FROM WASTE

ABSTRACT:
In our era water, where earth natural resources seemed to have no value, we should do more with what the Earth produces and adopt a sustainable waste management. Therefore we must turn to Nature, where there is no waste and even surpluses are metabolized by the system itself. By adopting the methodology of the Systemic Design, according to which the output-waste of one production process become the input-resources of another, it becomes possible to propose a new production setup that can metabolize all types of waste. From waste we could obtain new products and also new industrial process, such as quail eggs from cattle breeding or plate from palm leaves.

KEYWORDS:
systemic design, sustainable production, recycled materials, eco-friendly products

INTRODUCTION

Industrial development has always been based on the accelerated exploitation of all resources, human and natural [13]. Water, air, soil, from which most of the indispensable resources for human survival derive, until not too long ago seemed to have no value and were exploited in the conviction and presumption that they would never be depleted [7].

Now we must acknowledge the scarcity of these resources and plan ways to manage them more rationally. On the one hand we are witnessing the continuous rise in the price of raw materials and a strong demand on international markets for recyclable materials, while on the other hand we are producing more waste. Along parallel lines the increase in energy consumption is skyrocketing and so is the number of consumers. Global times and spaces require a permanent availability of energy and resources, but what is available to the whole is not necessarily available to each individual to the same extent and with the same amount of freedom [8].

The raw materials that allow us to produce energy take on a crucial supranational role and create worldwide political and economic scenarios. The situation becomes worse when the resources are non-renewable sources or sources that generate high environmental risks. The greatest energy demand is actually met in two ways: by increasing exploitation of the planet's resources and by conducting a more intensive search for energy efficiency.

These solutions, however, create a vicious cycle that does not guarantee the long-term sustainable development we are hoping for.

If energy influences every aspects of our daily life, we could go so far as to consider waste an indicator of lifestyles or consumption habits of the society in which we live [9]. It tells us what we consume, how much we consume, the way in which we consume it. This statement derives from a careful observation of the power of persuasion we are all subjected to everyday, through various media that exalt the equation according to which greater consumption favors a rise in one's well-being and social prestige. Our attention to the real value of goods is clearly limited. We ignore its value when it is being used and after using it, even briefly, and we ignore its value after it is discarded. Though in daily life we make an effort to eliminate solid urban waste by differentiated collection, we are paying less attention to industrial waste.

The latter is perceived as being far from our personal sphere, though the mass media reminds us of the growing importance of its impact and the proportions of the phenomena. And this does affect our daily life. Globalized society has reached the limit of its development and is becoming aware of its dependency on energy sources and natural resources and its need to achieve sustainability [1] for its consumption requirements.

DESIGN METHODOLOGIES TO REDUCE PRESSURE OF HUMAN ACTIVITIES ON THE ENVIRONMENT

Currently when we need to design an object or service, our approach is to think about the product to be created and work on the pre-project phase. We single out the actions required to solve exclusively the expectations consumers have of that product [5].

By thinking of the product as of the main focus of the project, we immediately outline the values correlated to it, such as the raw materials, its economic value, its value as a status symbol, possession, communication: the former are essential for starting the production process and the latter influence consumer dynamics. The act of purchasing is a vital moment because it applies leverage to the psychological system of purchasers and their desire for identification through possession [10].

In this scenario there are values associated with the functionality of a product, its life cycle and relationship with the environment. But these are taken into consideration because they are imposed and not strictly necessary for the logic of consumption. Nonetheless today harming the environment, lacking resources and the myth of unlimited development have forced us to think about and reconsider the role of humans in society: a sustainable human community interacts with other living systems, human and nonhuman, in ways that allow these the systems to live and develop according to nature. In the human sphere sustainability is fully compatible with having respect for cultural integrity, cultural diversity and the fundamental rights of the various communities to self-determination and self organization.

The new paradigm considers man its design focus, humans as part of an ecological context that acknowledges the interdependence between social and natural structures. In this scenario the role of life goes back to being essential biologically, ethnically and culturally. Likewise designers are faced with a future that will allow them to design and build ecologically sustainable communities, products and services that will be in harmony with the system of the natural world: the productive process must turn to Nature, the System par excellence, to understand the complexity of a system made up of relations between different beings and the continuous evolving flow of matter; moreover in Nature there is no such thing as waste and even surpluses are metabolized by the system itself [4].

If these conditions, which are fundamental for a living system, are adopted in production, they will favor the development of a zero-emissions production precisely because the waste (output) of one process is used as a resource (input) for another production process. We are getting into an era based not on what we can take from Nature but on what we can learn from Nature [2]: in terms of sustainability, the "projects" and "technologies" of Nature are far superior to human science and technology. We must apply our ecological knowledge and know-how to the fundamental redesign of our technologies and social institutions in order to fill the gap that today separates human design from the ecologically sustainable systems of nature.

THINKING BY CONNECTIONS: WASTE BECOME NEW RESOURCES

In a world that is ever more complex, like the world we inhabit today and will inhabit in the future, we must extend our gaze to the entire production process and see it in its entirety, i.e. not by single phases [7]. We must deal with everything produced, products and waste, to start implementing targeted actions to achieve a substantial harmonization of the relationship between the environment and local communities. Production must be seen as a support to society and not as an end in itself. Therefore we need to seek out new ways of producing that guarantee remarkable results in social, ethical and environmental terms and lead to an improvement in the quality of life.

The starting point is realizing that waste, created by manufacturing processes, or the end-of-life product, discarded and not valued, contains huge amounts of precious resources for other manufacturing processes; the goal is to build a network of know-how which, through true market mechanisms, would stimulate a reduction in all forms of waste and would help upgrade the remaining outputs. According to the first principle of Systemic Design the discards (output) of a process are used as resources (input) for another manufacturing process or products [3]: the outputs are enriched with new value and become a resource available to be in the manufacture of new products closely associated with the local skills.

Therefore it becomes possible to create new manufacturing scenarios where the output of one company, a useless material to be eliminated incurring expenses only, can be reused to ensure the survival of another company related to the business category or physical location of the first company. In this sense all in industrial production must reduce the use of no-renewable materials and evolve toward less energivorous processes, making uncontaminated outputs that can be reused for their qualities.

The methodology proposes that we add value to the discarded materials so we can eliminate waste disposal costs and create a network for marketing the outputs: this generates greater profits and creates jobs and wealth in the community by spawning new entrepreneurial initiatives, developing businesses and improving the already existing businesses [7]. By following these concepts of systemic design, the world of manufacturing, which today is truly lacking an environmentally mature culture, would succeed in achieving the goal of zero emissions.

NEW PRODUCTS FROM PRODUCTION OUTPUT

With this document we would like to illustrate a systemic production chain in which all the output are re-used and two products generated by manufacturing processes waste.

The first example regards a production chain that starts with a cow farm and ends with the retail sale of final products, passing from the milking phase to

slaughter. Till now there have been various critical points within the entire process due mainly to the insufficient valorisation and improper use of outputs which are thrown away carelessly. Among them I would like to point out the water which contains certain percentages of urine or milk or blood, in addition to the organs and blood of the animals. By applying the systemic methodology, and using Systemic Software, it was possible to establish new ways to use these resources and create local flows of material. The outputs from the cow farm were sent to other production enterprises: the water with urine content was sent to water treatment facilities to be treated. The manure, sawdust and urine were used in biogas production plants which produce methane and sludge that are excellent ingredients for high-quality compost for farming purposes.

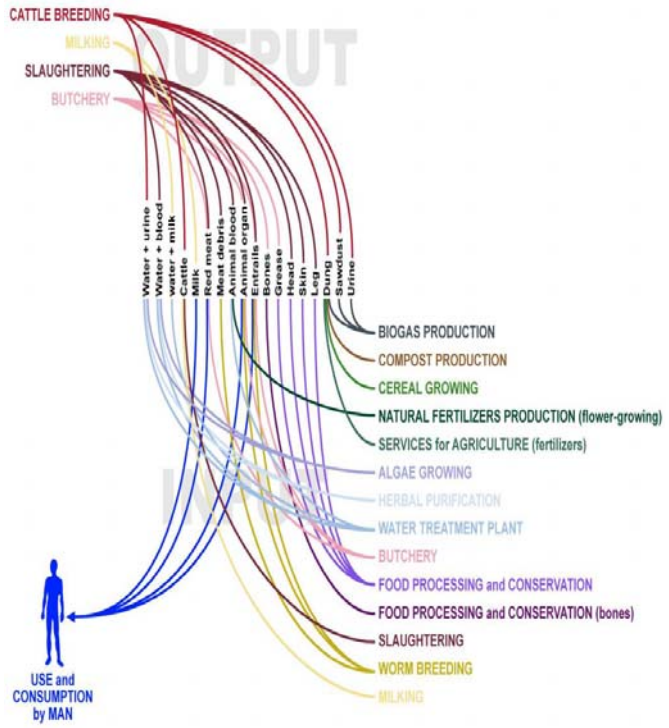

Figure 1 - New flows of material generated by systemic methodology

The outgoing material of the milking phase is currently thrown away but the water contains a certain percentage of milk. This resource is rich in nutritional value if managed systemically and can be used to feed freshwater fish. Numerous critical points were also found in the slaughtering process. Particularly noticeable was the problem of the squandering of certain fundamental by products with a high biological value, e.g. the blood [9]. In the new web of connections blood is used for the production of soil and natural flower fertilizer. Blood traces were also contained in the water sent to treatment plants and plant-filtering processes. The remains of the meat and some of the animals' organs and entrails give a major contribution to raising worms, an essential food for raising quail. Quail eggs are high-quality food products.

The greatest innovation consists of raising the awareness of producers that the problem of waste can be solved by activating complex relations in which the outputs of one productive process connect the nodes, which are local companies, of a network in which know-how, well-being, material and energy transit. The advantages of such approach are environmental and economic; among these the most important goal is to reduce the cost of waste treatment and therefore increase the profits from selling the company's outputs, reducing environmental costs, such as the consumption of energy, pollution and traffic caused by the transportation of materials; the use of already existing materials in loco removes the need to exploit virgin raw materials.

The second example is about the Areca palm leaves, which are transformed into plates (Eco vision_Eco friend, Balipaguli, Post Kodapadavu - 574 269 Bantwal Taluk, Karnataka, India). The leaf sheath of Area (Areca Catechu Linn) palm, extensively cultivated in South India as a cash crop, supplies a strong pliable material that is amenable to shaping. The bio plates are obtained directly from nature and it is not chemically modified neither coated during the manufacturing process. Moreover the plates are obtained from the dead leaves (come off), which could be otherwise rot: this product is obtained from the plant leaf part, which in the course of its biological life cycle, dries, falls and regenerates. The processing waste is reusable as food for the animals present in the farm or as fuel for the ovens needed for plate dehydration.

BioPlates are biodegradable and compostable, and can be used as animal feed and it is combustible too. Palm shed leaf sheaths are first carefully sorted and then thoroughly washed and mechanically pressed in a pre-heated form. A final trimming process gives finish to the products. The entire manufacturing process uses no chemicals, resins, and dyes, strengthening agents or synthetic materials whatsoever. A specialized baking & sterilisation process ensures that the plates are totally germ free, hygienic, and suitable for using for food. Moreover its biodegradable nature means that BioPlate can be easily disposed off after use, and over a period of time decays with the soil like any other naturally shed leaf.

Figure 2 and 3 – BioPlates

The third example is a textile obtained from salmon leather. This material is produced from salmon skin, fish canning waste: a byproduct of the fish processing industry that usually gets tossed into the landfill.

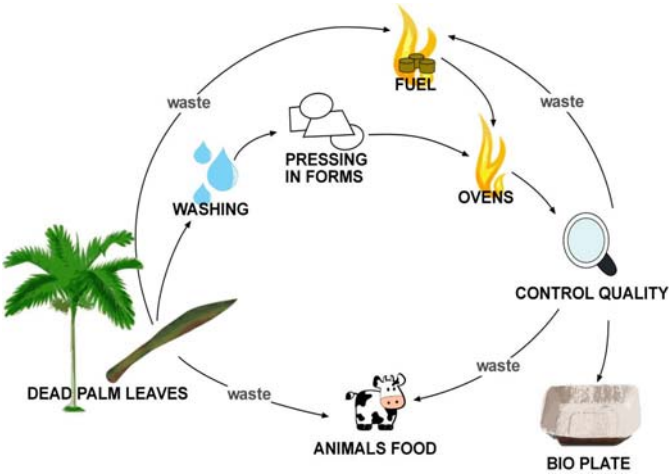

Figure 4 - Simplified systemic BioPlate production process

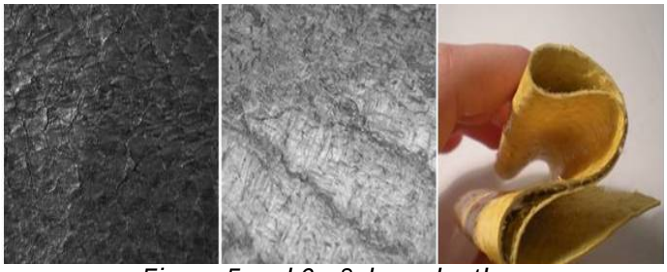

Figure 5 and 6 - Salmon leather

This leather has a vegetal base colour from salmon skins and is 100% chrome-free tanned. Salmon leather was recently used by a fashion designer [12] and in a Museum exhibition.

From recycled glass and medical waste, it's possible to produce a range of products ranging from furniture complements: tiles fully realized only using this recycled materials.

The pharmaceutical field conservation requires the use of materials whose properties (chemical resistance, stability) will not adversely affect the medicine characteristics with which is directly in contact, not only under conditions of normal use of the drug, but also if the product is subjected to a process particularly stressful, such as sterilization or freezing. The glass for pharmaceutical use must have a quality certificate to guarantee the neutrality of the container, under the rules of the European Pharmacopoeia: the characteristics are classified into three categories according to the chemical formulation of the mixtures and surface treatments. These glass, obtained from medical waste, such as beakers and vials, defined neither hazardous nor radioactive medical waste, are recycled and allow to obtain coatings of high aesthetic quality and extremely versatile for use indoors or outdoors.

Among the Italian companies of the art of re-use of recyclable materials, there is Cermyway (Ceramiche MyWay, Via L. Pirandello 7/9, 41042 Fiorano, MO, Italy) which produced Hailstone and Glass, composed of 98% recycled glass from medical waste.

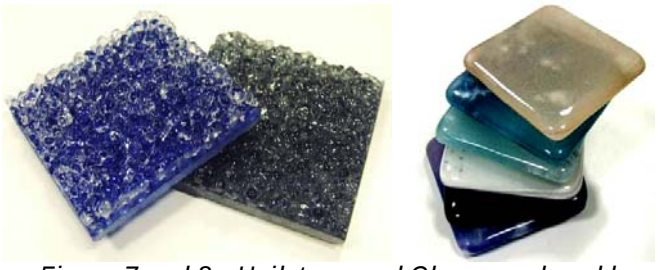

Figure 7 and 8 - Hailstone and Glass, produced by Cermyway

The growing awareness of waste management has produced many innovative ways of recycling waste into new products and materials. Much of our waste is packaging related. After use it is thrown into our trashcans and transported to expensive landfill sites or incinerators [11].

Smile Plastics (Smile Plastics Ltd, 244 Grays Inn Road, WCIX 8JR London, United Kingdom) is one of many companies across the world committed to sourcing and developing innovative ideas and markets for recycled materials, concentrating on transforming plastics into multicoloured sheets.

The original wastes are discarded shampoo bottle, rain boots, yogurt pots, mobile phone case, which can be seen in the surface. For example each phone case can be seen in distorted, tortuous detail, compressed into two dimensions but still clearly identifiable as someone's personalized mobile, saved from the landfill and preserved for ever as a table top or even as the latest style in coasters. The sheets obtained are not all identical: each product has a unique aspect.

Figure 9, 10 and 11 - Bottle produced by Smile Plastics and Origins by Yemm & Hart

Origins is the name of decorative material, produced by Yemm & Hart (Yemm & Hart Green Materials, RR1 Box 173, 63655 9610 MO Marquand, MO, United States), made from recycled polyethylene consumer detergent bottles. This material is comprised of one-gallon milk jugs, which are collected locally and processed by grinding, washing and forming the plastic into pellets [6].

The bottle recycling designation is HDPE. The decor is not printed, but is all the way through the material. Origins panel possess virtually identical properties compared with virgin panels. It's a non-toxic material that causes no harm to the environment during its manufacture or use and it helps to minimize waste.

CONCLUSION

In conclusion designers have to see the industrial world as a system, freeing us from focusing solely on the product and its life cycle, extending our attention to the entire commodity chain, and considering the problems of waste on the same level as that of raw materials [10]. In the future, designers will have this new responsibility: designing an object with all its functional, symbolic, cultural and technical factors fully coordinated and integrated, is now a well-established method, and yet today's world increasingly demands, and in future will continue to demand that projects to be seen as part of a system: different production situations need to be related to each other.

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AUTHORS & AFFILIATION

Claudia DE GIORGI[1], Clara CEPPA[2], Beatrice LERMA[3]

[1-3] POLITECNICO DI TORINO, DEPARTMENT OF ARCHITECTURAL AND INDUSTRIAL DESIGN, Viale Mattioli 39, TORINO, ITALY

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

http://acta.fih.upt.ro

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

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FACULTY OF ENGINEERING HUNEDOARA,
5, Revolutiei,
331128, Hunedoara,
ROMANIA
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Maria Mikela CHATZIMICHAILIDOU[1], Christos CHATZOPOULOS[2], Alexandros TSIGKAS[3]

INVOLVING MASS CUSTOMIZATION AND LIVING LABS IN PRODUCT DESIGN AND DEVELOPMENT PROCESSES

ABSTRACT:
The starting point was the "Democratization of Innovation". Eric Von Hippel keeping in mind the characteristic of "openness", highlighted the significance of Open Innovation practices. Acting as a threshold, Open Innovation boosted Mass Customization and due to Frank Piller' s backing, it became the paramount of marketing strategies. Nowadays, a new user-centered strategy, known as "Living Labs" has emerged. Our aim is to reveal the deeper relation between Mass Customized products and those developed under the Living Lab concept. The creation of a product through a Living Lab practice and a Mass Customization process can be considered as a round procedure and not a separate production methodology. Namely, in a Living Lab, a limited number of developers identify the attributes and functions of a product or a service. Then, this product goes across the production line and takes, from a wider amount of end-users, a Mass Customized form.

KEYWORDS:
Open Innovation, openness, Mass Customization, Living Labs

INTRODUCTION

During the last few years there is concern regarding the new form of innovation known as Open Innovation. This new direction enables production procedures, to take a more anthropocentric shape. Many researchers consider that new strategies as Mass Customization and Living Labs derive from the openness of innovation. As people geting more and more openminded new needs arise. Owning to this fact, new ideas should be generated.

New technologies stem from the new claims of production line, besides progressive marketing campaigns take place. Technology enables new value-chains to turn into a more network-like existence. Additionally, the user-citizen-consumer is becoming as much producer as consumer [1]. Thus, he exhibits into the system of innovation where a great mass of ideas and knowledge are accumulated into a "pool". As argued by Von Hippel and Thomke [2] the users are more often than the, manufacturers of technology, the source of innovations. According to them, users-customers are provided tools so as to design the product that best fits their needs. The basic problem is to overcome design and production limitations and integrate them to user's requirements. By and large, a user can express himself through Mass Cusctomized products and products developed in a Living Lab environment.

Refering to the first strategy, Mass Customization's point of view addresses the need of applying new technologies, aiming to bring the user into the innovation process. It is not about handling people as "guinea pigs", but about getting access to their thoughts and needs. In a Mass Customization process, the prime product is designed and given the basic characteristics by the manufacturer. As a next step, it comes through a mass production-like line and it is ready for use. The only issue that differs between Mass Customized and mass produced products is their final shape. Specifically, a mass produced product is ready for use, without allowing any intervention. On the other hand, a Mass Customized product has a shape of discrete matrices. These matrices are to be assembled by the customer in any way he prefers, shaping his own final product, i.e. Lego.

It is evident that, through all the surveys and projects which have taken place, the most of our interest is focused on Mass Customization. However, Living Labs is agnate to Mass Customization. In this paper, we firmly believe that these tow strategies are inextricably linked.

Living Labs represent a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts. The Living Lab approach strives to break the trial and error process of product development [1]. In other words, the goal is to eliminate the precarity while presenting a new product to the market. For instance, Living Labs involve the consumer into the development process, ensuring highly reliable evaluation, resulting in a significant reduction of technology and business risks.

Concluding, the objective is to address the alteration between Mass Customization and Living Labs. Firstly, the utmost characteristic of a Living Laboratory is its ability to interact with the end-user in real-time conditions and in his own habitat. In a Living Lab environment, the user-developer is the person that frames the initial product and then the product can be customized and mass produced by the enterprise. Whereas, as been mentioned before, the product in Mass Customization, is already defined before been released to the marketplace.

Even so, all these mentioned are generally known. But the novelty is detected in the deeper relation between Mass Customization and Living Labs aiming to develop a satisfactory product or service.

The remainder paper is structured as follows: In Section 2, we briefly discuss the forms of innovation, with a view to the reader's introduction to the field of innovation theory. Furthermore, the main idea underlying a Mass Customization procedure along with its properties is presented in Section 3. In section 4 we attempt to approximate to the notion of a Living Lab. The correlation between Mass Customization and Living Labs is presented throught a theoretical basis in the fifth section. When all is said and done, in the last section we recapitulate the facts and we gravitate to the contribution they have in new life circumstances.

THE FORMS OF INNOVATION

Innovation is a new way of accomplishing our visions. It may refer to the enrichment or the evolution of a new product or service.

Luecke & Katz presented one of the plethora of definitions concerning "Innovation": Innovation…is generally understood as the successful introduction of a new thing or method… Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services. It typically involves creativity, but is not identical to it: innovation involves acting on the creative ideas to make some specific and tangible difference in the domain in which the innovation occurs. For example, Amabile et al. (1996) propose: "All innovation begins with creative ideas… We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is necessary but not sufficient condition for the second".

For innovation to happen, we need something more than the generation of a new idea or an insight. There is a high need of tools, rules and discipline. To this way, emphasis is put on a more general process of creation, progressive thought and action.

Innovation may be:

- *A totally new product, unknown to the customers, produced from scratch*
- *A new production method*
- *A new target group*
- *A new supplier*
- *The preserve in the field of commerce*

The same mechanism of choosing value, providing value and communicating value – as described by Lanning and Michaels – can be superimposed on the three horizons model of the Innovation Matrix (Fig. 1) [3]. What this matrix illustrates more than anything else is that there is a number of interesting and potentially effective new ways of capitalizing on innovations that arise from the identifying value matrix square in Horizon 3, which can be regarded as the point from which the whole process begins.

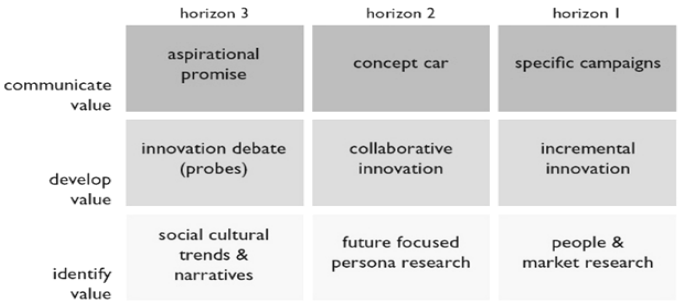

Fig. 1. The Innovation Matrix

As Werner Sombart said, Innovation and Enterpreneurship are the core of "creative destruction". Once you destroy something, something new is going to emerge.

At the same time, innovation has a dual action. Its first stream is Closed Innovation and the second is Open Innovation, where the latter supersede the former, due to practical reasons. This diversification has been analyzed bellow.

CLOSED INNOVATION

Control is the key component for Closed Innovation. To begin with, every single industry has to manage the ideas, the production, the marketing, the distributions, the financing and generally every obligation needed. This type of innovation, domain during the 20th century and it is attributed to the total absence of Universities and governmental interest in the field of exploiting science [4]. This in turn, had a domino effect, while industries were organizing their R&D systems with the absence of any assistance. The lack of time and the imposition, in order to cooperate with external factors, caused to the companies autarky and insociability. Company' s bountaries were sealed and impenetrable (Fig. 2) [4].

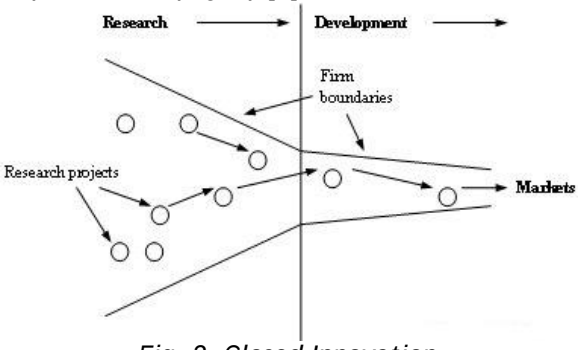

Fig. 2. Closed Innovation

Gradually, a plethora of factors caused the erosion of Closed Innovation. Some of those factors are mantioned below:

- *Workers' mobility*
- *Market extension*
- *Unused external ideas*
- *Capability for external suppliers*

Those mentioned were the vital factors which contributed, in order to build a new knowledge market. Knowledge and information, are not any more company's monopoly, they belong to employees, suppliers, customers, competitor and universities. Thus, during these processes Closed Innovation changed into Open Innovation.

OPEN INNOVATION

MIT professor, Eric Von Hippel introduced the "Democratizing Innovation" concept [5]. In his book, he insists on innovation communities and their significant role towards the openness of innovation. In particular, it is clear that users have no more reservations in revealing their innovative thoughts and actions.

But what's going on with the informal cooperation between users and the formal cooperation in order to develop a product? In both cases, the answer lies at the leading actor of the procedure, the user-innovator. Users are able to use simple tools and create a product on their own. The utmost result is the change of mentality, Open Innovation in other words.

In a world where free speech and knowledge liberty take place, companies can no longer afford the financial weight of research and this is why they prefer to buy or even rent ideas and innovation from external stakeholders. This happens with the purpose of supplementing their internal innovative functions. Of course, it is apparent that Open Innovation is no longer a linear procedure, while innovation is distributed to more than one stakeholder.

All in all, the conclusion is that, a company acting under the umbrella of Open Innovation has penetrable bounds (Fig. 3) [4], so as to serve external knowledge relations between innovation networks.

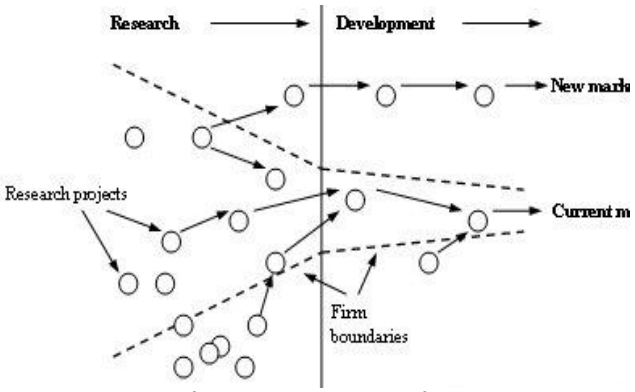

Fig. 3. Open Innovation

Yet, the amount of openness between industries differs. For instance, some companies choose to open up in some fields such as, product development, supplies, marketing. Nokia for example, considered product development as an in-house procedure. At the same time the 3D cell-phone development was an external matter.

In my view, it is highly significant to refer to creation nets, the forerunner of Mass Customization and Living Labs. According to this concept, this is a number of collaborators who aim to create new knowledge, relying on each other's information and taste.

Creation nets' managers focus on three principles:

- *Knowledge Acquisition*
- *Knowledge Integration*
- *Knowledge Exploitation*

Concluding this subsection, a reference to the flows of Open Innovation must be made. Firstly, it is probable for the user to have luck of knowledge. Also, personal aspiration and mentality could cause trouble to the process. Other problems may be restrictions, market distinctiveness, the misunderstanding and the lack of communication between customer and vendor.

MASS CUSTOMIZATION

As a consequence, after Open Innovation, new strategies emerged. One of them was Mass Customization. Concisely, Mass Customization meets two converse principles at once. On the one hand there is the price and on the other hand is the personalization of the product. Price, quality, flexibility and velocity must be taken into account.

The notion of Mass Customization was born by Stan Davis in 1987 [6], who supported that, the more you personalize a product, the more competitiveness you gain. Joseph Pine described Mass Customization as the opposite of Mass Production. Hart & Taylor were convinced that Mass Customization is the use of agile processes, witch aim to produce a variety of differentiated and personalised producs or services.

Although 200 years has gone by the 1st industrial revolution, little progress has happened in industry. Nowadays time is valuable and productive processes seem to be endless. That's why, to colossal strategies are in contrast. These are Mass Production and Mass Customization. But do they really differ? The secret of their ties is the fact that Mass Customization does not only focuses on production. But it constitutes Mass Production's evolution.

Trying to integrate consumer in an Open Innovation environment, a new type of consumer, the "procumer" (producer + consumer) [7], emerges. By this I mean that consumers are also able to configure and shape their own products. Due to Kondylis, under this contemporary philosophy, people are independent and equal beings, with separated roles and rights without facing any social discrimination. In fact, the acceptance of uniqueness boosted Mass Customization, from a social point of view. Kondylis referred to "Mass Democracy", but he was subconsciously referring to Mass Customization [8].

From a technological and industrial point of view, there is a dynamic relation between two competitive streams [7]. The one stream is Mass Production, where less people are needed in production processes and the other stream belongs to Mass Customization, where people' s involvement matters the most. A chart, which shows Mass Customization and Mass Production evolution through the years, follows (Fig. 4) [9].

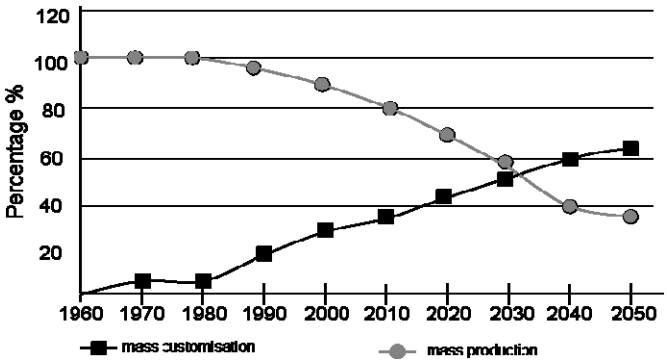

Fig. 4. The balance between Mass Customization and Mass Production

Lastly, owing to thought and will for cheap but unique houses led to "Mass Housing" [7]. To further explain, any user can easily configure his house, with the assistance of appropriate "configurators". Benros & Duarte [10] were those who paid the most attention in the field of Mass Customization.

Is Mass Customization worthwhile?

According to David J. Gardner discrete manufacturers struggling to apply Mass Customization practices so as to gain wider marketplace. The benefits are [11]:

- *Reduce engineering effort per order configuration.*
- *Create a department devoted to innovation.*
- *Differentiation.*
- *Connection between customer and vendor-enterprise.*
- *Increase velocity, while new products enter the market.*
- *Increase customer satisfaction.*
- *Reduce product cycle times.*
- *Enterprises become leaner and waste eliminates.*
- *Inventory decreases.*

Living Labs

Living Labs are Open Innovation environments where real life conditions do exist. User driven innovation is totally adapted to co-creation processes and Open Innovation Functional Region consists of SMEs Collaborative Networks and Virtual Professional Communities in a Public, Private, People Partnership.
In Europe, Living Labs are a very forceful tool in R&D processes. Thus, there is the European Network of Living Labs (ENoLL) [12] which is a European User Driven Movement. At the moment there are 129 websites correlated with Living Labs, with different scopes of interest. The 129 Living Labs network represent an impressive partnership of:

- *Public bodies*
- *Companies*
- *Final users*

In section 3, we discussed about Mass Customization phenomenon and this because it is the tie binding Open Innovation and Living Labs. As we have already mentioned, their common characteristic is "openness" [13]. Another reason why we correlate these marketing strategies is the attention paid on the subjective and individual user needs.
With the purpose of covering new needs in a meta-capitalist society, new practices are indispensable. In Living Labs' approach, users act as co-creators and constitute the core of the laboratory. Enterprises focus on user's deeper thoughts and needs. Furthermore, this is the biggest gain for an enterprise, while all the previous years, companies were struggling so as to have access to this fount of knowledge.
For one thing, historically the Living Labs idea appeared during the 90s aiming to grasp new technologies in people's own habitat [14]. The sheer fact is that, Living Labs were established in order to empower coordination in the European area and build a more anthropocentric profile. During the years, Living Labs have been characterized as environments, methodologies or systems. Undoubtedly, they can be used as an anthropocentric research and development area, where everything is co-designed, controlled and evaluated under open and co-operative real world's circumstances.

The matter of Living Labs

What's a living Lab? There is a great amount of definition about Living Labs and that's because it is a really new field of experimentation. Folstad presented three classes for Living Labs [13]:

- *Those for experience and experimentation in software, bears resemblance to open source practices.*
- *Those witch function as Open Innovation platforms.*
- *Those where users interact with products and services in order to better develop and shape them.*

Indeed, all three classes consider human to be the only source of innovation.
In addition, Living Labs have been defined as "experimentation environments in which technology is given shape in real life contexts and in which (end) users are considered 'co-producers" [15]. This definition differs slightly from the previous, but emphasizes on experimentation and not on research.
Needless to say, users are not "guinea pigs" but innovators. They aren't also employees, but an interesting and interested group which contributes to productive processes. A Living Lab environment, with its stakeholders is presented in Fig. 5 [16].

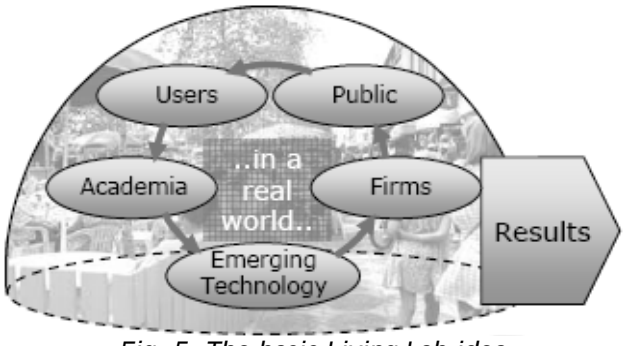

Fig. 5. The basic Living Lab idea

LIVING LABS AGAINST CONVENTIONAL LABORATORIES

Due to Anna Stahlbrost, the basic principles, which far hightlights the vast diferences between Living Labs and Conventional Labs, are addressed below [17]:

- Continuity: This principle is important since good cross-border collaboration, which strengthens creativity and innovation, builds on trust, which takes time to develop.
- Openness: The innovation process should be as open as possible since gathering of many perspectives and bringing enough power to achieve rapid progress is important. The open process also makes it possible to support the process of user-driven innovation, including users wherever and whoever they are.
- Realism: To generate results that are valid for real markets, it is necessary to facilitate as realistic use situations and behavior as possible. This principle is also relevant, since focusing on real users, in real life situations, is what distinguishes Living Labs from other kinds of open creation environments and Conventional Labs.
- Empowerment of users: The engagement of users is fundamental, in order to bring the innovation process in a desired direction based on human needs and desires. Living Labs efficiency is based on the creative power of user communities; hence, it becomes important, to motivate and empower the users to engage in these processes.
- Spontaneity: In order to succeed with new innovations, it is important to inspire usage, meet personal desires, and both fit and contribute to societal and social needs. Here, it becomes important to have the ability to detect, aggregate and analyze spontaneous users' reactions and ideas over time.

Fig. 6 [18] also illustrates the differences between the two types of laboratories. In the first half of the figure, the new product is designed and produced with the contribution of a little amount of people. Then, it is released to the market, without having any opportunity to be altered due to users' desires. In contrast, in the second case, the product is examined by a big amount of users and given to the enterprise, so as to be produced with mass production practices.

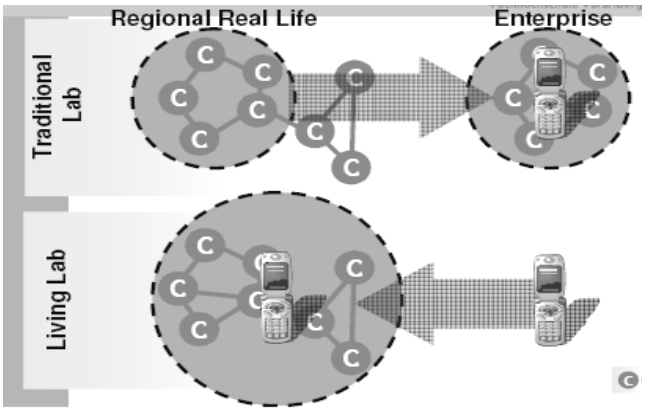

Fig. 6. Differentiation between the two types of laboratories.

RELATING MASS CUSTOMIZATION AND LIVING LABS

The creation of a product, or even a service, through a Living Lab practice and a Mass Customization process, can be considered as a round procedure and not as a separate production methodology. Namely, in a Living Lab, a limited number of developers identify the attributes and functions of a product or a service. Then, this product goes across the production line and takes, from a wider amount of end-users, a Mass Customized form. As a result, the enterprise takes into account the feedback provided by the end-users, so as to an ultimate product be produced with a mass production viewpoint. For a product to reach this point, this means that it has acquired its complete form that contains its purpose or goal of existence. This is what Aristotle calls "entelehia" [19].

The following figure (Fig. 7) portrays the whole procedure of developing a product. On the right half there is the Living Lab process, where the product is produced from scratch. Afterwards, information enters the enterprise and on the left half the Mass Customization process happens. Obviously, the process takes the shape of a French "8", which can last forever, if the product doesn't meet users' needs.

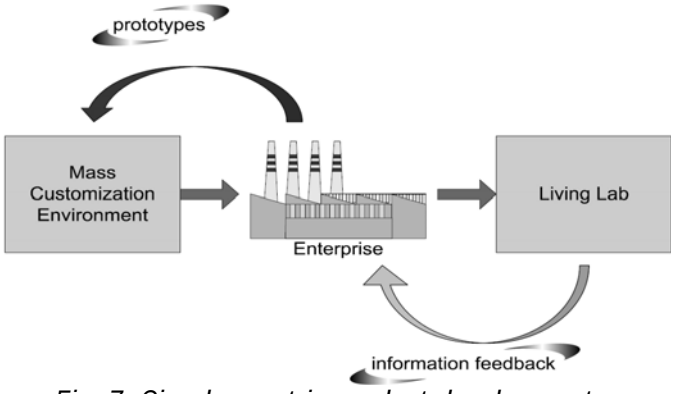

Fig. 7. Circular rout in product development.

As it has already been mentioned, there are some differences between the two strategies. For instance, a product, through a Mass Customization process, is shaped by the enterprise. What is more, the alternatives which are given by the "configurator", are also developed by the company. On the other hand, users have great agility and freedom to shape a product in a Living Lab. In particular, companies just give the idea of a product and then users give whatever characteristic they prefer to. The opposite value streams are given below (Fig. 8).

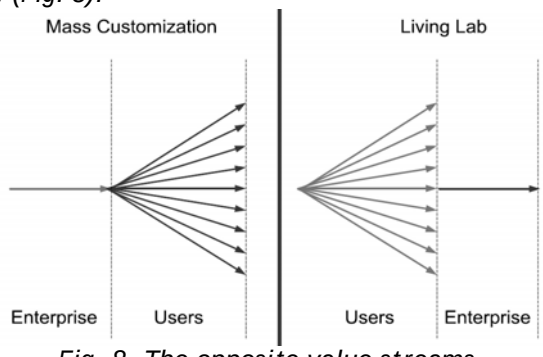

Fig. 8. The opposite value streams.

The aim of this paper is to illustrate the inextricable bind between Mass Customization and Living Labs. Customer becomes the producer of his own product and with his original ideas he also contributes to a "pool of ideas".

CONCLUSION

Concluding the description of the circular process, we recapitulate the facts. From the one side, the vital characteristic of a Living Lab is the ability of a direct contact with the user, in his own environment and life conditions. Firstly, in a Living Lab, a number of users give to the product some basic characteristics and functionalities. Hereupon, the product crosses the product line, where its sub-products are produced, prototyped and reshaped by the end-users, through Mass Customization.

The outcome of our novel idea is that, Mass Customization and Living Labs are not linear and self-contained procedures, but they should be taken into account as a conjoint course. And this is because people in modern communities are disposed, to spend their money, where their needs are totally covered.

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AUTHORS & AFFILIATION

Maria Mikela CHATZIMICHAILIDOU[1], Christos CHATZOPOULOS[2], Alexandros TSIGKAS[3]

[1-3] DEMOCRITUS UNIVERSITY OF XANTHI, DEPARTMENT OF PRODUCTION ENGINEERING & MANAGEMENT, VAS. SOFIAS 12, 67100 XANTHI, GREECE

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Nikola SUZIC[1], Petar VRGOVIC[2], Aleksandar RIKALOVIC[3]

POTENTIALS OF MASS CUSTOMIZATION ON FURNITURE MARKET OF VOJVODINA

ABSTRACT:
In this paper a research of furniture market of Vojvodina province (Serbia) is presented. The main goal was to establish if there is a market for customized furniture and what kind of customization would be welcomed from the customers point of view. For the purposes of research a questionary was composed. Results presented in the paper are derived from that questionary and presented in tables and diagrams. In the end a sum of conclusions was made on whole topic of research.

KEYWORDS:
mass customization, furniture market, panel furniture, Vojvodina province

INTRODUCTION

"New products must be different from what is already in the market and must meet customer needs more completely" says Pine [1], who attributes the increasing attention on product variety and customer demand to the saturation of the market and the need to improve customer satisfaction. Sanderson and Uzumeri [2] state that "The emergence of global markets has fundamentally altered competition as many firms have known it" with the resulting market dynamics "forcing the compression of product development times and expansion of product variety." Global changes in market and product variety can be seen in Fig. 1 and Fig. 2.

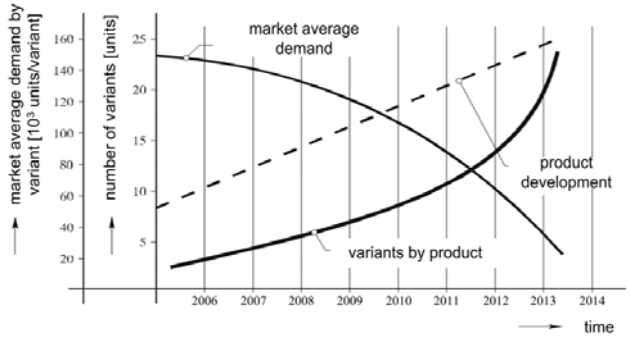


Fig. 1 Average demands of market buy product variant, with parallel rising of number of variants [3]

Customized production is also acknowledged for competitive advantage in developed countries of western world: "While standardised, mass-produced furniture is made more cheaply at similar or better quality in low-cost offshore countries, customized furniture gives producers who are close to customers a sustainable competitive advantage" [5].

The question is: Is there a market for customized products in developing countries? And if there is, do production companies have the ability to produce wide enough palettes of products to satisfy the needs of their customers? Are their production structures flexible enough to handle rapid and frequent change of market needs for many variants of products? And at last what are the characteristics, the properties of products whose customization will yield most promising results.

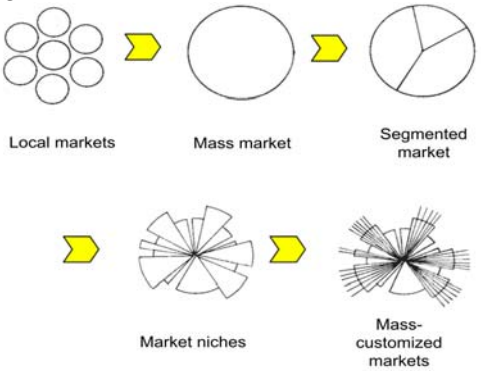


Fig. 2 Market development [4]

In the light of previously stated, a research of furniture market in province of Vojvodina (Serbia) was conducted during the year of 2010, and the results are presented in remaining of this paper.

THE STRATIFICATION OF SAMPLE

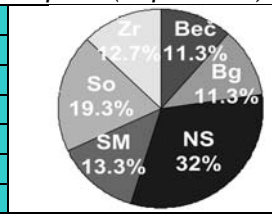
The research presented in the paper is a part and introduction to wider research in the field of production systems in mass customization [6]. The goal of research was to reveal the potential of furniture market in province of Vojvodina (Serbia), and if the potential exists, to determine what features of

furniture would be welcomed for customization from customers point of view in this region.

Five towns in the province were chosen for research sample: Novi Sad, Sombor, Zrenjanin, Sremska Mitrovica and Becej. Smaller number of participants in research came from Belgrade, although the city is not the part of province of Vojvodina, but it is resting on it's southern edge. Allocation of participants (in percents) can be seen in Table 1. The towns in which the research was done can bee seen on map of Vojvodina region (Figure 3).

Table 1. Allocation of participants(in percents)

Label	Town/City
NS	Novi Sad
So	Sombor
Zr	Zrenjanin
SM	Sremska Mitrovica
Beč	Bečej
Bg	Beograd



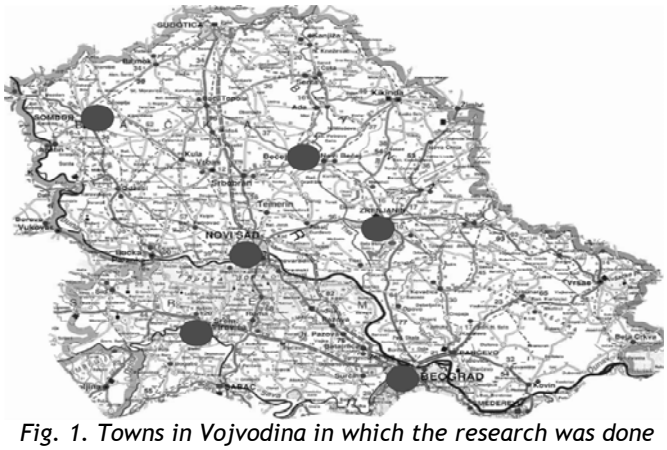
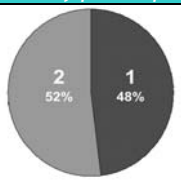
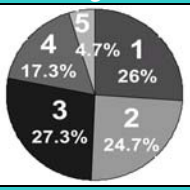
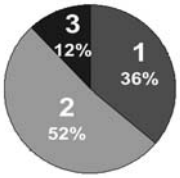
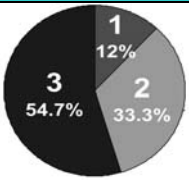


Fig. 1. Towns in Vojvodina in which the research was done

Table 2. Profile of participants

Gender of participants	Age
	
1 male *2 female*	*1 up to 30 years* *2 from 30 to 40 years* *3 from 40 to 50 years* *4 from 50 to 60 years* *5 over 60 years*
Do you live in house or apartment?	*Size of settlement you live in?*
	
1 apartment *2 house* *3 I am renting apartment/house*	*1 village* *2 suburbs or a smaller town* *3 large town or a city (over 50 000 inhabitants)*

Although the research included towns and cities, the area of towns was also included (Table 2) with 12% of participants coming from villages surrounding the towns, and 33% of examinees coming from suburbs, making it 49% all together. If we analyze the profile of participants in questionary, male and female participants were equally included, citizens of all ages and generations were represented (Table 2).

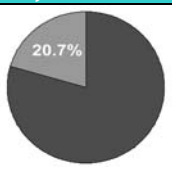
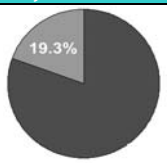
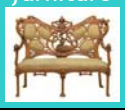
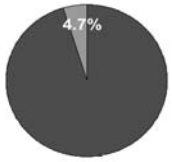
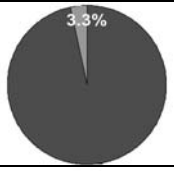
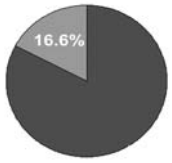
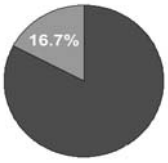
Giving the percentages presented in Table 1 and Table 2, we can conclude that the stratification of sample in the research is good.

ANALYZING THE PREFERENCES OF BUYERS

For the purposes of the research a questionary made of 14 questions was composed. Some of the questions are grouped in tables for better presentation of results. The questions were composed with purpose of finding out the preferences of buyers and perspectives of mass customization in furniture industry in Vojvodina region.

The analysis of collected results has shown that 26% of examinees does not plan to buy furniture at all in next two years. The preferences of those who are planing to buy furniture in next two years are given in Table 3.

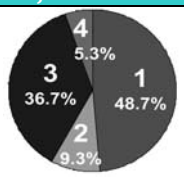
Table 3. Preferences of furniture buyers

I plan to buy:	smaller peaces of furniture	larger peaces of furniture
panel furniture 		
style furniture 		
panel and style furniture equally		

It is necessary to say that examinees could have multiple answers to this question, and that is the reason that sum of percentages in Table 3 is exceeding 100%, which did not affect overall results. Analyzing the results we come to number of 40% of buyers gravitating to panel furniture, 8% of examinees are buyers of style furniture, and 33,3% of them are buying both types of furniture. These results show that buyers in Vojvodina region are oriented to panel furniture rather than style furniture. The reasons for this fact can probably be found in the economic situation, not only is Serbia, but in whole Balkan region whose countries are still in transition period. This makes panel furniture more acceptable and realistic alternative for Serbian buyer. Research results are far from surprising and researchers expected similar findings.

After preferences of buyers were established a series of questions was asked regarding previous experiences of buyers. The emphasis was on place of purchase, and satisfaction of customers with already bought furniture (Table 4).

Table 4. Experiences with previous purchasing of furniture

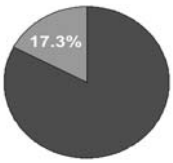
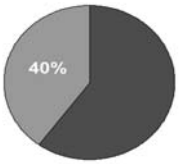
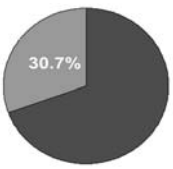
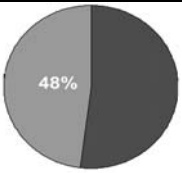
Where did you most frequently buy the furniture?	How often does it happen that offer of standard furniture does not match your needs?
	
1 in furniture stores 2 at carpenters, done by exact size 3 equally in furniture stores and at carpenters 4 nowhere, rarely or something else	1 never, standard furniture always or almost always satisfies my needs 2 sometimes it satisfies my needs, and sometimes it does not 3 in most cases it does not satisfy my needs

Furniture stores have proven themselves like dominant place for furniture purchase (48,7%), with large number of examinees that bought their furniture equally in stores and at carpenters (36,7%). Frequent comment that this group of buyers had is that they went to carpenters (and pay higher price) when they did not find what they were searching for in furniture stores.

The customers were then asked if the standard furniture offer satisfied their needs. Only 24,7% of them answered that standard furniture always or almost always satisfies their needs, 62,7% said that it sometimes satisfies their needs, and sometimes it does not, and 12,7% said that in most cases it does not satisfy their needs (Table 4).

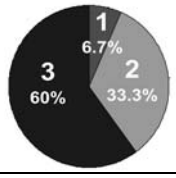
Customers who said that standard offer of furniture sometimes satisfies their needs or in most cases does not satisfy their needs where than asked about the furniture properties that did not meet their needs in past (colour, dimensions, quality and functionality of furniture). The examinees could pick out more than one property from given options (Table 5). Dimensions (40%) and functionality of furniture dominate the answers to this question, which leads to conclusion that there is a need for customization.

Table 5. Properties of standard furniture offer that customers marked as inadequate

Why standard offer of furniture did not meet your needs?	
colour	dimensions
	
quality	functionality of furniture (number of drawers, shelves, way of opening tc.)
	

After the questions that had intention of establishing if there is a need for customization in furniture industry, customers were directly asked if they would like to have option of customizing their furniture in next purchase, and in the end how much would that mean to them personally (Table 6). A great majority said yes to customization (93,3%), 60% of them said that it would mean a lot to them.

Table 6 Significance of customization to customers

Would you like to have possibility of furniture customization during your next purchase (number of shelves, drawers, dimensions, other colour etc.)?	
	1 no 2 yes, but it would not mean a lot to me 3 yes, it would mean a lot to me

In many cases customization brings with it higher prices and maybe even longer delivery deadlines in many cases, and question is if the customers are ready for new prices and deadlines. The main part of customers would pay 15% more than standard price (68,7%) and wait additional 15 days for their product (53,3%). But there was also a part of examinees that was ready to pay a lot more and to wait a lot longer to get the product they wanted (Table 7).

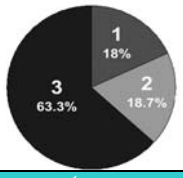
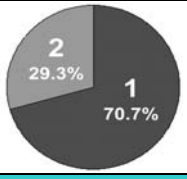
Table 7. Readiness of paying more and waiting longer for customized furniture

How much would you be ready to pay additionally for customized furniture (number of shelves, drawers, dimensions, other colour etc.)?	How longer would you be ready to wait for customized furniture (number of shelves, drawers, dimensions, other colour etc.)?
	
1 up to 15% of standard price 2 from 16% up to 30% of standard price 3 from 31% up to 50% of standard price 4 more than 51% of standard price	1 I do not want to wait for any reason 2 additional 15 days 3 from 15 to 30 additional days 4 more than 30 additional days

Further more the question is what would customer be ready to pay and what would be the range of customization in actual conditions. Even if the question is not so precise the results are accurate enough to give complete picture of furniture market and customers thinking.

The final part of questionary had intention of understanding what is potential of Internet and computers, and could they successfully be used buy production company in selling furniture using configurator tools (Table 8).

Table 8. Using Internet in home and readiness to customize furniture over the Internet

Do you use Internet at home?	Would you be ready to customize and buy your furniture over the Internet?
	
1 no 2 occasionally 3 everyday	1 YES 2 NO

Data gained from these two questions (Table 8) are encouraging. Percentage of potential customers using Internet on everyday basis is 63,3% and percentage of those who are ready to customize and buy furniture over Internet is even bigger (70,7%). Percentage of occasional users of Internet is also considerable (18,7%) and gets the sum of Internet user to 80% all together.

CONCLUSIONS

Analyzing the results of given research we come to some conclusions:

- *Market of province of Vojvodina is oriented on panel furniture. Potential reasons are probably the economic situation in country and in whole Balkan region. Having this fact on mind we can assume that panel furniture will remain dominant choice of buyers in next period.*
- *Furniture store (saloons) are the place were most of buyers purchases their furniture, and every tenth buyer goes directly to carpenter.*
- *During the research a pattern which could almost be a rule was noticed. The buyer would go to furniture store in hope of finding a product that would suit his needs, but if he would not find what he was looking for he would go to craftsman (carpenter) and order exactly what he wants but for a more higher price. So we can say that potential for mass customization exists, and the fact that the customer came to our store should be used. If our standard offer does not satisfy him he should be offered with customized products who would have lower price than those of craftsman's products.*
- *Dimensions and functional characteristics of furniture are the main properties whit which customers were not satisfied in their past purchases. Mass customization can meet customers needs in these properties very successfully.*
- *Majority of buyers (60%) would like to have opportunity to change properties of furniture, and 33,3% would like to have that option even if that would not mean a lot to them.*
- *As for the readiness to pay more or wait longer for customized furniture, 68,7% of examined buyers would pay up to 15% more than standard furniture. The encouraging result is that 22% of buyers would pay 16 to 30% more and 9,4% of them would pay even more. As for a prolonged deadline for customized furniture 28% of buyers are ready to wait a lot longer (more than 30 days longer) to get it. So we can concur that there is a population that would agree on higher prices and longer delivery deadlines only to get exactly what they need.*
- *There are 82% of Internet users (63,3% of everyday users) among examined buyers, and 70,7% of buyers would buy furniture over the Internet.*

If we would sum the complete research results we can say that there is a group of potential buyers of panel furniture (in province of Vojvodina) which would like to participate in creation of their products and is ready to pay a higher price for it. The only thing left is that production companies realize the potentials and take this part of furniture market.

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AUTHORS & AFFILIATION

Nikola SUZIC[1],
Petar VRGOVIC[2],
Aleksandar RIKALOVIC[3]

[1-3] UNIVERSITY OF NOVI SAD, FACULTY OF TECHNICAL SCIENCES, TRG DOSITEJA OBRADOVIĆA 6, 21000 NOVI SAD, SERBIA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Jocelyn BELLEMARE [1.]

THE CONFIGURATOR AS PART OF A CLOTHING MASS CUSTOMIZATION PROGRAM

ABSTRACT:
In the clothing industry, some companies have successfully applied mass customization principles to their formerly standardized products. However, mass customization is not generally well understood or implemented by companies, due to problems related to measurements, pattern adaptation, and inflexible manufacturing methods and lead times. This research project offers many possibilities for innovation and could constitute a major opportunity for certain players in the clothing industry. If prime producers want to seize the moment, they will have to better understand what is feasible in clothing mass customization, and thus help develop a new competitive advantage.

KEYWORDS:
Mass Customization, Configurator, Apparel industry

INTRODUCTION

The clothing industry is currently undergoing a period of turmoil due in large part to globalization. This industry represents an important source of economic activity and employment. Montreal is Canada's leader in the clothing sector and also ranks amongst the most important clothing manufacturing centres in North America (with Los Angeles and New York[1]). Following sustained growth in the 1990s, the industry is currently experiencing disruptions as a result of massive imports and economic variations in its market.

Significant breakthroughs by foreign new comers in the industry add to the existing local competition. As a result, Quebec businesses must face unprecedented rivalry. As products now seem to have an ever shorter life cycle, a phenomenon which is exacerbated by the introduction and implementation of new business models, businesses' commercial strategies must face mounting pressure, most notably for those involved in the sectors of fashion, textiles and clothing. This situation forces players in the Quebec industry to revise their organizational strategies in order to survive in this highly competitive market.

Solutions to these problems can mainly be found in the corporate strategies (namely, in commercial and manufacturing strategies) of the Quebec businesses that are being threatened. These companies must try to reinvent themselves and find new ways to satisfy their customers. In order to grow, to maintain the current level of employment and possibly to increase it, prime producers will need to develop new manufacturing strategies by orienting local production towards a flexible, quick-response system that allows for the production of various types of orders (small quantities, short deadlines, skilled labour, etc.). Thus, it will become essential for businesses to implement new strategies that correspond to the reality of current markets, in order to keep up with the rhythm of short cycle production. Businesses need focus on flexibility, adaptability and agility (Pine, 1993).

In an age where innovation and technological developments play an increasingly crucial role in counteracting the effects of lower wages found in other countries, the objective of this research is to demonstrate the importance of implementing mass customization manufacturing systems adapted to the needs of all actors in the clothing industry. Even though the local garment industry and that of emerging countries face each other on an uneven playing field, the local industry possesses a technological environment that could give it a significant advantage.

RESEARCH

With the recent surge in the use of new media and telecommunication, consumers are more and more demanding and informed. They are no longer satisfied with standardized products that force them to make compromises. The Internet influences customers' buying habits by creating needs that have to be satisfied instantaneously.

[1] Fashion and Clothing Industry Strategy, Minister of Economic Development, Innovation and Export Trade, Department of consumer goods – Quebec Report (2008)

In the clothing industry, these expectations not only imply having to constantly provide consumers with new options in terms of styles and colours, but also to allow them to find an affordable close-fitting clothing item and make it available to them almost as rapidly as if it was a standard-sized product. In order to meet these expectations, clothing companies must now propose custom-made products. Brands that offer personalized products (mass customization) are taking over both traditional and online stores. This is made possible by identifying the key points of measurement necessary to produce well adjusted, close-fitting garments. However, being able to take these measurements efficiently and effectively is crucial.

Although efficient and affordable technologies are available to provide a Body Scan, few businesses are able to meet the requirements of custom-made products for the following reasons:

(1) Lack of reliability of the measures provided by the Body Scan
(2) Problems related to the transmission of a large quantity of data to potential manufacturers
(3) Interface issues between the data generated by the Body Scan software and that used by pattern making, cutting and assembly.

In the apparel industry, some corporations (Levis, Nike) have successfully implemented mass customization principles to products that were thus far standardized. Even designers such as Jean-Charles de Castelbajac and Longchamp have played the role of pioneers in the luxury goods market by offering, respectingly, prêt-à-porter and customizable bags.

Nevertheless, mass customization somehow remains misunderstood or is rarely used by actors in the clothing industry mainly because of the widely variable measurements, of the problems in adapting patterns, of the need for flexibility of manufacturing delays and methods.

Many authors have produced research on mass customization; however, few of them have sought to identify the problems related to sizing and to so-called 'hidden data' coming from the customers (ease allowance, fulness, etc.)

The general aim of this project is to develop a configurator, using computerized information systems, that could be used to analyze and decode measurement data coming from peripheral devices in order to identify as precisely as possible.

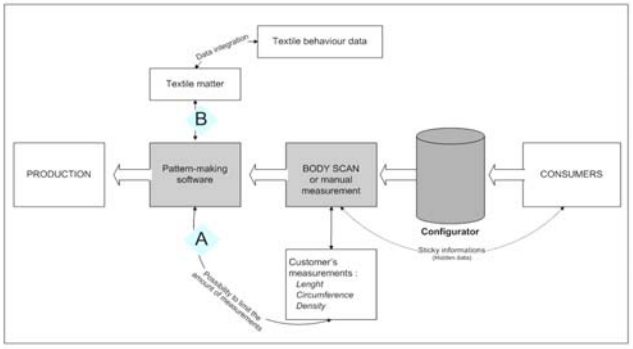

Fig. 1. Configuration for Clothing Mass Customization

In this context, the specific objective of this research project is to identify the fundamental variables and data that are necessary to produce custom-made clothing. The reduction of the number of fundamental variables (length, circumference, density and textile matter behaviour) will allow to significantly diminish the amount of data to analyze and send out in order to create an 'intelligent' pattern. We consider, in our hypothesis, that the amount of non-essential data for pattern automation can be reduced by 65%, if compared to current situation in the garment industry. In this research, we will not only try to reduce the quantity of data, but also to determine the minimal number of measures needed (minimum cardinalities). Moreover, using anthropometric measurements, like density, will enable us to identify key referential points which are essential to ensure proper fit. These referential points, when combined with data related to textile textures and behaviours, will allow for personalized pattern grading.

This research project therefore aims at reducing the amount of data while increasing the quality of automated clothing patterns, thereby allowing for the production of well adjusted custom-made clothing that meet customers' needs and expectations.

LITERATURE

Paradoxically, in an age where standardization is ubiquitous at an international level, the current catch phrase in the fashion world is: unique. Nevertheless, the confusion between personalization and mass customization still reigns. Inala (2007) contends that mass customization has become a competitive strategy for businesses that want to offer personalized products. The more a business provides opportunities to personalize its products, the more competitive it becomes (Pine, 1993). When clothing was made-to-measure, each one was cut and assembled for individual customers (Istook 2002). As a result, it provided a personalized fit (Workman, 1991). This type of production is what Pine (1993) referred to as personalized and handcrafted production. However, in order to be able to meet the demands of mass customization, all of a manufacturer's operations have to be based, according to Zipkin (2001), on flexible processes that allow it to respond rapidly to customers' requests. More often than not, mass customization consists in, for example, assembling basic items according to specific orders. Fashion being first and foremost relatively subjective, customers are increasingly focused on their own requirements and, consequently, more resistant to product standardization (Wang, Zhou et Zhang, 2009). Mass customization therefore becomes a crucial development solution for businesses specialized in garment manufacturing and the distribution (Pine, 1993). In fact, the demand for mass customization of clothing is only growing stronger. It has become possible thanks to the contribution of new technologies. Custom-made clothing requires a very thorough understanding of the expectations and

specificities of each individual (Peterson, 2008). According to Pine (1993), the success of mass customization rests mainly on a successful integration of the value chain. In some respects, businesses must accomplish a feat by performing well on two (2) axis that are generally on opposite sides of the spectrum in most bussinesses: maintaining short supplying lead times while offering custom-made products that correspond to clients' specifications.

THE PROBLEMS OF MASS CUSTOMIZATION

Agrawal, Kumaresh and Mercer (2001) indicate that the main problem of mass customization is related to the preparation of products according to customers' requirements. Von Hippel (1998) states that because of their lack of knowledge and experience, consumers do not know what they really want. It is thus important to simplify their request by offering them some guidance. Doing so not only requires knowing a customer's measurements and style, but also obtaining information that he never reveals: what literature refers to as "sticky information". The term "sticky information" is defined by Von Hippel (1994) as information hidden by a customer that provides, in certain cases, a company with a key competitive advantage and offers significant opportunities for innovation. For example, consumers know their needs and tastes better than manufacturers. It is therefore difficult for a manufacturer to obtain information that is either confidential or perceived to be so irrelevant that consumers reveal them sporadically, at best. This unknown data, like ease allowance, fit, proportion and the like, are essential to the production of custom-made goods. According to Ashdown (2007), they are at the source of most purchase returns occurring in stores.

In the American industry, clothing size standards were created following anthropometric studies conducted in the 1940s. The aim was to satisfy customers by allowing manufacturers to fine-tune their production in terms of sizing. Today in Canada, the government (through the Canadian General Standards Board) provides a code for each size which corresponds to specific body and clothing measurements. For men's apparel, the CGSB has been using the size chart that was introduced in the U.S.A. in the 1950s. In recent years, however, we have come to face certain problems related to fitting. Body proportions have changed since the 1940s and 1950s, or even since the 1980s. According to Norman Marks[2]: "Body measurements of Quebeckers have changed: clothing sizes based on body measurements established in the 1980s no longer correspond to reality. The new generation of men between 18 and 35 is much taller than the average height found in the 1980s."

Workman (1991), for example, indicates that the average height of men living in the United States in 1940 was 1,69 meters, compared to 1,76 meters today. Furthermore, according to Yunchu, Weiyuan and Cong (2007), effects related to nutrition and physical exercise have modified ergonomics body which make clothing adjustments more complicated. Following a study in collaboration with Size Germany, Melliand (2005) asserts that the average physical stature of men has increased by 16 cm since 1875. As a result, today's table of standard measurements for sizes 36 to 46 is no longer correctly adjusted. Standard sizing issues for clothing are only becoming more widespread with the advent of globalization (Faust, 2009). Because of this, order initiators do not respect standards and create their own size specifications that correspond to their target market or are consistent with their vanity sizing strategy. However, they still continue to use the generally accepted size values (Ulrich, Anderson-Connell and Wu, 2003). Without clearly established norms or standards, consumers are having difficulties finding their way, which generates frustration and confusion when trying on clothes.

Norman Marks confirms: "In the past, the best selling two-piece suit was made of a size 40 jacket and size 33/34 trousers. Nowadays, the same suit with size 34 trousers will be offered to this new generation of customers with a size 42, or even 44, jacket." For businesses, manufacturer's clothing sizes are inconsistent and can create important losses in terms of potential sales, according to Workman (1991).

The increase in purchase returns for clothes both in stores and on the Web creates headaches for retailers because it bears some consequences on their brand image (Park and Stoel, 2002). According to a survey conducted by Synovate in 2008, 58% of Canadians claim that it is very difficult to find clothes that fit them perfectly and 77% of people surveyed find that sizes vary from store to store. As a result, it appears important for stores to know their clientele and to offer clothes that fit customers adequately in order to increase their volume of sales per customer. Thus, some problems associated with mass customization must be corrected by the garment industry, they are:

a) The templates used to create basic patterns are not adequate;
b) The size standards and measurement charts have become obsolete;
c) The sizing per territory/population rapidly changes;
d) Some of the information hidden by the customer must be decoded by manufacturers

Faust (2009) contends that errors in measurements still prevail in the clothing industry. Even if a customer is given a sizing chart, it is still difficult for him to take accurate measurements on his own. Ashdown (2004) has identified a few simple problems that might be encountered. For instance, when measuring waist circumference, it is necessary to stand straight in a natural position and to hold the tape measure parallel to the ground. A slight imbalance could result in errors of up to half an inch on the final garment. The main problem occurs when measuring the waist girth. Norman Marks explain that some

[2] Interview in October 2009 : Norman Marks – Master tailor for men / MARKS INC/ Family business created in 1910

measure the narrowest part of the waist, while other use the navel or small of the back as a reference point. Yet, it seems that master tailors never need to ask themselves this question because their intrinsic knowledge and experience helps them decide how to take this rather complex measure. Moreover, Park and Stoel (2002) mention that data transmission errors taking place during the data transfer process create problems at the time of order. As for the 3D body scan technology, it sends more than 300 000 data items during a sample body scan (Ashdown, 2007) which increases the complexity of selecting valid data in order to obtain reliable information.

Ashdown (2007) indicates that computer systems need to accurately generate the information coming from both the pattern-making software and from the body scan. Issues arise when size charts and fit levels for different body types are not clearly established from the start. The key to success lies in the development, the architecture and the support of computer systems used to generate data based on individual body dimensions for pattern-making software, which need to be adapted individually. Despite the fact that all these approaches aim to produce apparel as accurately as possible, it appears that the great number of constraints makes it difficult to find a compromise between performance, accuracy and technicality during the production process.

THE PRODUCT CONFIGURATOR

Configuration is an essential aspect of mass customization because it creates the possibilities to guide customers as they are making choices. Piller (2004) contends that the primary objective of a configurator is to ease the decision-making process of customers using a Web-based interface. Product configuration systems play an important role in supporting the mass customization paradigm, as it helps to determine the degree of personalisation that a business will offer. Thus, the role of the configurator is to create a link between consumers and manufacturers (Inala, 2007). Mass customization does not equate to an increase in costs. According to Pillier and Moser (2006), using a configurator could significantly reduce costs since its Web-based technolgy dimishes the time required to take orders. Figure 3 demonstrates how the configurator would operate in a clothing mass customization program:

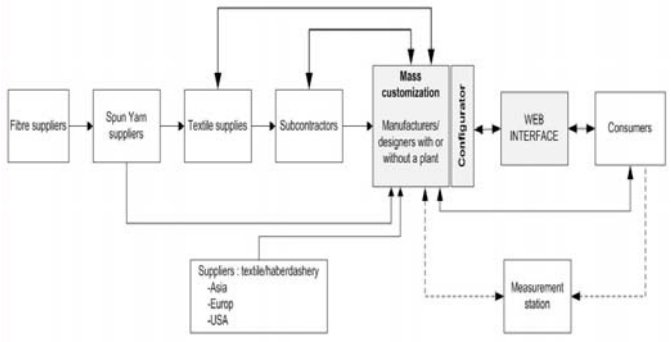

Fig. 2. Mass Customization Configurator for apparel industry

A product configurator must be used along with a high-performance technological platform so as to allow for interaction between customer and manufacturer as the product is designed. This creates an interface between the customer and the supplier which provides opportunities for value co-creation in both the apparel and fashion industries.

In the current context, businesses use catalogs and manual production methods. Catalogs provide a predefined and limited number of combinations for a product without necessarly fulfilling all of a customer's specific needs (Quin and Yang, 2009). Manual configuration, on the other hand, essentially relies on human expertise and necessitates competent and highly skilled workers (Rogoll and Pillier, 2004). However, a lack of expertise eventually requires investments in terms of time and efforts; moreover, it forces employees to keep up to date with frequent technical changes and improvements. As a result, the configuration of a product to meet a customer's requirements can become a complex task which gets more demanding as the number of components and options increases. When the configuration requires numerous variations, the possibility of making errors also rises which can result in production delays. The repetition of subsequent steps may be required which can be costly. Thus, Ashdown (2007) contends, mass customization creates various technical challenges that need to be overcome before mass customized garments can be produced.

The technological risks associated with a configurator project are essentially related to the development of a system that can share and process data and parameters (the parameter configurator) originating from various sources such as: the data entry tools (e.g. the Body scan), the basic garment patterns, the marker-making software, the automatic cutting table and the administrative and financial data. In short, none of the existing technological system seems to provide a solution for mass customization in the apparel industry. Rogoll and Pillier (2004) indicate that the optimal product configurator needs to create an interface between different programming languages and function entirely independently. Incidentally, these criteria add to the level of uncertainty associated to this type of installation.

METHODOLOGY

The first stage of this research project is a preliminary study of the fundamental variables and data needed to produce a custom-made garment. This first step will allow for the production of a thesis which is itself an integral part of a larger research project. The proposed approach will aim, in part, to identify the fundamental variables and data essential to the fabrication of custom-made apparel. After this thesis has been submitted, the data obtained will be analyzed and modelized which will allow for the creation of a product parameter configurator. Moreover, in the near future, we will assess the modalities of implementation of this technology and

its progressive use in the fashion and garment industries.

The preliminary phase of this research project will take place in a manufacturing environment specialized in men's fashion. At first, we will study the mass production and custom-made environments that exist in this industry. Next, will will analyze three models pants provided by manufacturers specialized in athletic wear, sportswear and workwear. Each pattern will be analyzed and dissected in order to assess the fitting and grading methods used in relation to size and type of textile. From this first study, we will formulate a hypothesis on the fundamental variables needed to produce a garment using mass customization.

In order to validate the fundamental variables that will enable us to create our configurator, we will conduct a study on the process involved in body measurement (length, circumference, density and stature) using both a body scan and manual measurements. A group of 12 men will be recruited to allows us to modelize the variables and data linked to a fabrication model that is part of a real manufacturing process. So as to facilitate research based on individual shape groupings, we will use Rasband and Liechty's (2006) figure types represented by the letters H-O-X and V to categorize different types of silhouettes. Four groups will be made up of men (of different stature) wearing a size 40 jacket and trousers of sizes 32 to 38. It will then be possible to validate the data through our configurator and produce garments using rapid prototyping. A thorough examination of the clothing items produced will be carried out during the fitting phases in order to analyze their "fit". This will allow us to determine which variables appear to be problematic.

Mass customization offers a new business model and growth opportunities for small manufacturing businesses and clothing companies. Indeed, from mass or large volume production, businesses in this industry will be able to profit from this value-added advantage. According to Zipkin (2001), this type of production will be possible on a large scale because new technologies will become more easily accessible. This project originated from the idea of creating the "optimal" product configurator which would have the capacity to efficiently translate customers' desires and associate them with their anthropometric and anthropomorphic characteristics.

CONCLUSIONS

This research offers great possibilities in terms of innovation and could constitute an outstanding opportunity for several actors in the clothing industry. If prime producers want to make the most of this prospect, they will need to better understand what can be done in terms of clothing personalization and mass customization so as to formulate an appropriate strategy on how to use their measurement configurator. From the start, mass customization needs to directly involve customers in the designing and manufacturing phases. Moreover, this customization model must provide opportunities to generate savings by reducing stocks and by allowing for a better integration of all actors in the supply chain. Mass customization offers possibilies to reach, or even surpass, customers' expectations. Therefore, it needs to provide a knowledge base of consumers' needs and preferences and thus create opportunities for market segmentation.

This research project will provide tools for fashion industry businesses that will allow them to gain a competitive edge through custom-made and short lead time projects. The opportunities created by the absence of such a service or system needs to be used by businesses in this industry to reposition themselves on the garment and apparel markets, both locally and internationally. If actors in the fashion and garment industry accept this change of direction, this project could evolve into an extremely competitive business model that could represent a viable option for companies in different sectors.

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AUTHORS & AFFILIATION

Jocelyn BELLEMARE [1.]

[1.] ECOLE POLYTECHNIQUE OF MONTREAL, DEPARTEMENT OF INDUSTRIAL ENGINEERING, MONTREAL, CANADA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Ivica VEZA[1], Natasa JURJEVIC[2]

MASS CUSTOMIZATION OF LARGE, COMPLEX PRODUCTS

ABSTRACT:
This paper gives an overview of past researches in implementation of mass customization. It has been noted that mass communication is principally used for three basic reasons (main purposes): transfer from mass production into mass customization, increased possibility of choosing components and increased productivity and quality as well as shorter delivery times for products manufactured as one-of the kind. Special attention has been paid to mass customization of large, complex products with a reference to shipbuilding.

KEYWORDS:
mass customization, large, komplex products, complexity, shipbuilding

INTRODUCTION

MC has transformed many industries and brought about a possibility of a fast reply to individual customer demands. Such approach, accompanied by adequate production effectiveness has allowed companies to retain their positions on the market and proved vital for business success. From the customer's view, this change in approach to production and sales was accepted really fast. On the other side design and production have to solve many new problems.

This, first of all, refers to accepting the fact that design, production and use process, as well as product write off have to been seen comprehensively and that each product function, characteristics (production, aesthetic or usage), every way of use, maintenance and product disposal has to be foreseen on time during the design period.

Large, complex products represent a special problem as their complexity stems not only from its complexity but from its production process complexity as well.

In the past every product was built as 'one of a kind' – each product was also a project apart. That way did not allow unification of certain production processes, production acceleration and faster and better product price anticipation.

PAST MC APPLICATIONS

Past experiences show that MC can be applied in three possible ways:

1. *By changing the approach to production from mass production into mass customization (clothes, footwear ...)*
2. *MC is implemented only at the end of the production process mainly as a marketing tool. MC is used only to select components (bicycles, cars, ...)*
3. *It is used to increase their operational efficiency and at the same retain traditional individual approach (motors, Marelli Motori, complex process plant F.L. Smidth).*

FROM MASS PRODUCTION TO MASS CUSTOMIZATION

Due to growing globalisation and market competitiveness most of manufacturing companies have cast aside the mass production paradigm and started adapting their products to their customers' needs. Certain number of products can, at present, be bought adapted to individual customer's requirements and needs without any change in price.

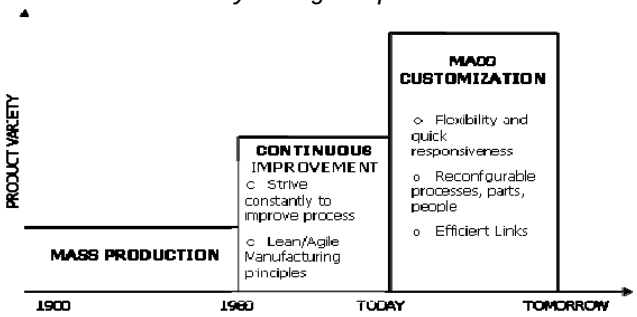

Figure 1. From Mass Production to Mass Customization

There are pages on the Internet that allow their customers to buy clothes and shoes adapted not only to their needs and wishes but to their appearance as well: size they wear, characteristics of their body and even hair colour. My Virtual Modal page helps create fashion outfits by creating virtual models i.e. avatars.

Apart from choosing clothes without affecting production certain clothes and footwear retailers allow not only cosmetic adjustments, but the possibility to influence size and shape as well. In this way Adidas not only offers a choice of numerous colours, but also to customize the shoes with regard to

comfort, fit (exact measurements) and functionality (cushioning etc.).

CUSTOMIZATION BY CHOICE OF COMPONENTS

Customization to customer demand can be done by choosing individual product components. In that way customers choose among chosen, previously developed and manufactured components offered by the manufactures and thus compound their unique product from many different feasible combinations.

Car industry is no exception and most car companies today offer customers a possibility to choose the desired look of their car. However, there is a problem of how to define what the customers really want or think they want and what the company can offer. Car industry has thus developed product/sales configurators to make defining orders according to specific customer's needs easier.

In most cases configurators enable exchange of different product components. Without going into product or production process details, configurator enables the producer to see the customer needs that have been formed in accordance to displayed offer. This enables fast and simple product definition, helps both the customer and the sales person and prevents choosing components or component combinations that are unwanted for security, production or other reasons.

This example shows that a configurator was used as a sales tool only with it function to sell a customized product. Such configurator is limited to interaction between manufacturer's offer and individual customer choice without the information exchange with any other design or production department. Product customization is done only at a superficial level and does not affect its functional domain. It is considered normal that a customer will not be able to choose an adequate car configuration as he lacks specialized knowledge that would enable him to change components directly affecting the product's function [1].

Customers of Bayerische Motoren Werke AG can use an online tool kit to design the roof of a Mini Cooper with their very own graphics or picture, which is then reproduced with an advanced digital printing system on a special foil. The tool kit has enabled BMW to tap into the custom after-sales market, which was previously owned by niche companies. In addition, Mini Cooper customers can also choose from among hundreds of options for many of the car's components, as BMW is able to manufacture all cars on demand according to each buyer's individual order.

Bicycle manufacturer Steppenwolf is one of the pioneers of mass customization. It was founded at the time when bicycle sales were plummeting so Steppenwolf looked for a way to rise above the crowd, offer something different and create a brand. Buyers choose individual bicycle components according to their wants, needs and interests from the representative of the manufacturer. The basic principle of assembled-to-order has to be complemented with flexible organisation that will in terms of quality integrate external factors - suppliers and retail traders as well.

Pandora.com enables users to browse radio stations to find the music they like. Users give information about their favourite songs, and Pandora creates customized radio channels playing music in accordance to user's profile characteristics. In December 2008 Pandora.com had 21.5 million listeners who created over 361 million radio stations.

CHANGE FROM ONE OF THE KIND

The biggest challenge to the companies offering large, complex products that demand unique approach to each separate product is how to shorten delivery dates, and at the same time rise productivity and product quality. Hvam [2] describes implementation of MC principle in a company that produces complete processing plants for cement manufacturing. As this is a really complex product that is usually planned as one of a kind, this approach, accompanied by the use of modular product structure and configurational system shows that use of MC is both possible and useful even for such extremely complex structures.

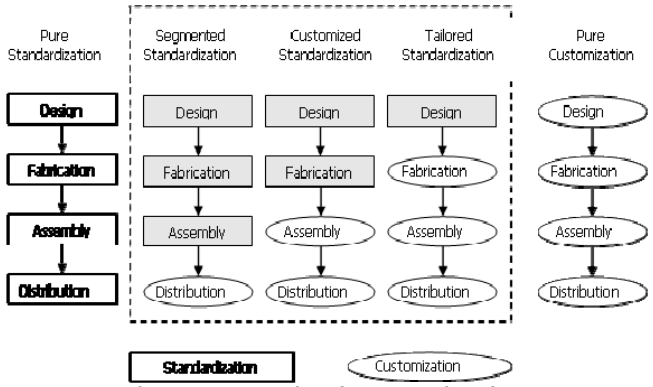

Figure 2. Levels of Customization

Marellimotori (electric motor manufacturer) manufactures all kinds of electric motors and delivers them to their customers in accordance to their demands. Motors are used for different purposes so the need for their adaptation is great. By using mass customization Marellimotori have managed to achieve greater diversity of produced motors at competitive prices. Standard motors or their adaptations can be chosen as well.

MC IMPLEMENTATION

The idea of MC – to offer customers the product they want– is commercially fully justified. However, the very MC implementation is a problem and many companies have been disappointed (Levi Strauss' custom jeans) Even today many executives consider that MC, although enchanting, is an impractical idea that can be used in a limited number of cases (DELL).

A research [3] done in over 200 different companies from over 8 different countries has shown that if MC is correctly understood and implemented it represents a strategic mechanism that can be applied in most types of businesses. MC will not take the company and its trade into an idealized state where it will know what a customer wants and what goods to produce in order to

satisfy the individualized customer requirements and all that at the mass production price. MC is about moving targets by developing a set of organizational capabilities which in time will supplement and enrich present business.

A company has to fulfil three fundamental MC requirements:

1. *A possibility to identify product attributes within customer requirements.*
2. *A possibility to re-usage and*
3. *A possibility to offer customer support in order to identify and construct solutions according to their demands.*

There is not only one, best way leading to MC and improving competitiveness; every single company and its mangers need to adapt their approach and methods according to their specific business.

Past practice has confirmed that diversity of needs and requirements constitutes a problem that has to be minimalised. Requirements have to be unified in order to create a product that satisfies everyone (one size fits all) or no one (mass production).

MC does not represent a single, definite business strategy to be adhered to strictly but it is a set of organizational capabilities that can enrich any business.

Every approach to MC must take into consideration different product or industry specific factors.

The three basic common requirements that need to be defined in order to do business in accordance to principles of MC are:

1. *Solution space development*
   a. *identifying particular customer needs attributes (product attributes where customer wishes diverge the most)*
   b. *defining solution space that determines what is offered and what not*

Creating offer possibility framework is a complex and expensive procedure that can be helped by several approaches, such as creating an interface that is easy to use, analyzing customer feedback

2. *Robust process design implies*
   a. *customized products delivery accompanied by efficacy and reliability of mass production*
   b. *flexible automation, although a contradiction in itself is nowadays common in auto industry, as well as in pharmaceutical, food and other industries*
   c. *process modularity –fast adaptation to changes in customer demands*
   d. *investment in knowledge – staff required to have wide spectrum of knowledge, not only specialized*
3. *Choice navigation*
   a. *offer help*
   b. *when dealing with extremely large, complex products it is really necessary to create a fast tool that will enable multiple iteration, learning from errors and giving fast quality answers*
   c. *it is possible to save by avoiding later errors*
   d. *Croatian shipyards are valued because of tailor made approach to shipbuilding and this is a characteristic that can be incorporated in an overall MC process.*

MC implementation in itself does not represent a change over from one to other destination but it is a non stop way in which the motion is in the continuum whose ends are determined by MP and MC, and the company position in this spectrum is determined by three criteria. A company can implement MC through improving all three criteria or only some of them; it all depends on technology and competitiveness of a given market.

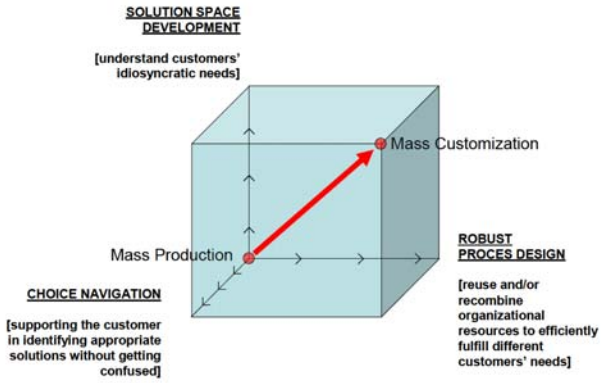

Figure 3. The Mass Production - Mass Customization Continuum [3]

Products, processes, organisation all represent one aspect of this complex system. In order to understand better how this system operates it is good to model it in several different ways [4]: by breaking it into subsystems in which it is easier to encompass all relevant date and information pertinent to every distinct subsystem; by recording relationships between subsystems that together give an integrated system behaviour and by analysing system entries and exits and determining their influence on the system (it is important to set system limits as they define 'the inside' of the system).

System segmentation [5] of production system can be done by using axiomatic design procedure where it has to be said that companies usually start a project with the already existing production structure and they view it as a certain restriction. Axiomatic design [6] suggests mapping among four basic domains and encourages designers to define the capabilities and limitations of the system first.

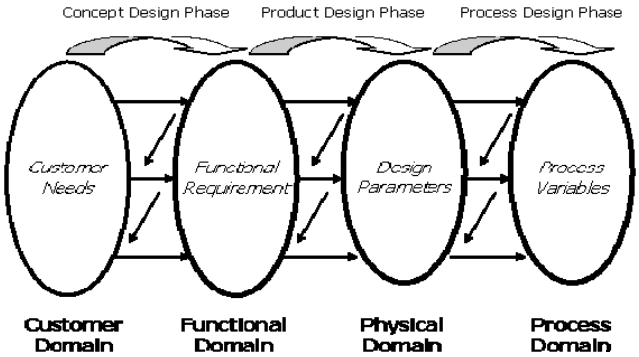

Figure 4. Axiomatic Design Domains

Companies use product platform in order to increase number or variants and shorten product delivery time, lower expenses and satisfy customer needs. The key to successful product family lies in creation of a platform. There are a major number of papers that deal with possibilities, tools and methods of implementation families and product platform of various forms. Scientists, as well as industrial experts have to try to span the gap occurring between planning and creation on one side and use of product platform on the other side. The impact of developing products based on families and platforms on the initial definition, project and manufacturing processes has also been studied.

Certain authors advocate modular product implementation and analyze product development process, modular project, Design for modularity (DFM), design for manufacture and assembly, flexibility and cellular manufacturing system [7].

Creating a basic unit into which different components (modules) can be fitted thus enabling different variants of the same product to be produced is considered to be one of the most important aspects of modular production.

Basis has to be capable of supporting, with its structure and use, all expected product variants, and individual components must bear characteristics which put together create complex products [8].

In this way modularity can shorten project development time, enable customization – adaptability and product expansion, increase quality, create certain standards and shorten time to delivery.

MC OF LARGE, COMPLEX PRODUCT

Complex management [9] represents a development of a framework that will allow designer to customize product to customer requirements easily. The main complexity source in the whole product plan is represented by a large number or information and interdependencies that affect or not only product variants, but all product aspects. The authors study complexity for the very beginning of the project when it is still possible to analyze later consequences.

System complexity is determined by many factors:

- *time change*
- *number of interrelationships and interconnections, both positive and negative*
- *non-linear behaviour and interactions*
- *small entry changes can be the cause of huge consequences (butterfly effect)*
- *systems are adaptable – they can learn*
- *systems can evolve to even greater complexity in order to achieve even better performances*
- *stochasticity.*

PRODUCTION SYSTEM COMPLEXITY

Production system complexity of a given product derives from many sources:

1. *Product complexity derives from:*
   a. *Product size (large number of components, large number of work hours, large supply order demands).*
   b. *Product plan (calculation of large number of components produced out of different materials, different designer from different department are interdependent, different regulations and standards have to be met)*
   c. *Product diversity that is simultaneously produced by the company (number of products, variants, storing)*
2. *Production process complexity derives from:*
   a. *Required spatiality (large space needed to process materials, make product and store it; coordination of large number of employees, and large quantities of equipment)*
   b. *Process (complex early operations flow, complex changes, constant quality checks, need to outsource).*
   c. *Supply (large number of suppliers and orders, quality control of delivered products, delivery times).*

Other sources that increase the complexity of the whole system and as such have to be taken into consideration are complex informatics system and greater ecological demands throughout the whole production process.

CHARACTERISTICS OF SHIPBUILDING PROCESS

For the purposes of complex product production the final product is seen as a single, unique product. Globally seen all complex products of some company have common characteristics (in a shipyard – every ship is a unique product) Certain researches (interviews with Greek ship owners who intend to modernize their fleets with newly built ships [10]) have shown that the most valued shipyards are in Japan (Hitachi, Mitsubishi, Misui) and South Korea (Hyundai Heavy Industries, Daewoo, Samsung) and Korean shipyards are considered to provide best value for money. However, the same researches have shown that the ship owners want ships built in accordance to their specific wishes which indicates a need for flexible shipyards when it comes to cooperation between the ship owner and the shipyard regarding the changes in the project.

Modern ship designers face many demands that regard more complex ship structures, increasing safety demands and higher ecological standards. Ecology standards have mainly been regulated by IMO standards and regulations (International Maritime Organization) – a set of conventions to which everyone involved in maritime traffic (from ship designers and ship owner to recycling plants) have to comply.

Soon, a new convention on ship recycling will take effect („Hong Kong International Convention for the safe and Environmental Sound Recycling of Ships"). In order to implement this convention well a green passport has been developed. It is a document that will follow a ship during its whole life span – from the plan to aging and will contain all information about material use to construct it, as well as materials – waste generated during its use. Green passport will be used for both new constructions and already existing ships and will be subject to approval and inspection.

Complex ship structure contains a large number of variables and limitations. In the early project phases a large number of precise dates is lacking so the whole process is iterative with a spiral flow of approaching the final result. Bulk, load bearing capacity, stability, strength, length of welding on a specific ship can not be determined precisely and as one characteristic changes the others change to in conformity.

It is necessary to preserve light weight in order to increase load bearing capacity, but without impairing the needed strength; retain the required ship speed and minimal fuel consumption; ensure ship stability in all sea conditions and against damages…

Shipbuilding process with all its features is considered to be a highly complex production business system. A complex product requires a complex production process which in turn requires unique and special shipbuilding organisation structure. Uniqueness and specificity of organisational structure is seen in its 'width', i.e. a large number of business and production functions, as well as in its 'depth' i.e. a large number of organisational and management levels. Moreover, shipyards have developed relationships with numerous partners that participate in vessel building, as well as in preparatory and production part of shipbuilding process. Shipyards, at the same time, perform their activities on more than one object at different production or preparatory phases, so a complex matrix planning organisation structure dominates.

Table 1.: Comparison of characteristics of shipbuilding process with characteristic of mass production

Shipbuilding	Mass production
- low volume	- high volume
- complex, non repetitive on product level	- standardized and repetitive products
- production in loose network	- integrated production system
- handcraft	- automated process
- long throughput time	- short throughput time
- customization	- no customization
- product is partly designed and engineered to order	- no design and engineerig changes are allowed

Table 2. Comparison of characteristics of shipbuilding process with characteristics of mass customization

Mass customization	Shipbuilding
- medium to low volume	- low volume
- repetitive on process level but not on product level	- 80% repetitive on process/product level, 20% is engineerd and produced to order
- automated when beneficial	- production in loose networks
- integrated production system	- manual processes
- customization within certain constrains	- custom within certain constrains
- short throughput	- long throughput
- product is design for customization	- modular design where some modules are standardized and other are customized
- customization to order	- customization to order

The whole shipbuilding process at its first level is divided into shipbuilding preparatory processes and shipbuilding production processes. Main characteristics of these processes are [11]:

- *multi stage development i.e. intermittency with a large number of inter products*
- *considerable interactivity and technological process inter dependence*
- *most part of these processes are non repetitive process with different activity length*
- *the process is implosive, as there is a large number of components – raw materials at the start, and a small number of different final products in the end*
- *processes happen in numerous parallel or consecutive flow, with small or large time overlapping*
- *processes are technologically different and different equipment is used*
- *processes are mainly work intensive*
- *in production processes there is a 'movement of product through the process' as well as 'movement of process through the product',*
- *different inputs and resources, both proper and external, are needed for the process to take place*
- *buyer is present from the very beginning of the process (a known buyer).*

The following tables show comparison of shipbuilding characteristics to characteristics of mass productions and mass customization [12].

AN EXAMPLE OF MC IMPLEMENTATION IN PRODUCTION OF LARGE, COMPLEX PRODUCTS

Today F.L. Smidth covers over 30% of world market for cement producers' equipment. The company has to implement a configuration system that enables a fast drafting of initial customer offer. Prior to implementing configurators the company needed from 3 to 5 weeks and 10 to 15 experts from various sectors to form an offer. All this knowledge is now stored in a configurator and by using it any offer can be compiled in about 2 days. The system enables fast simulation of various solutions, and all in concordance with customer requirements. Moreover, facility optimisation is done by using standard company modules or standard equipment purchased from the supplier. This approach leads to further lowering of price, as time needed for calculations, project documentation and individual production of separate parts is saved. The amount of information transferred from one department to another is also diminished thus diminishing the error possibility, as well.

The most important customer requirements for cement factories can be summarized as: price and financing conditions, delivery time, operational costs (running costs as workforce, energy, transport, maintenance are critical for the cement factory's overall rentability) and energy consumption and environmental load (emissions). In recent years, there has been an increasing focus on minimazing energy consumption and emission from cement factories.

Product configuration at F.L. Smidth is done is seven phases: analysis of specification processes, product

analysis, object-oriented analysis, object-oriented design and choice of software, programming, implementation and maintenance and further development.

Cost incurred by creating configuration system derives from configuration team, model development, information finding and operation and maintenance. The advantages are, however, manifold and superior in relation to costs. They are a new way of working, new opportunities, greater use of modularisation, high efficiency in producing offers, ease of access to knowledge and information and transparent solutions [13].

CONCLUSION

More and more companies meet with the increasing customer demands that require delivery of custom made products that are customized according to unique needs of each individual customer, and at the same time delivery times, pricing and quality have not changed significantly from mass produced products.

This development of manufacturers can be achieved by implementing a concept known as 'mass customization' or production of customized products where advantages of mass production are still retained.

In the last few decades it has been difficult to forecast the market needs, the offer is greater than ever, and production possibilities more incontestable, so many companies search for the way out by reducing prices, enriching the product choice and offering unique, quality products.

Large, complex products constitute a specific problem as there is no possibility to standardize the product or its production process.

This paper gives an overview of past implementation of mass customization in different industries and through three different implementation possibilities

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AUTHORS & AFFILIATION

Ivica VEZA[1],
Natasa JURJEVIC[2]

[1-2] UNIVERSITY OF SPLIT, FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE, SPLIT, CROATIA

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

[1]Abdoullah NAMDAR, [2]Azam Khodashenas PELKO

KAOLINITE CHEMICAL ELEMENT AND MORPHOLOGY PROPERTIES IN GEOMORPHOLOGY

ABSTRACT:
The geotechnical problems could be investigated with different methods, in this research work authors made an investigation on kaolinite modified under the thermal for 6 hours from 100°C to 500°C in increment of 100°C for studying morphology, chemical composites and mechanical properties behavior of soil using SEM, XRF and triaxial tests. The result revealed that the thermal not changing kaolinite unit weight and cohesion up to application of 500°C it could be expected of well resisting of this material under fire and also the thermal modified kaolinite angle of friction and it is resulted in the improvement of safe bearing capacity. And this is observed that the improvement of kaolinite mechanical characteristics under heat is not due to changing chemical composite and morphology this is may be due to modification of structural atomic of kaolinite minerals. It could be suggested that thermal could modified construction material and using that without shaping in the factory, and could be used as an unformed material and use as per requirements in the site for solving geotechnical problem like settlement, deformation, stability and failure of subsoil and structures.

KEYWORDS:
Stability; Bearing capacity; SEM; Cohesion; Angle of Friction

INTRODUCTION

The kaolinite is one of the important material, this could be modified trough the investigation to finding appropriate construction material for reduction of geotechnical problem based on economically.
There is investigation on Thermal conductivity values, in the temperature range 300 - 1200 K, have been measured in air and at atmospheric pressure for a Kenyan kaolinite refractory with 0% - 50% grog proportions. The experimental thermal conductivity values were then compared with those calculated using theoretical models. On the contrary, the conductivity values for the sample containing ≥ 40% decreased with increase in temperature in a manner consistent with the Eucken law [1]. There is research on physico-mechanical properties of fired clay bricks manufactured with different percentages of CBs are reported. The results show that the density of fired bricks was reduced by up to 30 %, depending on the percentage of CBs incorporated into the raw materials. Similarly, the compressive strength of bricks tested decreased according to the percentage of CBs included in the mix. The thermal conductivity performance of bricks was improved by 51 and 58 % for 5 and 10 % CBs content respectively [2]. It has been reported on the deep clays exhibit pronounced strain anisotropy both during mechanical loading as well as during heating and cooling at constant stress in drained isotropic conditions. During mechanical loading vertical strain is larger than the horizontal one. During heating the vertical strain is larger than the horizontal one within the elastic range; the opposite is observed in the elasto-plastic range. The above described response can be interpreted adopting a consistent rotational, kinematic hardening thermo-elasto-plastic constitutive law [3]. In a scientific work it has been presented a new thermo-plastic mechanism for isotropic thermo-mechanical paths including thermal hardening. It is based on considerations of the thermal effect on void ratio. After a discussion of the experimental evidence, the formulation of the thermo-plastic yield mechanism is introduced. Typical features are analyzed and the responses of the model discussed. The proposed model is validated on the basis of experimental results on two different clays [4]. There is an investigation on thermal effects on the mechanical behavior of saturated clay. The study was performed on CM clay (kaolinite) using a temperature-controlled triaxial apparatus. Applied temperatures were between 22 and 90°C, The obtained results provide observations concerning a wide scope of the thermo-mechanical behavior of clays [5]. Research interest in the thermo-mechanical behavior of soils is growing as a result of an increasing number of geo-mechanical problems involving thermal effects. These

problems with non-isothermal situations are mainly encountered in the field of environmental geomechanics [6]. It has been reported the differences between kaolinite and smectite structures are notable, mainly as a result of the degree of weathering in the different compounds. Nevertheless, the kaolinite structure possesses great advantages in many processes due to its high chemical stability and low expansion coefficient. As a consequence of adsorption, the kaolinite structure and the soil solution pH will change. To analyze the adsorption behavior of kaolinite, Pb, Zn and Cd were studied at three different concentrations (1, 2 and 3 mmol/l) and over different periods of exposure (0.1, 1, 2, 4, 8, 12 and 24 h). The kaolinite retained up to 10.0 Amol/g of Pb, 8.40 Amol/g of Zn and 6.00 Amol/g of Cd when it was mixed with the 3 mmol/l concentrations of heavy metals. In each case, the adsorption eventually reduced the solution pH from 4.6 to 3.7. The changes in pH over time indicated both the release and retention of hydrogen ions by the mineral, probably involving the hydroxyl edge sites and exposed hydroxyl planes. The size of the atomic radii are 1.81, 1.71 and 1.53 A° for Pb, Cd and Zn, respectively, compared to the 0.79 A° for H. This difference, along with the differences in hydrated radii, will affect the structure of the clay causing stress in the molecule. Changes in the mechanical and chemical properties of the clay are discussed as the interactions of the heavy metal cations with the kaolinite could affect the structure of the kaolinite and influence properties such as swelling capacity, compaction capability and the double-layer behavior. The kaolinite in this study contained some illite which may have increased the pH 7 cation exchange capacities to 17.8 mEq/100 g. using the adsorption data, the reactions at the clay water inter phase and the probable effects on the physical properties and structure of kaolinite are discussed. [7]. It has presented that the thermal behavior of a formamide-intercalated mechano-chemically activated (dryground) kaolinite was investigated by thermo-gravimetry-mass spectrometry (TG-MS) and diffuse reflectance Fourier transform infrared spectroscopy (DRIFT). After the removal of adsorbed and intercalated formamide, a third type of bonded reagent was identified in the 230 - 350°C temperature range decomposing in situ to CO and NH_3. The presence of formamide decomposition products as well as CO_2 and various carbonates identified by DRIFT spectroscopy indicates the formation of super-active centers as a result of mechano-chemical activation and heat treatment (thermal deintercalation). The structural variance of surface species decreases with the increase of grinding time. The ungrounded mineral contains a low amount of weakly acidic and basic centers. After 3 hours of grinding, the number of acidic centers increases significantly, while on further grinding the super-active centers show increased basicity. With the increase of grinding time and treatment temperature the amount of bicarbonate- and bidentate-type structures decreases in favor of the carboxylate- and monodentate [8]. It has find in a scientific research work that Contact freezing of single supercooled water droplets colliding with kaolinite dust particles has been investigated. The experiments were performed with droplets levitated in an electrodynamic balance at temperatures from 240 to 268 K. Under relatively dry conditions (when no water vapor was added) freezing was observed to occur below 249 K, while a freezing threshold of 267K was observed when water vapor was added to the air in the chamber. The effect of relative humidity is attributed to an influence on the contact freezing process for the kaolinite-water droplet system, and it is not related to the lifetime of the droplets in the electrodynamic balance. Freezing probabilities per collision were derived assuming that collisions at the lowest temperature employed had a probability of unity. Mechanisms for contact freezing are briefly discussed [9]. It is well established from the literature, experimental study and theory, about the effect of the heat on kaolinite characteristics and a number of theoretical and computational studies have been performed by various researchers to determine the clay behavior when submitted to the thermal it was understood that the clay behavior is changed due to application of thermal based on huge number of experimental and theoretical investigation executed but kaolinite mechanical behavior under the thermal for 6 hours from 100 ºC to 500 ºC in increment of 100ºC based on chemical element analysis, morphology in connection with triaxial experiments never has been documented. The purpose of the entire research exercise would be to (i) identification of bentonite chemical element, morphology and mechanical properties under thermal (ii) formulate some useful guidelines in using bentonite in the construction industry.

METHODOLOGY AND EXPERIMENTS

Soil testing is an integral part of analysis and design in Soil Engineering. A proper evaluation of soil samples and determination of relevant soil properties simulating field-loading conditions are essential components of the practice of foundation engineering [10]. Researches in unsaturated soil mechanics considerably developed in the past decades, through the simultaneous development of experimental investigations and theoretical analyses [11]. To improvement of construction material a series experimental on soil submitted to thermal for 6 hours from 100ºC to 500 ºC in increment of 100 ºC executed. The main objective of the experiments was to analyze and development of ideal construction material in the laboratory condition. The evaluation of both for the macro and micro of kaolinite characteristics have been taken systematically trough of laboratory testing. In the laboratory triaxial and SEM tests were conducted. The affect of thermal on the kaolinite mechanical properties and morphology have been analyzed.

The triaxial test is a method for determination of shear strength of all types of soils under different drainage condition, in this method cylindrical

specimen submitted to the stress from all direction, this is subjected to confined pressure from the sides and also from the top gradually axial force applied up to shear failure of specimen. The axial force is the major stress and confides pressure is the minor stress and there is no shear stress form the side. The total axial stress at the time of shearing is sum of major and minor stresses. Due to increasing axial stress the shear stress developed based on compressive stress.

The electron microscope is a scientific instrument for shape and size identification of the very fine scale objet that is a good representation and resolution of the three-dimensional particle it has more capability compare to light microscopes, the scanning electron microscopy (SEM) studies helps to understand the micro to macro surface features of the soil samples. The morphology of six soils sample was studied using SEM. The SEM studies of the six soil samples of the investigations were carried out using instrument; JSM-840A, JEOL-Japan. The SEM has been done to assessment of correlation between shape and size of soil particle with its mechanical properties.

The Terzaghi method has been used to calculation of soil foundation safe bearing capacity assumed depth of 1.5 m and widths of (2.5m) × (2.5 m). For all models, safe bearing capacity considered to assess soil foundation improvement thorough the interpreting of the suggested results. Formulas for calculation of safe bearing capacity are the following:

$$q_f = 1.3C\,N_c + \gamma D N_q + 0.4\,\gamma B N_\gamma \quad (1)$$

$$q_{nf} = q_f - \gamma D \quad (2)$$

$$q_s = (q_{nf}/F) + \gamma D \quad (3)$$

Also N_q, N_c and N_γ are the general bearing capacity factors and depend upon depth of footing, shape of footing and Φ, have been used from suggestion by the Terzaghi calculation method [12].

RESULTS AND DISCUSSION

When the thermal is applied on the kaolinite the weight of soil not changing that is reason unit weight almost is very close together. The table 1 indicated that increasing thermal not effected on improvement soil cohesion and could expect in same on permeability. The soil internal angle of friction is also increased. There is no linear correlation between increasing thermal and angle of friction but this is positive correlation, observation of this phenomenon helps for prediction kaolinite behavior in this temperature range without conducting soil mechanic experimental for modification of its characteristics based on thermal application. In the room temperature kaolinite has 1360.63 KN/m² safe bearing capacity, when submitted to the thermal for 500°C improved up to 4356.27KN/m².

Due to maintaining constant level of kaolinite cohesion at different level of temperature could be understood that the chemical composite is not changed and only structural atomic changed and it is reason of kaolinite mechanical behavior when this is submitted to the thermal.

Table 1 the Kaolinit mechanical properties

Model No	Temperature °C	γ (KN/m³)	C (KN/m²)	Φ [·]	SBC (KN/m²)
1	RT	13.4	80	0	1360.63
2	100	13.1	80	7	1967.68
3	200	13.5	80	10	2312.03
4	300	13.3	80	15	3130.27
5	400	13.3	80	13	2801.60
6	500	13.1	80	20	4356.27

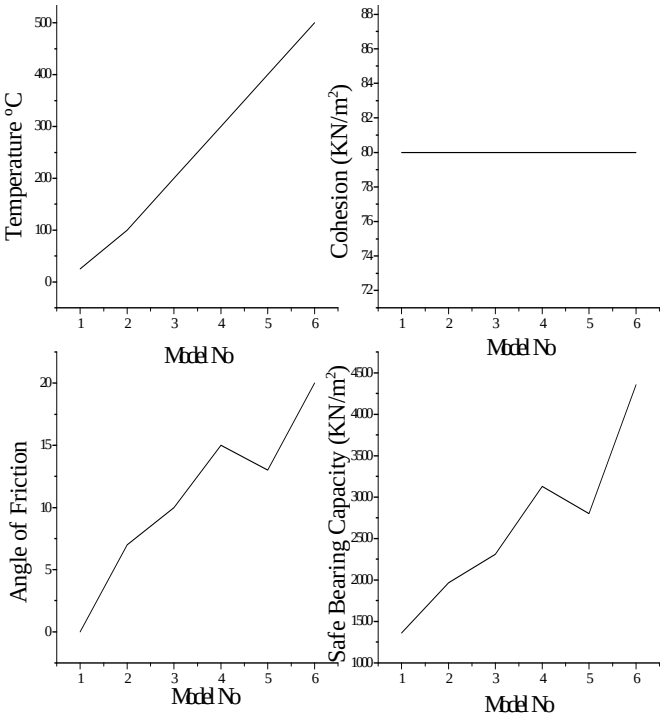

Figure 1. The Kaolinite mechanical properties

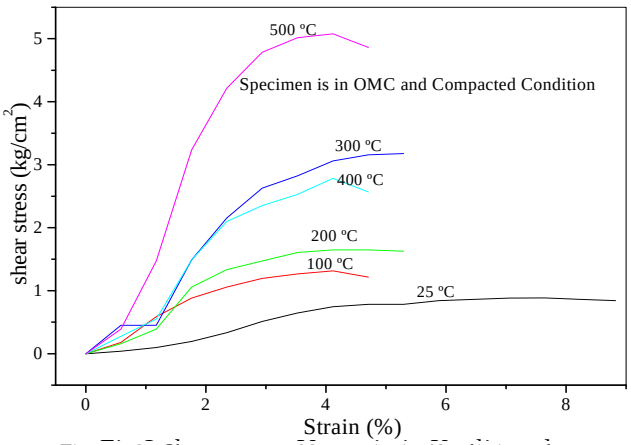

Figure 2. Shear stress Vs strain in Kaolinite clay

The fig 2 indicated that stress-strain relationship of Kaolinite at different level of temperature from triaxial test. When the thermal is increased the stress-strain relationship increased but not linear and always increasing of thermal not resulted of improvement of soil bearing capacity in this regard could bring example when soil is submitted to the 400°C. The SEM photographs have clearly revealed the surface morphology, shape and size of the minerals, which mechanically extracted from soils. In the Fig 3-8 indicated that the modification of soil morphology under all conditions are closely similar and there is not any significant change observed and also this kind of

result is observed about soil chemical composite from the XRF experiment (table 2) it could be expected that the soil structural atomic is main reason in modification of soil mechanical properties.

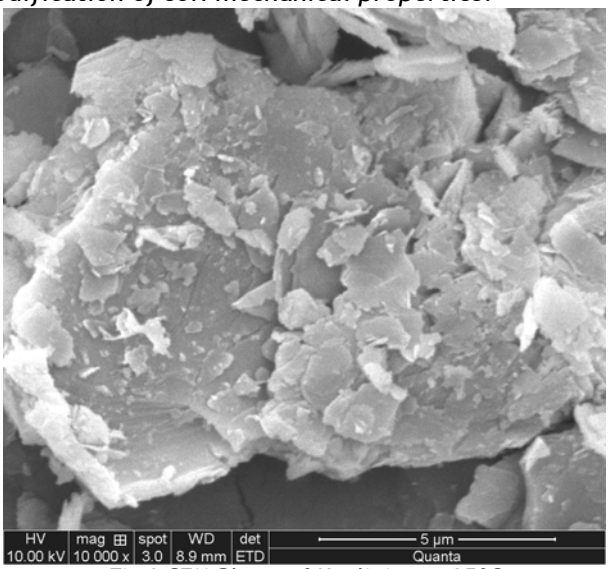

Fig 3 SEM Photo of Kaolinite at 25°C

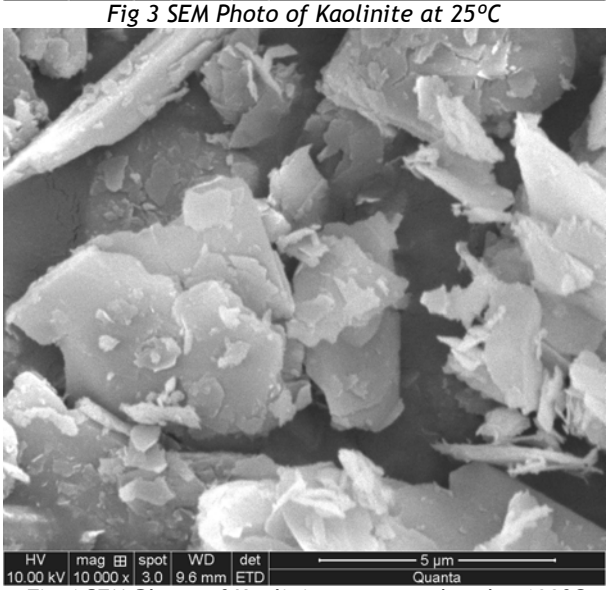

Fig 4 SEM Photo of Kaolinite processed under 100°C for six hours

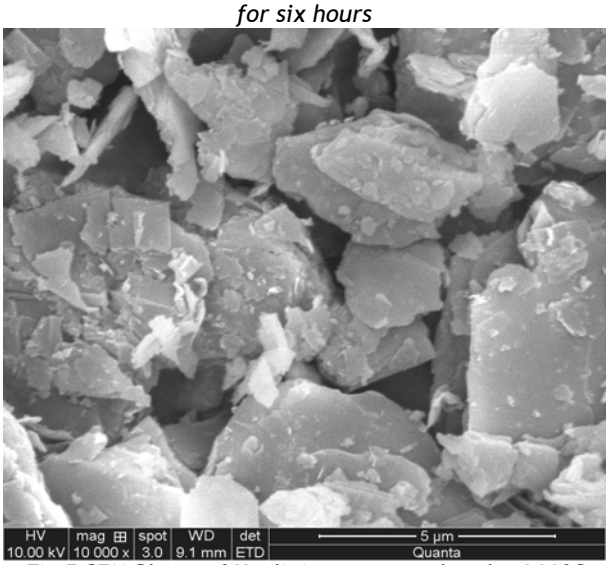

Fig 5 SEM Photo of Kaolinite processed under 200°C for six hours

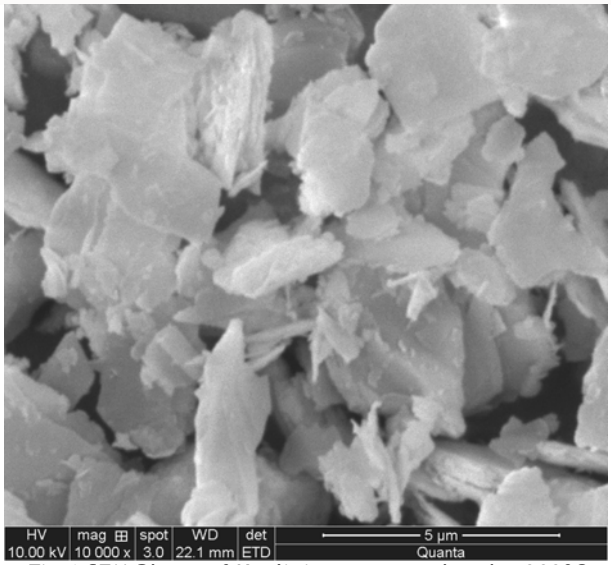

Fig 6 SEM Photo of Kaolinite processed under 300°C for six hours

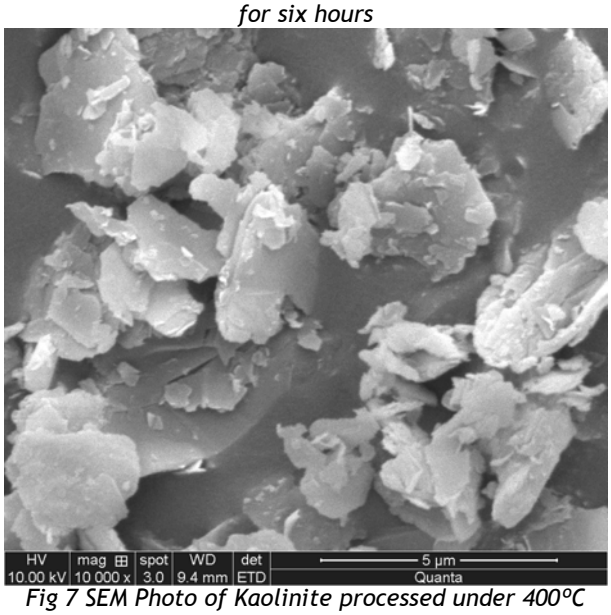

Fig 7 SEM Photo of Kaolinite processed under 400°C for six hours

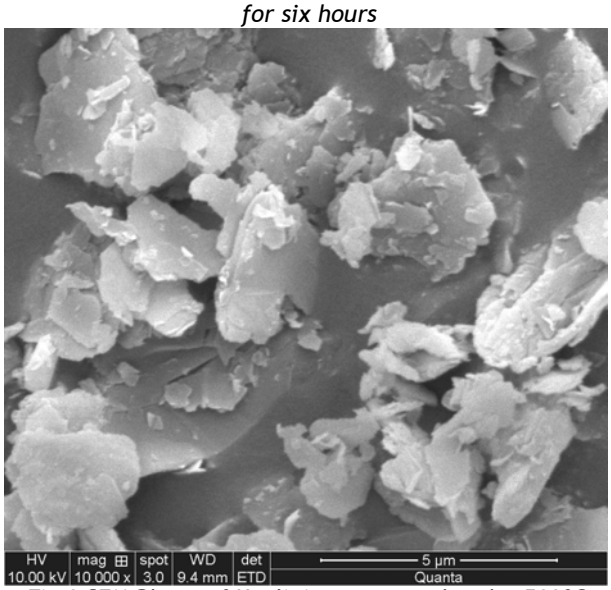

Fig 8 SEM Photo of Kaolinite processed under 500°C for six hours

The creation of thermal in some part of structure after construction due to positive affect on the subsoil and

improvement of some part also could causes of differential settlement and could be leads to structure instability.

Table 2 Chemical element in the Kaolinite at different level of temperature

Heat °C		O	Al	Si	K	Fe
25	Wt %	48.94	13.58	30.20	6.07	1.21
	At %	63.54	10.45	22.33	3.23	0.45
100	Wt %	47.58	13.39	30.40	6.92	1.71
	At %	62.48	10.43	22.74	3.72	0.64
200	Wt %	49.49	13.94	29.19	5.92	1.47
	At %	64.09	10.70	21.53	3.14	0.54
300	Wt %	38.38	14.24	37.48	6.85	3.06
	At %	53.42	11.75	29.71	3.90	1.22
400	Wt %	42.06	13.19	36.21	5.95	2.58
	At %	57.08	10.62	28.00	3.31	1.00
500	Wt %	45.29	13.66	32.71	6.34	2
	At %	60.12	10.79	24.86	3.46	0.77

CONCLUSION

- The thermal not changing kaolinte unit weight and cohesion up to application of 500 °C it could be expected of well resisting of this material under fire
- The thermal modified kaolinte angle of friction and it is resulted in the improvement of safe bearing capacity
- Improvement of kaolinte mechanical characteristics under heat is not due to changing chemical composite and morphology this is may be due to modification of structural atomic of kaolinte minerals
- From this investigation understood that the weak soil foundation could be modified using heat technique in suit for improving of soil foundation

NOMENCLATURE

Φ (Degree)	=Angle of Friction
C (KN/m^2)	=Cohesive of Soil
OMC (%)	=Optimum Moisture Content
SBC (KN/m^2)	=Safe Bearing Capacity
γ (KN/m^3)	=Unit Weight
q_f (KN/m^2)	=Ultimate Bearing Capacity
q_{nf} (KN/m^2)	=Net Ultimate Bearing Capacity
q_s (KN/m^2)	= Safe Bearing capacity
N_c	= General Bearing Capacity Factor
N_q	= General Bearing Capacity Factor
N_γ	= General Bearing Capacity Factor
B (Meter)	= Width of the Foundation
D (Meter)	= Depth of Foundation
F	=Factor of Safety = (3)
SEM	=Scanning Electron Microscopy

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AUTHORS & AFFILIATION

[1]Abdoullah NAMDAR,
[2]Azam Khodashenas PELKO

[1.] FACULTY OF CIVIL ENGINEERING, ISLAMIC AZAD UNIVERSITY OF JOLFA INTERNATIONAL BRANCH, IRAN
[2]MYSORE UNIVERSITY, INDIA

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
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5, Revolutiei,
331128, Hunedoara,
ROMANIA
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

N. A CHOWDHURY[1], Md. Anayet Ullah PATWARI[2]

DEVELOPMENT OF MICROPROCESSOR BASED CONTROLLING UNIT FOR FLEXIBLE CONTROL OF A ROBOT STRUCTURE

ABSTRACT:
Robots, specially self-controlled robots are part and parcels of flexible manufacturing system. Most robots are designed for special purpose automated task in manufacturing processes. Robot building blocks, such as controls, motors, drives etc. are standardized to a high degree that keeps the costs down on a competitive level for special made machines. The objective of this project was to design, construct, and to test hardware and software to create a micro-controller based robot platform for flexible movement of a robot. This paper demonstrates the implementation of Pulse Width Modulation technique and usage of Infrared signal in robots using microcontroller. Initially an obstacle detecting device was made using infrared signal. Depending upon the responses of the obstacle detector the robot is able to change its direction in such a way that the obstacle is avoided. After that Remote Control feature was added for easy controlling of the robot base. This designed base will be coupled with robot body for automated guided functions within a manufacturing system.

KEYWORDS:
Self-controlled Robot, Microprocessor, obstacle detection

INTRODUCTION

A robot has a mechanical body and an electronic nerve system to drive it. Robot allows easy reprogramming capability to adapt to varying task requirements and can support flexibility by solving diverse tasks in cooperation with human operators. For the robot to do some useful work it is required to make a program with some kind of intelligence. This can vary from hardware logical circuits implementing some early robots to low-level reflex code on micro-controllers used in many small robotics projects. Many research works [1-5] are going on for the development of robot. In launching the robotic system, system engineering and design consideration have been made and several alternatives [6-8] to robot such as manual operation, semi-mechanization and special purpose hard automation have been addressed. Self-controlled robots are equipped to navigate a flexible guide path network that can be easily modified and expanded. A self-controlled robot system can vary in size from a short, simple layout to a complex layout with computer integration automatically interfacing with other automated manufacturing equipment. SRS systems consist of several components: the base i.e. the legs or wheels, navigation system, a controller which is usually a computer, the connection between the computer and the sensors and motor. Though the application of self-controlled robot ranges from small robotic arms in automated industries to the robots used in searching perimeters in security systems or the robots used in climate research of north or south poles, they are mainly used in those industries where the system is fully automated.

In complicated robotics systems, the control system can go up to advanced neural network [9-10] control systems running on powerful microcomputers networked together. These are all contributing to a steady increase in the capabilities of robot. Robots currently under development may widely be used in the factory, mining, defense, and nuclear and offshore industries. The developed countries are successfully using robots and automated machineries in their important industries. Nowadays countries like Japan, USA, and China are making successful use of robots in their car industries, pharmaceutical industries. They are also building intelligent and recreational robots like 'ASIMO' and 'AIBO; and considering these cases it won't be so long when robots will do household works, like cooking, cleaning, even bringing the newspaper. Recent developments in robotic applications have shown a trend towards precise and high speed motion to accomplish a specific task. However, the efficiency of the available industrial robots is severely reduced by the complexity of their operation.

In mathematical terms, the planning and control of robot motion is a very heavy computational burden to be executed in real-time. Problems in the control of robots arise from the vast computational complexities associated with the mathematical formulations, in addition to the need for appropriate adaptive control methods to achieve the required precision and speed. The aim of this research work is to develop a new microprocessor based robot for performing multi-operation in manufacturing systems. To avoid collision an obstacle identifying modules has been incorporated in the designed system. The present work has two different parts, in which part one was mainly for the construction of the robot body [11] and part two was focused on developing the base of the robot for flexible control. This paper is mainly focused on the development of the control system of the base of the robot by microcontroller.

FEATURES OF SELF-CONTROLLED ROBOT

1. *The base of the robot is powered by two dc motors. The car can move forwards, backwards, turn left and right at required angles by rotating the motors at different rates.*
2. *The path of the base car is controlled by an on-board microprocessor through an installed path program.*
3. *The source and destination positions of the base car on the microprocessor can be specified. The microprocessor gives the car the necessary directions.*
4. *There are infrared signal generators on the robot. If there is any obstacles present on the way, the infrared signals will be reflected by the obstacles.*
5. *There are signal receivers for infrared signals. When infrared signals are received, the signal receiving circuit gives input to the microprocessor. The microprocessor then stops the dc motors and the robot stops.*
6. *When there is obstacle on the left, the robot turns right and when the obstacle is on the right, the robot turns left according to the signals received.*

Mechanical design:

A four wheeler is used in this study (as shown in Figure 1) because of its proper balance. A differential gear was designed and manufactured to control the driving wheels. Two dc motors are used along the axes of the front and rear wheels because of its easy use and low cost. The drive is given to the rear wheels. Direction of movement is fixed by rotating the front wheel and rotating movement is given by another dc motor.

Position of motors

- *The driving motor is placed in the axis of the rear wheel. It has a support from the body of the car. A counter balance on the opposite side would have been needed if it was a three wheeler.*
- *The direction changing motor will be at the axis of the front wheel.*

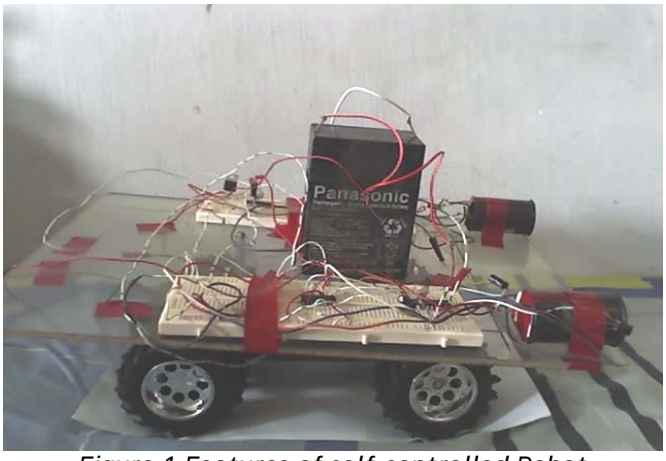

Figure 1 Features of self-controlled Robot

ELECTRICAL CONTROL OF SELF-CONTROLLED ROBOT BASE

The designed robot base is a wheel-mounted carriage which may be programmed to travel along a predetermined path between two locations upon which a robot hand can be mounted. The robot can also be used as an alternative to conveyors and cranes for transporting materials, components and tools between manufacturing centers. The flexibility of this robot lies in its ability to be easily programmed to travel along alternative routes. Most moving robots are guided "off-board" by inductive wires which are either concealed underground or adhered to the factory floor surface in the form of metallic strip. Kinetic power is usually provided by on board electrical batteries. Route programming is commonly achieved via on board local intelligence. Many robots also incorporate sensors which can detect location, cargo and collision and other handling. Flexible as they are, the majority of robot's are constrained to the routes of the inductive wires and thus cannot truly be described as free ranging. However, more sophisticated versions are now being developed, most of these are based on principle of software-programmable routes, which are thus very easily changed and are infinitely variable popular guidance system utilizes laser signals, ultrasonic and navigation via gyroscopic detection. The electrical system can be divided into several parts: Power supply system, Microprocessor interfacing circuit, IC controlled signal generator and IR LED based signal sending circuit, Signal receiving circuit

Power supply system:

Power supply system is a very vital part in the robot. The choice of suitable power supply system ensures the proper functioning of robot. Due to major constrains it is very difficult to select the proper power source. Power supply system for the dc motors and driving circuits: The power of robot is supplied from on board power supply system. The current design of our robot contains two dc motors of 5V each. So it is easily possible to supply the power from two separate 9V battery. This type of 9 volt DC battery is available in market and cheap in price consideration. Using rechargeable battery is a better option. In that case a charger will be needed. The charger will convert AC current to DC current through an adapter

and supply 8.5~9 V to the battery. But for the smooth functioning of the motor a lead-acid battery was used to power the two motor. The motors were selected such that the power supply circuit remains as simple as possible.

Power supply for the circuits:

The ultimate goal of this work is to make a real robot which will operate wirelessly and without any external control. Arrangement needs to be made to power the signal sending and receiver circuit. The usual power required to run the circuits are very low-5V would be sufficient. This power is also possible to be supplied from available DC battery in the market.

DC motor:

DC motors can be viewed as electric motors without commutators. Typically, all windings in the motor are part of the stator, and the rotor is either a permanent magnet or, in the case of variable reluctance motors, a toothed block of some magnetically soft material. All of the commutation must be handled externally by the motor controller, and typically, the motors and controllers are designed so that the motor may be held in any fixed position as well as being rotated one way or the other. Most steppers, as they are also known, can be stepped at audio frequencies, allowing them to spin quite quickly, and with an appropriate controller, they may be started and stopped "on a dime" at controlled orientations.

The Motor Controller:

For the movement of the robot two DC motors are used. One motor is connected with the front wheel, which controls the left-right movement of the robot, and one motor is connected with the rear wheel, which controls the forward-backward movement. Figure 2 show pin configuration of the motor controller.

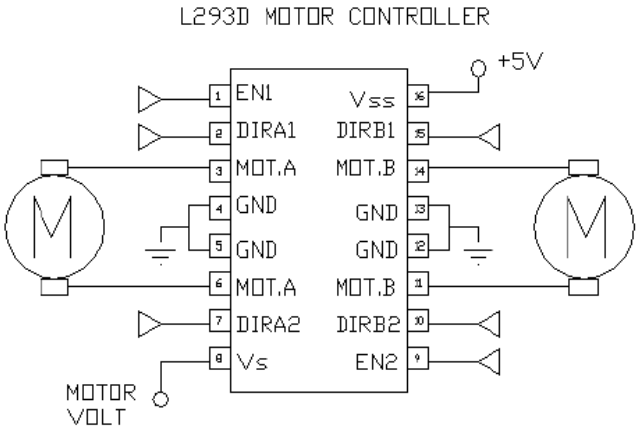

Figure 2. Pin configuration of L293D motor driver IC

SIGNAL GENERATING AND SENDING SYSTEM

Signal is generated by PIC16F84A. This signal is send through resistors and transistor. The signal is send by an infrared LED. This infrared signal, if reflected by obstacle, will be received in the receiver module. The IR LEDs are placed on the front right and left sides.

Signal receiving system:

Signal is received in the receiver module. Two receiver modules are used to receive the signal which is reflected by the obstacles. When the receiver module receives or gets the signal it gives input to the microprocessor. In the microprocessor the program is written in such a way that when it gets signal from the receiver module, it can detect the obstacle near the robot. Then it takes decision as quickly to give input to the motor and the robot instantly stops there and changes its direction. For the generation of the clock speed for the microprocessor, an oscillator is used.

Signal Functions:

For the obstacle detection system, infrared light instead of ultra-sonic sound, which is emitted from an IR-LED is used and if there is any obstacle within its range the light will reflect back and an IR-receiver module will pick up the signal. Then the receiver module will send the signal to a microcontroller which will compare received signal with the sending signal. And if the frequencies of the two signals match then the microcontroller will come to a decision that there is an obstacle nearby and give an output to the brain which will come to a decision to avoid the obstacle. Figure 3 shows the circuit diagram of the controller.

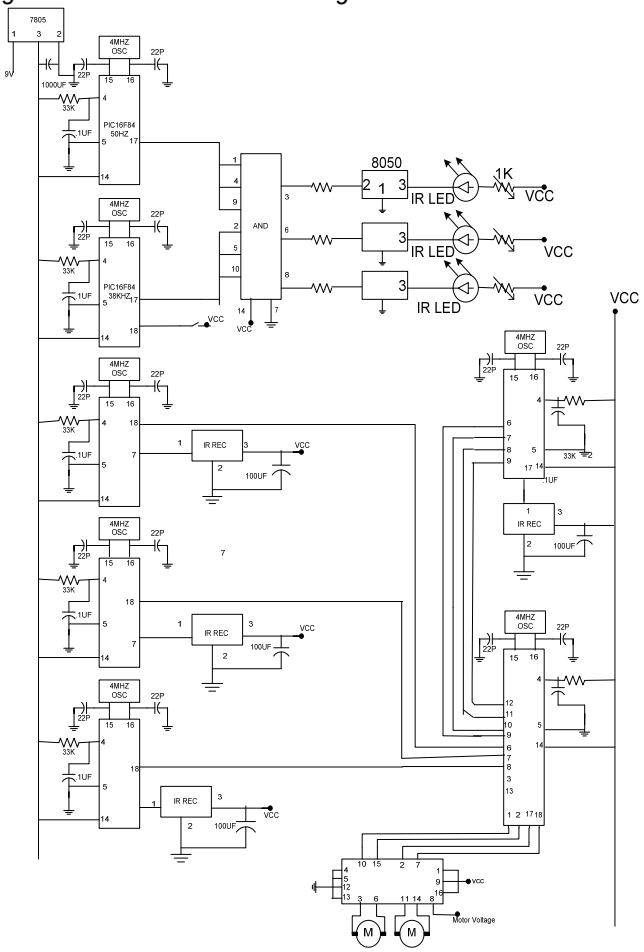

Figure 3: Circuit diagram of the designed controller

SOFTWARE IN ROBOT

Obstacle detection software was made based on the flow diagram shown in figure 4, which will enable the featured robot to detect the obstacle and control the movement of the robot. Any obstacle will be detected and the robot can change its direction to avoid collision.

Software description:
The functionality of the software can be described in a few lines:

- *Start moving forward*
- *If the LEFT sensor is triggered, the rear motor will stop shortly & front motor will start and the front wheel will turn RIGHT (the robot will stop shortly and then will turn right)*
- *If the RIGHT sensor is triggered, the rear motor will stop shortly & front motor will start and the front wheel will turn LEFT (the robot will stop shortly and then will turn left)*
- *If both sensor triggered then the robot will stop*
- *Go back to moving forward*

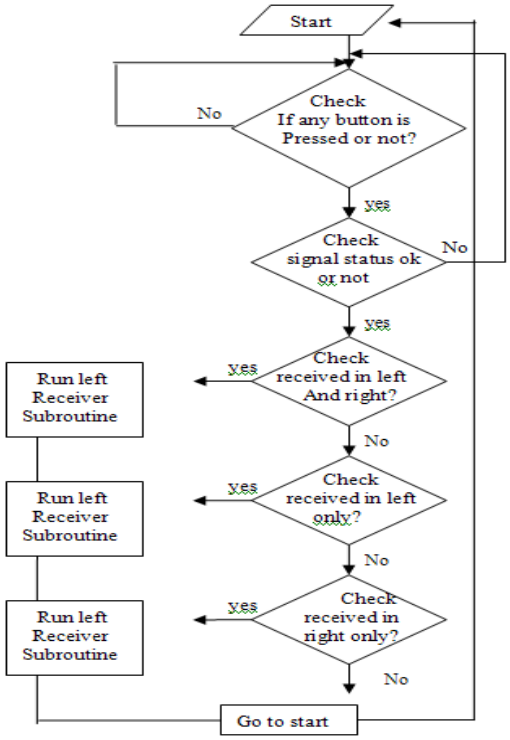

Figure 4: Flow chart for obstacle detection system

CONCLUSIONS

A micro controller robot base was designed and manufactured for flexible control of the robot structure used for the manufacturing system loops. The flexible movable controlled base of the robot may help to perform many automated task during manufacturing processes. An obstacle detecting device was introduced using infrared signal so that the robot body can change its direction to avoid collision.

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AUTHORS & AFFILIATION

N. A CHOWDHURY[1],
Md. Anayet Ullah PATWARI[2]

[1-2]DEPARTMENT OF MECHANICAL & CHEMICAL ENGINEERING, ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT), Board Bazar, Gazipur-1704, DHAKA, BANGLADESH

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

Amal Khalil Sar SOUR[1], Abdelnaser OMRAN[2]

WATER CRISIS IN GAZA STRIP, PALESTINE

ABSTRACT:
Water crisis is a major environmental problem and day by day, this problem is increasing with the rapid growth of industrialization and urbanization in all parts of the world. This paper is an attempt to investigate the water crisis in Gaza strip in Palestine because the water crisis in Gaza continues to worsen as the groundwater becomes increasingly polluted and the political situation delays hope of ''resting'' the Gaza aquifer and finding solutions for proper disposal of sewage and solid waste. The current situation results in diseases and violates the basic human rights of the people of Gaza. However, this study is proposed few strategies to minimize the risk, one of these strategies are secure Palestinian water rights and to strengthen water institutions to be able to govern water effectively and efficiently.

KEYWORDS:
Water crisis, environmental problem, Gaza strip, Palestine

INTRODUCTION

Even if, access to safe water resources is a global concern, as human rights, stating that all citizens have a right to water of good quality for personal consumption at costs they can afford. In Palestine, people are struggling for access to water, and against contamination of the only sole and precious resource that they have. Geography, politics, and war combine to make the Gaza Strip a worst-case scenario for water resource planners (Bohannon 2006). Long-term overexploitation in the Gaza Strip has resulted in a decreasing water table, accompanied by the degradation of its water quality. Due to high levels of salinity and nitrate pollution, most of the ground water is inadequate for both domestic and agricultural consumption. The water is unfit for human consumption, and the risk of contracting an infectious disease is high. The rapid rate of population growth in the Gaza Strip and dependence upon ground water as a single water source present and failure of the existing infrastructure to cope, considered as a serious challenge for future political stability and economic development. This comes as the Israeli Occupation Forces continue impose block and siege, to prevent access of needed material to maintain and improve water system in Gaza strip, in addition to reduce fuel and electrical supplies to Gaza, which disrupts the operation of many water wells, thus affecting the authorities' ability to pump water to the population. Thus, although the water quality is bad, it is not always available, because the current electric is needed to pump water to consumers and the electricity is not consistently available. The environmental situation in the Gaza Strip was already serious prior to these events, due to underinvestment in environmental systems, lack of progress on priority environmental projects, and the collapse of governance mechanisms. The recent escalation of Israel hostilities caused additional damage and increased the pressure on environmental facilities and institutions. Water supplies were affected by damage to water wells and drinking water pipes, as were wastewater systems. The water crisis in Gaza continues to worsen as the groundwater becomes increasingly polluted and the political situation delays hope of ''resting'' the Gaza aquifer and finding solutions for proper disposal of sewage and solid waste. The current situation results in diseases and violates the basic human rights of the people of Gaza. WHO established international standards for salt levels of chemical compounds in water, such as nitrate and chloride. For safe and healthy human consumption of drinking water these salt compounds cannot exceed the WHO guidelines. For nitrate, the WHO standard is 50 mg/l and for chloride it is 250 mg/l. The Gaza aquifer has nitrate levels over 100 mg/l and chloride levels averaging 1000 mg/l. accordingly, how can adversely these unsafe and unacceptable levels affecting the health of Palestinians citizen in Gaza Strip? Today, only 5-10 percent of the water of Gaza's portion of the Coastal Aquifer is safe to drink. Poor water quality in Gaza leads to serious health concerns, with vulnerable groups such as children suffering most.

THE EXPECTED RIGHTS FOR PALESTINIAN TO ACCESS HEALTH AND SAFETY WATER

The Gaza Strip has narrow surface area, about 365 km^2, and rapid population growth (which is about 3.8% based on estimates of the Palestinian Center for Census Statistics) has led to an increase in census, up to the approximately 1,416,543 people, in 2007,

increased to about 1, 5 in 2010, and the high population density of up to about 6,708 people / km^2, population growth is still continuing. Gaza is located on the southeastern coast of the Mediterranean sea between latitudes 31° 16[11] and 31° 45[11] and longitudes 34° 20[11] and 34° 25[11] East. It is about 1.33% of the total area of mandate Palestine. On the east, it is bordered by Israel, on the south with Egypt, on the north is Israel and on the west is the Mediterranean Sea. The Gaza Strip is one of the most densely populated areas on the earth. Because of their isolation, the inhabitants of this area between the Mediterranean, Egypt and Israel are reliant on being self-sufficient. Beneath the ongoing conflict in the Gaza Strip is a groundwater crisis that's rapidly depriving Palestinians of drinkable water. The Gaza Strip is underlain by the sole source of fresh water from the Shallow Coastal Aquifer, which is contiguous with the Israeli Coastal Aquifer to the north. Gaza is the 'downstream user' of the portion of the Coastal Aquifer system that lies beneath Israel, due to the natural flow regime in the aquifer which is from southeast to northwest toward the Mediterranean Sea. Thus, the ground water flows coming from Israel into the Gaza portion of the aquifer, and hence water abstraction in Gaza does not affect Israeli water supplies. Amnesty International Report, Troubled Waters: Palestinians denied fair access to water (2009), which states that:

"The inequality in access to water between Israelis and Palestinians is striking. Palestinian consumption in the Occupied Palestinian Territories (OPT) is about 70 liters a day per person – well below the 100 liters per capita daily recommended by the World Health Organization (WHO) – whereas Israeli daily per capita consumption, at about 300 liters, is about four times as much. In some rural communities Palestinians survive on far less than even the average 70 liters, in some cases barely 20 liters per day, the minimum amount recommended by the WHO for emergency situations response" (AMNESTY, 2009).

According to the Costal Municipalities Water Utility in Gaza Strip (CMWU): "The groundwater underneath Gaza is becoming limited due to Israel's construction of trap wells [about 27 wells] inside Israel, along Gaza's eastern political border, siphoning water supplies from the aquifer before they reach Gaza." It is estimated that the annual recharge of the Coastal Aquifer from rainfall in the Gaza Strip is in the range of 40-45 million cubic meters (UNEP, 2009). Approximately 90% of the population of the Gaza Strip drinks water from municipal groundwater wells and 15%, mostly in agricultural areas, use private wells (Shomar, 2006).

WATER SITUATION IN GAZA STRIP

Only 5% - 10% of the aquifer is suitable for human consumption and that this supply could run out over the next 5 to 10 years without improved controls (UNISEF, 2010). The Coastal Aquifer being the only water resource in Gaza Strip suffers from deficit in the water amount which has been leading to deterioration in the quality and quantity of groundwater. Different field studies found that the ground water has poor quality, and it is quickly becoming contaminated not just with nitrates only, but with salts as well. The poor quality of groundwater is due to over-extraction from the aquifer and this has allowed seawater intrusion, hence the high salinity of Gaza's groundwater as a result of over pumping of groundwater by about 1.5 million of the Gaza Strip's people, which caused depression in the level of groundwater. This has created a slope in the groundwater table, allowing the naturally saline groundwater to flow steadily westward and spoil the aquifer under the Gaza Strip. Referring to CMWU in Gaza Strip, About 160 million cubic meters of water was taken from the underground aquifers last year to supply about 1.5 million people with drinking water and for agriculture, but that natural replenishment amounted to only 80-90 million cubic meters. Consequently, the ground water deficit is arisen to more than 80 million cubic meters last year, and if this situation continues reserves, then it will be collapsed in the next few years. Accordingly, most of ground water in Gaza strip is unfit for human use, and tap water in Gaza is known to be very salty and undrinkable. The decrease in usable water reserves has also been linked to climatic changes, such as lower rainfall, which have slowed the recharge rate of the aquifer. Other factors are a rapid population growth and increasing urban sprawl, leaving little space for rainwater catchment areas, in addition to continuous Israeli invasions to Gaza strip and destroying wide range of green areas and cutting trees which also affect negatively on the ability to catch water. Poor groundwater quality can also be attributed to pollution from wastewater seepage and the infiltration of agricultural fertilizers.

"With no other source of water available to them, Palestinians in Gaza have long resorted to over-extraction from the Coastal Aquifer, by as much as 80-100 MCM/Y – a rate equivalent to twice the aquifer's yearly sustainable yield. The result has been a marked, progressive deterioration in the quality of the water supply, already contaminated by decades of sewage infiltration into the aquifer. Today some 90-95 per cent of Gaza's water is polluted and unfit for human consumption" (AMNESTY, 2009). Inadequate sewage treatment infrastructure and damage to wastewater and drinking water pipelines has allowed sewage water to contaminate drinking water supplies, leading to sharp increases in water borne diseases in many areas. In addition to that, failure to control over-pumping has led to sea-water intrusion into the aquifer to the extent that, in 2003, only 10 % of the wells produced water of World Health Organization (WHO) drinking water standards (UNEP, 2003). The results of a 10-year monitoring program revealed that more than 90% of the available water is not suitable for drinking purposes as a result of elevated chemical contaminants as well as microbiological organisms (Shomar, 2010).

WATER QUALITY IN THE GAZA STRIP (WHO STANDARDS)

According to the CMWU (the water service provider in Gaza):

- 65% of water wells are contaminated with nitrates
- 57% of water wells are contaminated with chloride
- Water tests have shown some wells with high values of fluoride (EWASH, 2010).

In most parts of the Gaza Strip, the nitrate concentration in groundwater is far above the WHO accepted guidelines of 50 mg/liter as nitrates (up to 331 mg NO3/liter) (EWASH, 2010). The situation is deteriorating more because; the groundwater aquifer of Gaza is extremely susceptible to surface-derived contamination because of the high permeability of sands and gravels that compose the soil profile of Gaza (Zeitoun et al., 2009). This means that sewage, irrigation water, and 'leachate' from overwhelmed and unsealed landfills can easily percolate down into the aquifer (Shomer, 2010). The lack of proper sanitation and certain agricultural practices are polluting Gaza's aquifer. Only about 60% of the territory's 1.5 million inhabitants are connected to a sewage collection system. Raw sewage discharged into the river Wadi Gaza in the middle area of Gaza Strip and this sewage flow directly to the sea, which snakes through urban areas, jeopardizes the health of the communities living on its banks, or swimming in the sea. In a recent report, the UNEP (2009) stated that groundwater supplies, upon which 1.5 million Palestinians depend, are in danger of collapse as a result of years of over-use and contamination that have been exacerbated by the recent conflict. The report on the environmental condition of the Gaza Strip following the hostilities, calls for the aquifer to be ''rested'' and alternative water sources found. Unless the trend is reversed now, damage could take centuries to reverse.

HOW THE POLITICAL SITUATION AFFECTS GAZA'S PEOPLE ACCESS TO WATER

There are environmental and geographic concerns, but there also political problems (UNEP, 2009). The whole of Gaza's civilian population are being punished for acts for which they bear no responsibility. The closure therefore constitutes a collective punishment imposed in clear violation of Israel's obligations under international humanitarian law. Resulting in many environmental problems has accelerated and exacerbated which prevent effective management, due to siege and closure boarders. Among all these problems, there are attempts to in particular access to safety and healthy water resource. Gaza is one of the good examples where politics, environment, and human activities combine to escalate water problems. The influence of each component and the interaction among the components varies with events of the day, as well as the relationship of new environmental insults to longer term of environmental degradation (Shomer, 2010). Since 2005, Gaza's water supply has been affected by restricted access to power, fuel and spare parts. Several major sewage-treatment projects funded by foreign donors including one in the northern area (SIDA 1999), were frozen after Hamas won elections in 2006. Their project aimed to treat sewage in north Gaza and it was worked on for 2 years and a pressure pipeline and a pumping station were constructed. These projects were stopped after Hamas won the elections. Desalination plants planned by donor countries have also all but fizzled due to security concerns and sanctions against the new Hamas-led Palestinian government (Bohannon 2006). Also, Israeli invasion of Gaza (Operation Summer Rain, June 2006) has caused untold damage to water infrastructure, with destruction of the Gaza Electric Station affecting the operation of the majority of wells, pumping stations and sewage treatment facilities (CMWU, 2006). The tightened siege and blockade of the enclave and boarders that Israel has imposed on the Gaza Strip since Hamas sized power, and took over control of the security apparatus there in June 2007 has greatly harmed Gaza's environmental health system, which had not functioned well beforehand. Equipment and supplies needed for the construction, maintenance and operation of water and sanitation facilities have been denied entry to Gaza, this directly affects Gaza's ability to maintain its sanitation and water treatment facilities, which hampered many services such as providing good quality and quantity water to Palestinians citizen in Gaza Strip, and since the siege began, ability to access to water are not available After almost 2 years of strangling closure that left residents in a very fragile and vulnerable state, Gaza Strip was imposed by the Israeli military offensive operations on the morning of December 27, 2008, and the Strip was under continuous attack for 23 consecutive days further multiplying the pressure on the Strip.

"Water resources in the Gaza Strip were already in the throes of an environmental crisis prior to the latest escalation of hostilities. However, the recent events aggravated the situation in several ways. First, the collapse of sewage treatment during the period accelerated the pollution load into the underlying aquifer. Second, the lack of reliable and sufficient drinking water supply during the fighting meant that the population used whatever waters it had access to, irrespective of its supply source. Third, even water supplied through municipal systems and private tankers was both untreated and untested, leaving the population exposed to contamination" (UNEP, 2009).

Water and sanitation conditions worsened further during and after the attack, that the water and sanitation infrastructure sustained damage, depriving many of running water and threatening many others from the risk of being infected with water borne diseases as a result of water contamination by leaking wastewater. During the attack the Coastal Municipalities Water Utility "CMWU" which is responsible about providing water and wastewater services in Gaza Strip announced its inability to maintain its services in both the water sector in terms of production and distribution and wastewater sector in terms of collection and discharging in Gaza Strip

governorates. Despite several appeals to all international aid agencies and organizations to help out and support the technical teams in keeping all water and wastewater facilities operational and repairing the infrastructure damages and destructions caused by the Israeli bombarding, but all these requests were declined which lead to serious crisis in Gaza Strip during this period. About 10,000 Gaza residents do not have taps in or near their homes and an additional 60 percent of the population (about one million people) does not have continuous access to water. Amnesty International, Troubled Waters - Palestinian's denied fair access to water (2009) states: "Israel's recent military offensive in Gaza, operation "Cast Lead", lasted from 27 December 2008 to 18 January 2009. During these 22 days, Israeli attacks caused some US$6 million worth of damage to Gaza's water supply and sewage and wastewater facilities and infrastructure. In northern Gaza, three water facilities were destroyed and the emergency sewage treatment plant was damaged, as well as water distribution networks. In central Gaza, Israeli attacks damaged the Sheikh 'Ajlin sewage treatment plant, causing the raw sewage to inundate more than a square kilometer of agricultural and residential land ruining the crops. In both northern and eastern Gaza, Israeli tanks and bulldozers dug up or damaged water mains. At the height of the hostilities, more than 800,000 people, over half Gaza's population, were without running water. Months later, the WHO reported that samples taken from the public water supply, water storage tanks, and water wells in areas that sustained serious damage during operation "Cast Lead" were still contaminated, and that this was reflected in higher rates of acute watery diarrhea, especially in young children, and viral hepatitis.

The impact of the damage has been particularly acute and long-standing because of Israel's continuing blockade of Gaza, and the impact this has in preventing the import of the spare parts, equipment and other materials needed to repair and improve the water supply and sanitation systems and other infrastructure" (AMNESTY, 2009). As a result of this war, and referring to CMWU fast track report, 11 wells and four reservoirs were damaged, as well as 19,920 m of water pipes and 2,445 m of sewage pipe network. Damage occurred in four locations of the sewage network and pumping stations, the North Gaza sewage treatment plant, water utility premises, and many household water-storage systems. The damage to the electricity network and the power shortages also affected the normal water supply and wastewater pumping and treatment in the Gaza Strip. As a result, it is reported that nearly 840 households (with an average family size of around 7.25 persons) suffered damage to their water supply. A further 5,200 households lost their roof water tanks, and another 2,355 tanks suffered damage. Also, the destruction caused by Israeli shelling, tanks and bulldozers damaged Gaza's sanitation network, causing 150,000 cubic meters of untreated and partially treated sewage waste water to flow over agricultural and residential land and into the sea during the attacks. The daily average of wastewater being pumped into the sea is still a staggering 80,000 cubic meters. Nearly, 10% of the population of the Gaza Strip did not receive proper water supplies immediately after the cessation of hostilities, and a population of 32,000 did not have access to proper water supply even 3 months after the ceasefire was concluded (WHO, 2009).

The escalation of violence caused aggregate of contamination, such as hydrocarbon contamination at industrial sites, sewage contamination around broken storage tanks, continuing sewage contamination around sewage treatment plants, storm water infiltration areas, and contaminated sewage drains and coastline. Furthermore, because both the weapons used and the materials present within the buildings had chemical constituents, it had to be assumed that every damaged site, including impacted agricultural areas, was also potentially contaminated. In addition to the continuation of the above many obstacles during the, Gaza Strip faced acute shortage in necessary spare parts, equipments, and machines for affording the required infrastructural services had to deal with electricity insufficiency and fuel (diesel) shortage as power supply alternative for restoring these services, which lead to serious water crisis in the last three years. Accordingly, the water crisis exacerbated, that since January 2010, there has been a serious deterioration in the supply of electricity in the Gaza Strip, which disrupts the operation of many water wells, thus affecting the authorities' ability to pump water to the population. The immediate reason is that Gaza's sole power plant, the Gaza Power Plant (GPP), is able to produce only half the electricity that it did prior to January 2010, due to a lack of funds needed to purchase the industrial fuel required to operate the plant. As a result, almost all of about 1.5 million Palestinians residing in the Gaza Strip, with the exception of those who live in the Rafah area (The Rafah area has scheduled cuts of 6-8 hours a day), must cope with scheduled electricity cuts of 8-12 hours daily, compared to 6-8 hours prior to January 2010. These power cuts exacerbate the already difficult living conditions in Gaza and disrupt almost all aspects of daily life, including household chores, health services, education and water and sanitation services. People living in tall apartment buildings particularly lack water supplies since they depend heavily on energy to pump it to their homes. Certain areas in Gaza have not had any water for days (OCHA, 2010). The above mentioned electricity crisis strongly affected negatively on sewage treatment, as the proper operation of Gaza City's sewage treatment plant requires 14 days of uninterrupted power supply for the full duration of the treatment cycle. Daily power cuts disrupt sewage treatment and hinder the completion of the treatment cycle, with the result that partially treated and untreated sewage is discharged into the environment; Gaza's water authorities release 60-80 million liters a day of raw

and partially treated sewage into the Mediterranean Sea, in order to avoid sewage flooding residential areas. Electricity is also needed for pumping water for domestic use and irrigation. Because the pumps cannot be operated continuously, water supply for domestic use is insufficient, raising hygiene and health concerns. In order to pump water to households, the water wells must receive electricity in synchronization with electricity supply to the same households. Almost all the households receive water for only 5-7 hours a day (OCHA, May 2010).

How Gaza Residents Are Coping The Situation

Meanwhile service providers are obliged to supply water intermittently trying to keep the minimum level of service, Gaza resident straggling to cope the situation with different strategies, to overcome the situation in order to obtain enough water for their daily life's needs. These attempts differ according to the level of status or needs. Most of them tend to secure their water for drinking purposes from the purchasing water from largely private small-scale brackish desalination plants, which are prevalent throughout the Gaza Strip, by paying a considerable fee in addition to the expenses of the bad quality water from municipal service, which in total can afford good quality water from the municipal service. These desalination plants purify brackish water from wells and sell to residents either wholesale by tankers or retail by jerry can. There are at least 40 private desalination plants producing more than 2,000 m3 a day. There are also estimated to be more than 20,000 home desalination plants. As this sector is unregulated, there are concerns as to water quality (EWASH, 2010). High concentrations of salts and nitrates are difficult and costly to remove from drinking water supplies. Prices for purchased desalinated water are high: NIS 50/m3 (US $ 13 per cubic meter) and place additional financial strain on many households; those who cannot afford it are may be unsafe.

The operation of desalination plants has at times been hindered due to the blockade and lack of entry for spare parts, electricity and water purification chemicals such as chlorine necessary to run them (EWASH, 2010). Desperate to secure safe water resources, the population has responded by drilling private wells - many of them unlicensed - which have further contributed to the degradation of the aquifer. According to AMNESTY report, 2009, Palestinian families who do not have enough water to meet their basic needs often have no choice but to resort to coping strategies which carry risks for their own health, negatively affect their food security, and damage the groundwater resources. These include:

- *Buying water from unsafe sources (agricultural wells, which are not monitored for quality or adequately chlorinated) and boiling before consumption by young children, as most families cannot afford to buy sufficient fuel to boil all their drinking water.*
- *Reusing the same water for several tasks: water used to boiled vegetables is reused to wash dishes, then reused again to wash floors and then finally reused to flush toilets.*
- *Flushing toilets less frequently.*
- *Washing less regularly and fully, using a bucket or jug to limit the water used instead of showering.*
- *Washing clothes and floors as infrequently as possible and using a small quantity of water to hand-wash clothes in a bucket rather than using a washing machine.*
- *Only growing rain-fed crops in their home gardens or not keeping a home garden at all in dryer areas.*
- *Keeping fewer animals or none at all.*
- *Drilling unlicensed shallow wells (AMNESTY, 2009).*

Health Impact Of Water Crisis In Gaza Strip

The water required for each personal or domestic use must be safe, therefore free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health. Furthermore, water should be of an acceptable color, odor and taste for each personal or domestic use (EWASH (2010). According to EWASH (2010), the water situation in Gaza strip, and referring to different reports, researches and experts, the tragic situation there indicates a high probability associated with many water born diseased among the Palestinian citizen in Gaza strip, that without access to safe water, adequate sanitation and proper hygiene, children are particularly vulnerable to sickness caused by water borne disease. UNEP report assert that a number of environmental and health impacts may be related to this environmental crisis, due to lack of good quality water may which lead to an increase in disease; water and sewage water may mix, exacerbating health problems; sewage from damaged treatment plants may be released onto agricultural and other land and; untreated or undertreated sewage may be drained out to sea, causing problems to the marine environment, and for people using the sea.

The effect of people consuming contaminated water at levels over safety standards for many years, leads to an accumulation of chemicals in the body that can cause chronic diseases such as cancer, liver problems, renal failure, kidney problems and reproductive difficulties. Referring to different health effects reports, the health problems are: 50 % of Gaza's children have a parasitic infection; children and adults suffer from diarrhoea; that in Gaza, diarrhoea, an easily preventable disease, is behind 12 percent of young deaths. Furthermore lack of safe water is an immediate cause of under nutrition for millions more children, which can have lasting impact on a child's cognitive and physical development. high chloride levels causes kidney disease; consumption of saline water leads to salt levels in humans that causes kidney dysfunction, heart failure, neurological symptoms, lethargy, and high blood pressure; excessive levels of fluoride are toxic, causing gastritis, ulcers, kidney failure, bone fluorisis (bone fractures and crippling), and teeth fluorsis (black lines around gums and tooth

decay); and Nitrate levels in the Gaza Strip have continued to rise and currently present a health risk throughout the territory. High quantities of nitrates in drinking water can have significant health repercussions, particularly for infants. A recent UNEP report recommended that a comprehensive study should be conducted on the prevalence of "blue baby" syndrome, also known as methaemoglobinaemia, in addition to prevalence of and gastric cancer. Consequently, safe water should immediately be provided in the Gaza Strip to all children less than one year old, in order to ensure their health is protected from disease caused by nitrate contamination. Since people do not have other water alternatives they consume the brackish water for daily survival. Palestinians have no other options currently and the current numerical figures show the demand for water exceeds the water supply more than 90 per cent of the water extracted from the aquifer in Gaza is contaminated and unfit for human consumption. Waterborne diseases are common. The Department of Health of the UN Relief and Works Agency (UNRWA) reported in its February 2009 Epidemiological Bulletin for Gaza Strip that: "Watery diarrhea as well as acute bloody diarrhea remain the major causes of morbidity among reportable infectious diseases in the refugee population of the Gaza Strip." (EWASH, 2010; AMNESTY 2009; UNEP, 2009).

Is There Any Potential To Resolve The Crisis?

As the ICRC has stressed repeatedly:

"The dire situation in Gaza cannot be resolved by providing humanitarian aid. The closure imposed on the Gaza Strip is about to enter its fourth year, choking off any real possibility of economic development. Gazans continue to suffer from unemployment, poverty and warfare, while the quality of Gaza's health care system has reached an all-time low" (ICRC, 2010).

Assembling enough suitable materials to carry out sanitation projects is a slow and haphazard process. Materials obtained through the tunnel trade can be of questionable quality, while some items, such as certain electro-mechanical pumps, cannot be found at all, which hobbles construction efforts. The options for improving the water situation in Gaza remain effectively unchanged since 2000. Namely, additional supplies must be made available: through desalination, wastewater treatment and reuse, import from Israel, or import from the West Bank. Currently, the unstable conditions in the Gaza Strip make large scale engineering projects impossible to implement. The less technically difficult options of water import from Israel or the West Bank are loaded with political implications and complexities. Both require the cooperation of Israel to ensure their implementation as additional pipelines would need to be constructed, and in the first case, the Israeli water company, Mekorot, would have to supply the water; whereas in the second, a pipeline would have to be constructed across Israeli territory and furthermore, an agreement would have to be reached on Palestinian water rights in the West Bank. Unfortunately, the socio-political developments in Gaza place insurmountable hurdles in the way of all attempts to reform, upgrade, or even maintain that infrastructure in proper working condition. To redress this situation, aid is needed to develop alternative water supplies, such as desalination, and infrastructure for sewage disposal must also be restored and expanded to meet the needs of a growing population. All of this can be achieved by devote the unacceptable and inhumane collective punishment for more that 1.5 million Palestinian people for more than 3 years, and open the boarders to facilitate entrance of all needed materials, and equipments to rehabilitate and improve the water situation in Gaza strip.

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AUTHORS & AFFILIATION

Amal Khalil Sar SOUR[1], Abdelnaser OMRAN[2]

[1-2] SCHOOL OF HOUSING, BUILDING AND PLANNING, UNIVERSITI SAINS MALAYSIA , 11800, MINDEN, MALAYSIA

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

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5, Revolutiei,
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

D. RAJENTHIRAKUMAR[1], S.G. HARIKARTHIK[2]

LEAN MANUFACTURING: IMPLEMENTATION IN A CONSTRUCTION EQUIPMENT MANUFACTURING COMPANY

ABSTRACT:
Lean manufacturing is an applied methodology of scientific, objective techniques that cause work tasks in a process to be performed with a minimum of non-value adding activities resulting in greatly reduced wait time, queue time, move time, administrative time, and other delays. This work addresses the implementation of lean principles in a construction equipment company. The prime objective is to evolve and test several strategies to eliminate waste on the shop floor. This paper describes an application of value stream mapping (VSM). Consequently, the present and future states of value stream maps are constructed to improve the production process by identifying waste and its sources. A noticeable reduction in cycle time and increase in cycle efficiency is confirmed. The production flow was optimized thus minimizing several non-value added activities/times such as bottlenecking time, waiting time, material handling time, etc. This case study can be useful in developing a more generic approach to design lean environment.

KEYWORDS:
Lean Manufacturing, Value stream mapping, Cycle time, Takt time, Cycle efficiency

INTRODUCTION

Lean manufacturing is based on the Toyota Production System developed by Toyota which focuses on eliminating waste, reducing inventory, improving throughput, and encouraging employees to bring attention to problems and suggest improvements to fix them [1]. Lean manufacturing has increasingly been applied by leading manufacturing companies throughout the world. A core concept of lean manufacturing is pull production in which the flow on the factory floor is driven by demand from downstream pulling production upstream. Some of the changes required by lean manufacturing can be disruptive if not implemented correctly and some aspects of it are not appropriate for all companies [2]. A lean manufacturing facility is capable of producing product in only the sum of its value added work content time. Features of a typical lean manufacturing model include: one unit at a time production, non-value added time eliminated, production in the work content time only, and relocation of required resources to the point of usage. In the present day of manufacturing, assembly line can be formed easily for any industry whether it is a small-scale or a large-scale industry. When the tact times are calculated for every part manufactured in the industry through different part movements, then the problem of locating machines on the shop floor occurs when it is a job type production unit; this problem is the main reason for reconfiguration of machines and layout design for every demand. To eliminate these problems, a proper method is required to achieve a rhythm in manufacturing lean assembly line by identifying value adding, non-value adding, and necessary non-value adding activities through an optimum feasible tact time.

This paper presents a case study of a large-scale construction equipment manufacturing industry facing the problems as discussed above. This work addresses the implementation of lean manufacturing on the construction equipment assembly, with a focus on the activities of paint shop which should have a proper rhythm of assembly line, minimizing wastages like bottleneck time, waiting time, material handling time, etc. The prime objective is to develop different strategies to eliminate waste. The lean tool value stream mapping (VSM) applied as a method to lead the activities.

LITERATURE REVIEW

Currently, assembly lines are still fundamental to get the smoothing of production system [3], and they are studied under several operative perspectives seeking its flexibility [4, 5]. Both concepts are subjects of pull systems. In assembly lines, pull and lean systems are concepts frequently connected, although they pursue different objectives; pull system toward the reduction of work-in-process (WIP) and lean system toward minimizing the buffer variability [6]. Moreover, with respect to the election of production control system in a pull system, the alternatives considered are focused

on kanban [7] and constant work in process (CONWIP) [8], both of them focused toward the reduction of WIP.

Although many tools exist, from its origin, VSM has demonstrated its efficacy [9–13]. Following the benchmarking perspective, as well the use of a contrasted tool, facilitates the interchange of improvements. It is a tool that provides communication solutions for practitioners to obtain maximum efficiency and definitions of theoretical development points to become a reference among redesign techniques [12]. A detailed description of VSM can be seen in Rother and Shook [14]. Thus, as improvement tool simplifies the measurement of times without added value, so the calculation of indexes of lean metrics is easier and it is possible to enhance the operative actions with strategic results.

This paper unifies several gaps and it shows how value stream transformation actions can achieve high levels of performance in a short time and in a real industry, inside a context of an assembly line with a small space and that it requires flexibility.

PROBLEM DEFINITION

This work deals with the end to end perspective of reducing waste at an assembly line paint shop of a construction equipment manufacturing company. The major tasks involved in the paint shop are sketched in Figure 1 and the layout is given in Figure 2.

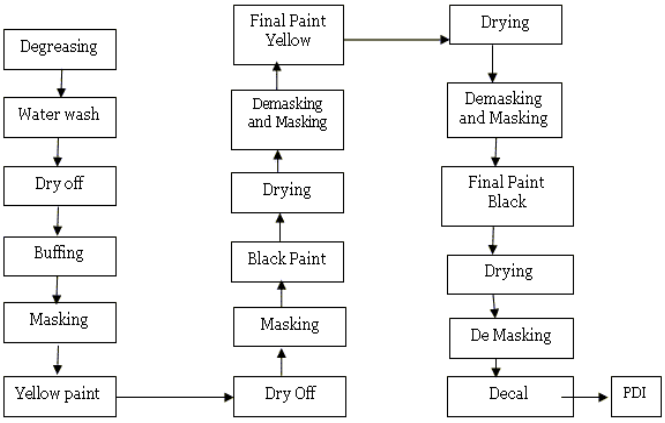

Figure 1. Major tasks in the assembly line paint shop

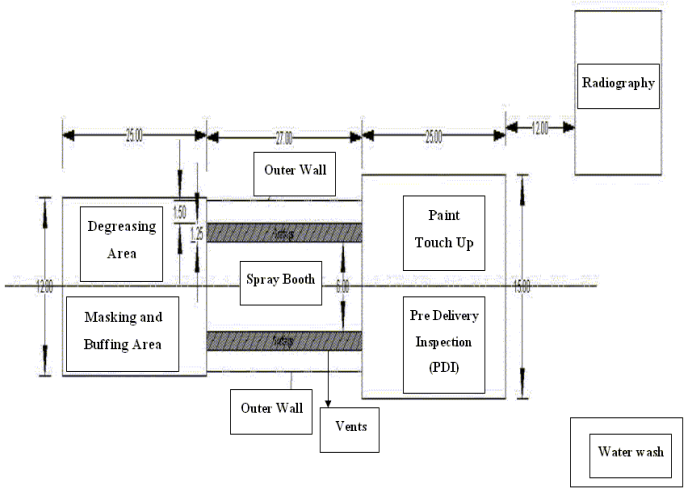

Figure 2. Layout of the assembly line paint shop

After intense brain storming and a thorough study of the paint shop, it was observed that the paint shop activities contain various forms of non-value-adding activities as follows:

- *Drying which takes eight hours increases cycle time*
- *Paint shop floor space insufficient for 100 tones*
- *Inadequate lighting (850 lux)*
- *Paint coagulation*
- *Ineffective blower performance*

Certainly, all of these factors lead to high production lead time. In the existing conditions, the average production lead time is found to be around 9688 min and the cycle efficiency is found to be 3%, which is not sufficient.

LEAN IMPLEMENTATION

In order to implement lean principles, a task group was formed with people from different parts of the organization, all having rich knowledge and information pertaining to process, production, equipment and planning. The objectives of the operation were (i) to reduce the level of non value activities present in any form by implementing the various lean tools (ii) to reduce the overall process time of the assembly line paint shop through improvements in the water wash, masking, drying processes and eliminating over processing of final black paint (iii) to introduce a safety trolley for masking radiator cover and (iii) to increase the cycle efficiency. The methodology adopted to achieve the objectives is given in Figure 3.

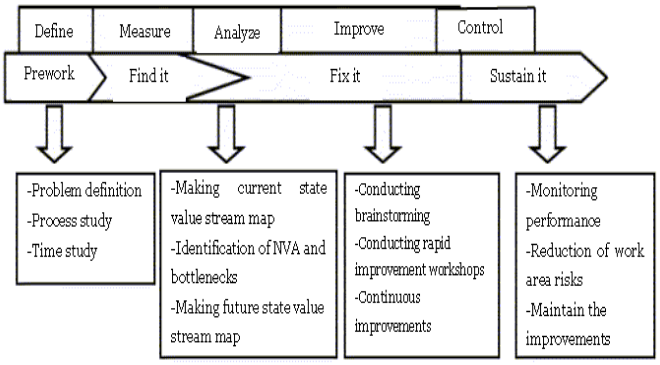

Figure 3. Methodology For Lean Implementation

Current state value stream mapping

To construct the current state value stream map, relevant information was collected by interviewing people on the paint shop floor. As a prework, process and time study was performed and Table 1 summarizes the overall activities associated with the paint shop along with their processing time. Data relevant to the customer, such as quantity to be delivered, delivery time were observed and information related to the assembly line, such as processing time, inventory storage, inspections, rework loops, number of workers and operational hours per day were collected and documented properly. To complete the value map, a timeline is added at the bottom of the map recording the lead-time and the value-added time. Eventually, the value stream map for the current state is constructed as shown in Figure 4.

Table 1. Current state paint shop processes and processing time

Name of the process	Average processing time in minutes		Name of the process	Average processing time in minutes
De-grease	15		De-masking	10
Water wash	60		Painting: yellow	60
Dry off	55		Drying	290
Buff	45		De-masking	26
Mask	40		Painting: black	35
Yellow paint	120		Drying	120
Dry off	240		De-masking	15
Mask	10		Decal	35
Black paint	20		PDI/rectification	30
Drying	60			

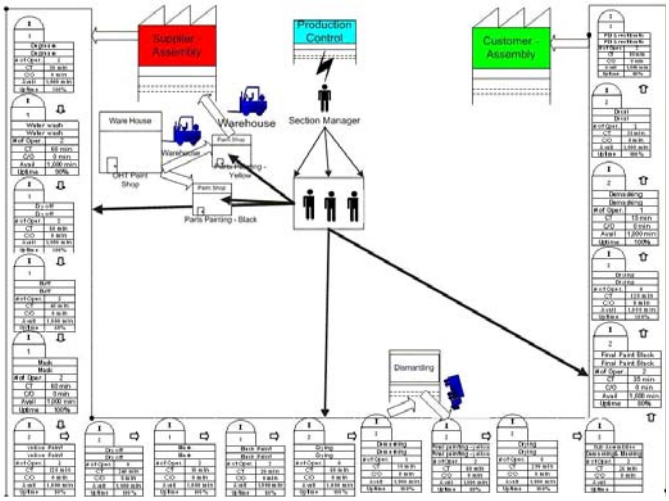

Figure 4. The present value stream map

As observed from the value map, various value-added activities present in the flow line, bottlenecks are identified and quantified in time, as shown in Figure 5 and Table 2. It is found that about 293.80 min, or 22.85% out of 1286 min, were value added activities, compared to 992.2 min or 77.15% of non value added activities. It is concluded that the drying process is the major issue which is not within the current levels of demand. If the growing levels of demand increases, drying is not within the tact time.

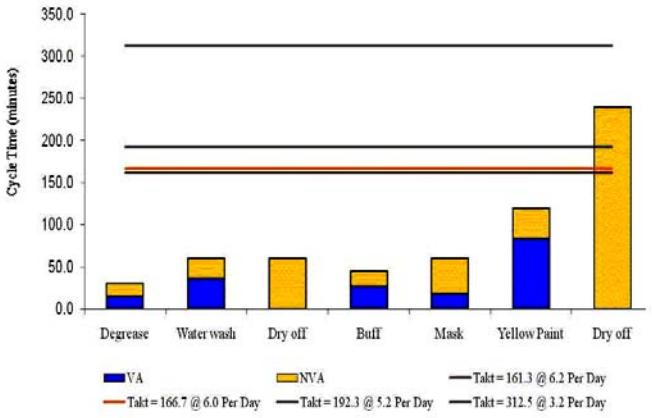

Figure 5. The present state va/nva time

Table 2. Current state va/nva time analysis

Name of the process	%VA	VA time (min)	NVA time (min)	Average processing time in minutes
De-grease	60%	9.00	6.00	15
Water wash	60%	36.00	24.00	60
Dry off	0%	0.00	55.00	55
Buff	60%	27.00	18.00	45
Mask	30%	12.00	28.00	40
Yellow paint	70%	84.00	36.00	120
Dry off	0%	0.00	240.00	240
Mask	30%	3.00	7.00	10
Black paint	70%	14.00	6.00	20
Drying	0%	0.00	60.00	60
De-masking	60%	6.00	4.00	10
Painting: yellow	70%	42.00	18.00	60
Drying	0%	0.00	290.00	290
De-masking	30%	7.80	18.20	26
Painting: black	70%	24.50	10.50	35
Drying	0%	0.00	120.00	120
De-masking	50%	7.50	7.50	15
Decal	60%	21.00	14.00	35
PDI/rectification	0%	0.00	30.00	30

Tact time

Tact time can be defined as the time required to produce one unit of daily salable quantity. To calculate tact time in the context of present problem, the average demand per two shifts was found to be 3.2 units of components under study. The company runs for two shifts, 500 min per shift excluding break time. This results in a tact time of nearly 312.5 min. Therefore, it is concluded that one unit of product must come out during every 312.5 min interval.

Total cycle time and cycle efficiency

Reducing the lead time in any production system is a continuous improvement process. While addressing the problem, the production lead time for the existing conditions was first calculated. The various components associated with lead time are identified separately and different practical strategies are adopted for improvement. In general, the various components associated with the lead time of any production process are (i) Waiting time before process (ii) Setup time (iii) Process time (iv) Waiting time after process (v) Transfer time. Considering all the elements involved, a total cycle time of 9687.50 minutes was calculated.

Also, the total cycle efficiency involved in the process is found to be approximately 3.2%. In order to reduce the total cycle time and increase the cycle efficiency, various strategies such as problem identification, data documentation, motion and time study, improvements made, operation sheet review, and continuous monitoring are adopted.

Initiatives taken to increase the cycle efficiency are:

- Standard work sheet is prepared
- Warm water is utilized to facilitate quicker drying process
- Permanent mask using rubber material designed to facilitate better functioning

- *Stringent monitoring is done and improvement opportunities are addressed in time*
- *Wherever possible, inefficient operations are eliminated; for example, oven drying process is developed*
- *To handle higher capacity, construction equipment layout modification was done*
- *To improve operator safety, safety trolley was designed for masking process*

Reducing time for masking process

To Reduce the masking time, permanent mask using rubber material was designed which in turn reduces the cost of masking. The improvements are shown in Figure 6.

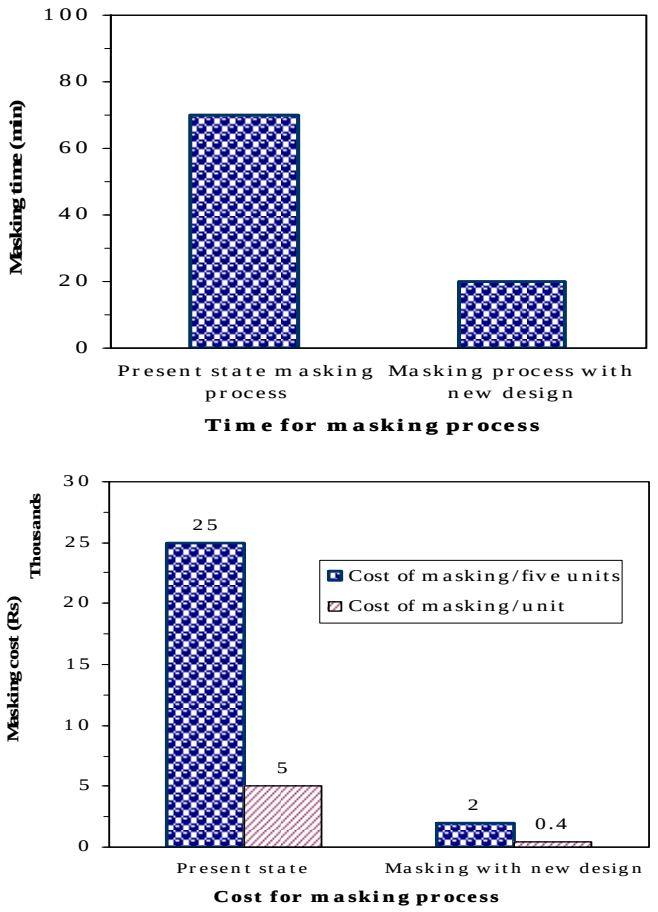

Figure 6. Masking process time reduction

Improvement of drying process

As a part of improved drying process, warm water was used for water washing of the equipment which results in 58% of time savings. From the current state analysis, it was clear that the drying process was the major bottleneck. In the present state, drying process was carried out outside the paint shop by allowing the unit to dry in hot sun which took 16 hours to complete. Also time amounts to 650 minutes on an average was spent for paint drying operation which included yellow painting, black painting and final yellow painting. Instead ovens of LPG type were introduced for drying process and the process time was decreased to 240 minutes. The improvement is shown in Figure 7.

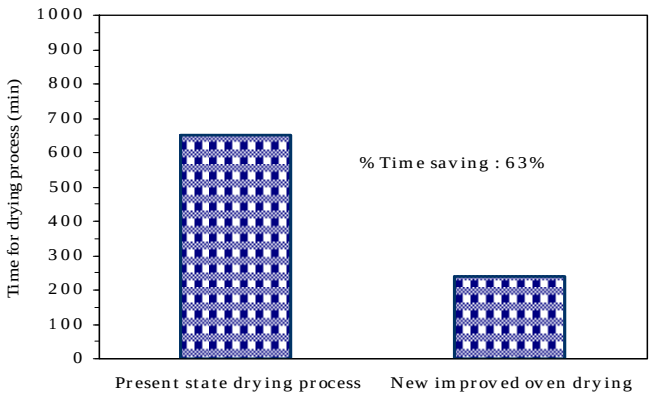

Figure 7. Improved drying process

Improvement in safety

It was found that the operator masks the unit by standing in the bumper of the construction equipment which is unsafe as shown in Figure 8. As a part of safety risk assessment, a new trolley was designed for masking radiator cover, where the operator stands near the corner of the equipment. By using the newly designed trolley, the operator is able to mask the radiator easily without any issues as shown in Figure 9. Since the trolley was developed using scrap materials, the labour cost is the only cost element associated with the new safety equipment.

Figure 8. Present state masking – operator risk involved

Figure 9. Masking with safety trolley – operator risk eliminated

Future state value stream mapping

Finally, the future state value stream map is constructed as shown in Figure 10, which reported a considerable depletion in non-value-added time. A drastic reduction in time for drying process is also observed. Furthermore, the process lead time is reduced to 725 min as illustrated in Figure 11.

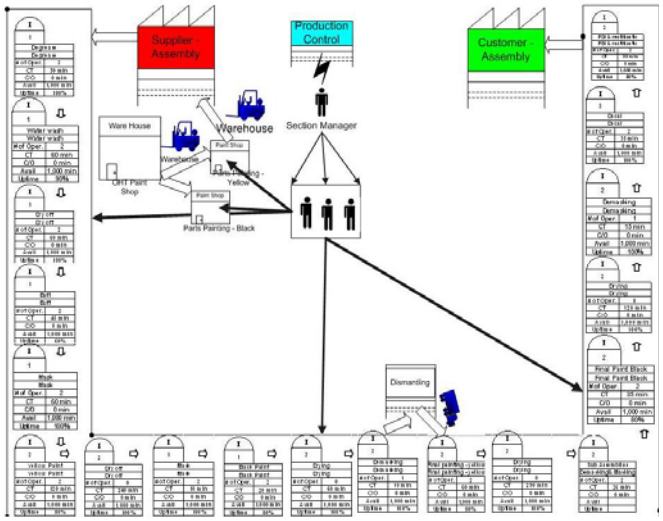

Figure 10. The future state value stream MAP

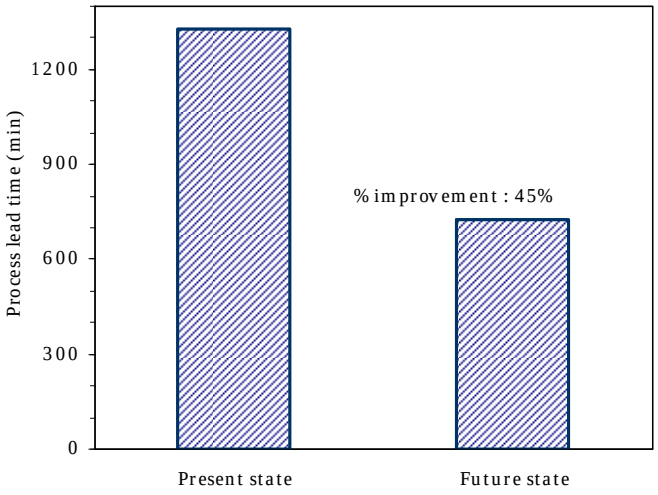

Figure 11. Reduction of process lead time

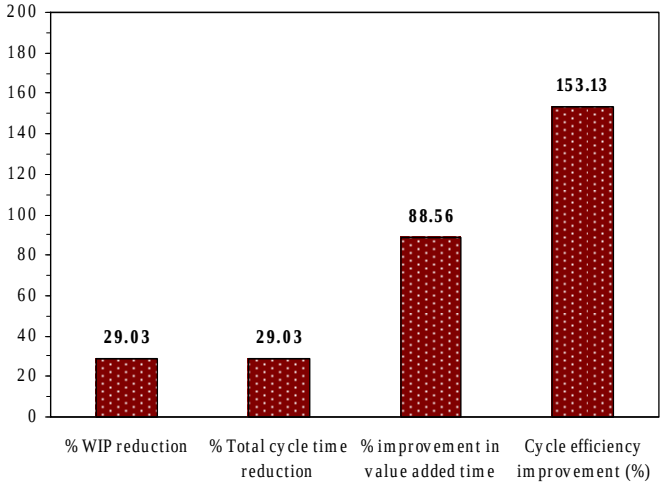

Figure 12. Improvements after lean

Table 3 outlines the value stream analysis report for the future state. It is found that about 554 min, or 76.4% out of 725 min, were value-added activities compared to 171 min or 23.6% of non-value-added activities. Comparing the value maps, it can be concluded that a 821.2-min reduction in non-value-added activities is achieved. Figure 12 depicts the various benefits made after the implementation of lean.

Table 3. Future state VA/NVA time analysis

Name of the process	%VA	VA time (min)	NVA time (min)	Average processing time in minutes
De-grease	80%	12.00	3.00	15
Water wash	80%	48.00	12.00	60
Dry off	100%	60.00	0.00	60
Buff	80%	36.00	9.00	45
Mask	80%	12.00	3.00	15
Yellow paint	70%	84.00	36.00	120
Dry off	100%	120.00	0.00	120
Mask	80%	4.00	1.00	5
Black paint	70%	14.00	6.00	20
Drying	50%	30.00	30.00	60
De-masking	70%	7.00	3.00	10
Painting: yellow	70%	42.00	18.00	60
Drying	50%	30.00	30.00	60
De-masking	50%	5.00	5.00	10
Decal	100%	35.00	0.00	35
PDI/rectification	50%	15.00	15.00	30

CONCLUSION

This present work provides a case study of the improvement of a construction equipment company non value added activities by means of lean tools. It focuses the revamp of operations by eliminating non value-added time and improving cycle efficiency through VSM. It can be concluded that VSM is an effective tool for identifying the processing wastes.

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AUTHORS & AFFILIATION

D. RAJENTHIRAKUMAR[1],
S.G. HARIKARTHIK[2]

[1-2] DEPARTMENT OF MECHANICAL ENGINEERING, PSG COLLEGE OF TECHNOLOGY, Peelamedu, COIMBATORE – 641004, TAMIL NADU, INDIA

ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

[1]Heikki MARTIKKA, [2]Ilkka PÖLLÄNEN

OPTIMAL DESIGN OF SEISMICALLY LOADED VESSELS

ABSTRACT:
This paper presents results of optimal design of seismically loaded thin shelled liquid containing cylindrical vessels. Three support structures are bearing plate anchored to foundations, columns and cylindrical skirt. The goal is maximisation of customer satisfaction on the structure. The goal is defined as product of fuzzy satisfaction functions for decision variables like cost and limit states like buckling and overload. Discrete design variables are used. The FE method and standards are used to verify the optimum design. The results agree satisfactorily.

KEYWORDS:
Seismic engineering applications, Steel structures, FEM calculations, Fluid structure interaction, Fuzzy design

INTRODUCTION

Background for this study is global need to utilise safely liquid containing vessels under seismic loading. A preliminary optimal design of the interconnected vessel equipments concepts is needed before detailed design.

Seismic loading excitation excites interaction between the ground, supports, shells and the inner fluid and also the neighbouring connected industrial large structures. In optimal design these have to be considered simultaneously with all interactions. First the earthquake causes overturning moments and base shear which cause bending and direct shear stresses at the vessel shells. Next seismic actions cause sloshing and tilting of the liquid level which increase the hydrostatic pressure and thus the hoop stresses.

Standards present many approaches which need to be utilised to get finalised acceptable designs. One is Nch 2369 Of.2003-API 650 2008 [1] for mechanically anchored Liquid tanks. Rules for buckling resistant designs are considered in [2] by ECCS Technical Committee 8. Structural stability and buckling of steel shells European Recommendations, 1988, NO 56. Theory and analysis of plates is considered by Szilard [3]. Steel structure design is considered in [4] Stahlbau handbuch and by Case et.al [5]. The theory of pressure vessels is considered by Harvey [6]. Malhotra, Wenk, and Wieland, [7] have proposed a simplified procedure for seismic analysis of liquid storage tanks. Malhotra [8] has studied seismic strengthening of liquid storage tanks with energy dissipating anchors.

Basic general fluid mechanics theory is discussed by White [9]. Martikka and Pöllänen have applied multi-objective optimization using customer satisfaction goal formulation with fuzzy models in [10] and in [11].

The purpose of this study is to present results of application of this methodology of fuzzy optimisation with FEM verification to designing of seismically loaded liquid storage vessel.

DESCRIPTION OF THE VESSEL MODELS.

Common support models

Liquid storage vessels are generally cylindrical. Common supports options are ground support with no skirt, elevated support with shell skirt and elevated support with columns. These are shown in Fig.1

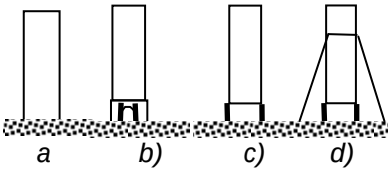


Figure 1. Support options. a) Ground support with no skirt. b) Elevated support with shell skirt. c) Support with columns. d) Cable stiffening

Basic dynamic behaviour of skirt and column supported models

Main features are described in the sketch of Fig. 2. The ground support model is considered later.

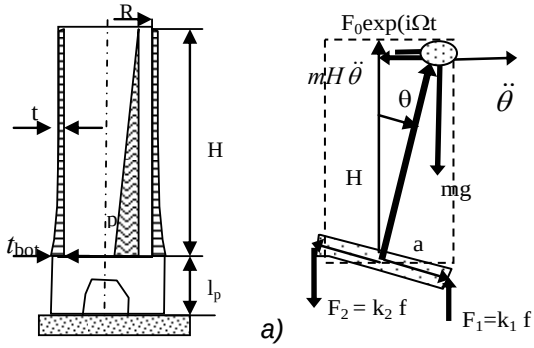


Figure 2. Shell skirt modelling. a) Sketch. b) A 2D two spring one lumped mass dynamical model.

A two spring one mass and stiff frame model, Fig.2 and Lagrange's dynamics are used to get an approximate lowest eigenfrequency. Vessel mass can be lumped to its centre of gravity. The Lagrange's function L is difference of the kinetic energy T of the mass and the potential energy V.

$$L = T - V$$

$$T = \frac{1}{2} m v^2 \Rightarrow v = H\dot{\theta} \Rightarrow T = \frac{1}{2} m H^2 \dot{\theta}^2 \qquad (1)$$

$$V \approx mgH\tfrac{1}{2}\theta^2 + kR^2\theta^2$$

The equation of motion for the one dof angular displacement is obtained with

$$\frac{d}{dt}\left[\frac{\partial L}{\partial \dot{\theta}}\right] - \frac{\partial L}{\partial \theta} = F_\theta \qquad (2)$$

The simplified equation of motion is

$$\ddot{\theta} + \left(\frac{g}{H} + \frac{2k}{m}\left(\frac{R}{H}\right)^2\right)\theta = F_\theta \qquad (3)$$

The solution is sum of homogeneous and particular solutions. Lowest eigenfrequency and eigenperiod T for a bearing plate anchored to ground having two springs 2k one mass m model is obtained as

$$\omega = \left(\frac{g}{H} + \frac{2k}{m}\left(\frac{R}{H}\right)^2\right)^{\frac{1}{2}} \quad , \quad T = \frac{2\pi}{\omega} \qquad (4)$$

Horizontal Elastic Seismic Response Spectrum

For the horizontal components of the seismic action, the elastic response spectrum S_e (T) means spectral acceleration S_A. It is defined by standards EN 1998-1:20004(E) and EN 1009-1:2004(E) [2] by the following four discrete expressions

Curve 1

$$0 \le T \le T_B, \quad S_e(T) = a_g \cdot S\left[1 + \frac{T}{T_B}(\eta \cdot 2.5 - 1)\right] \qquad (5)$$

Curve 2

$$T_B \le T \le T_C, S_e(T) = a_g \cdot S \cdot \eta \cdot 2.5 \qquad (6)$$

Curve 3

$$T_C \le T \le T_D, \quad S_e(T) = a_g \cdot S \cdot \eta \cdot 2.5\left[\frac{T_C}{T}\right] \qquad (7)$$

Curve 4

$$T_D \le T \le 4s, \quad S_e(T) = a_g \cdot S \cdot \eta \cdot 2.5\left[\frac{T_C T_D}{T^2}\right] \qquad (8)$$

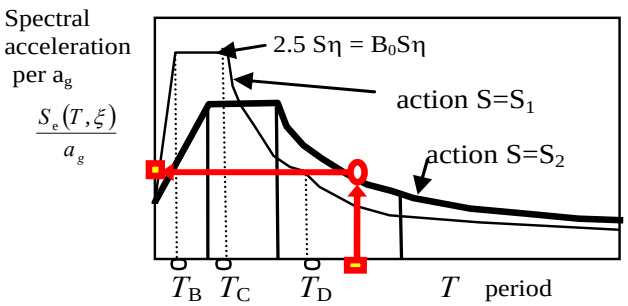


Figure 3. Spectral horizontal acceleration per ground acceleration vs.period of eigenvibration of the structure

Table 1. Some typical earthquake data values, η, damping correction factor, with reference value of 1 for 5% viscous damping.

	Seismic action j=1	Seismic action j= 2
S (j)	1	1.1
$B_0(j)$	2.5	2.3
$k_1(j)$	1	1
$k_2(j)$	2	2
$T_B(j)$	0.12	0.25
$T_C(j)$	0.35	0.9
$T_D(j)$	2.4	3
a_g (j)	2.7	1.6
η(j),	1	1

Here T= vibration period of a linear single -degree-of freedom system, a_g is design ground acceleration: Now the chosen ground type is type A (hard rock v_s > 800m/s). The soil factor S depends on the hardness of the ground.

For hard grounds (A) S =1 and for soft ground (E) S = 1.4, η is the damping correction factor with a reference value of η = 1 for 5% viscous damping

ξ is the viscous damping ratio of the structure expressed in percentages

$$\eta = \sqrt{\frac{10}{5 + \xi[\%]}} \qquad (9)$$

Typical values are

$$if\ \xi \approx 0 \Rightarrow \eta = \sqrt{\frac{10}{5+0}} = 1.4, .if\ \xi \approx 5\% \Rightarrow \eta = 1$$

Seismic Load On A Liquid Filled Tank

Seismic loads and responses of liquid filled vessel are complex tasks to analyse. Thus a simple to use and also a reasonable accurate model is needed. The common method is to separate the fluid into functionally different fictive parts, convective mass on top of impulsive mass as shown in Fig.4.

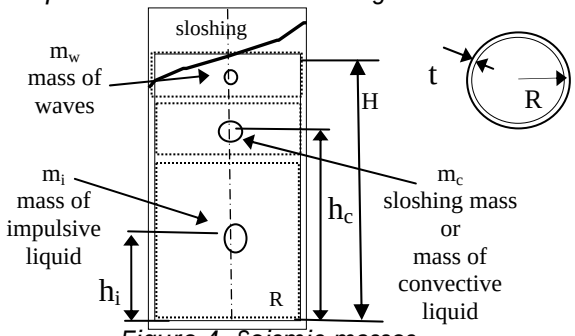


Figure 4. Seismic masses

Mass model curves are shown in Fig. 5 based on data by Malhotra et al[7].

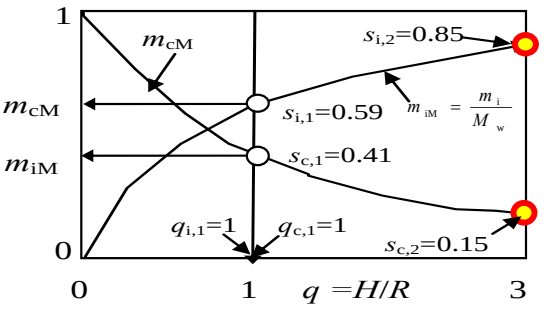


Figure 5. Mass vs. aspect ratio q curves

Model can be fitted to the experimental curves

$$m_{iM} = s_{i1} \cdot q^{ei} = \frac{m_i}{M_w}$$
$$m_{cM} = s_{c1} \cdot q^{ec} = \frac{m_c}{M_w}, q = \frac{H}{R} \quad (10)$$

Base shear V is sum of impulsive and convective components. The simplified structure has two masses and two eigenperiods, T_c for convective vibration and T_i for impulsive vibration

$$V = V_i(T_i, \xi_i) + V_c(T_c, \xi_c)$$
$$V = (m_i + m') \cdot (\ddot{u}_i + \ddot{z}) + m_c \cdot (\ddot{u}_c + \ddot{z}) \quad (11)$$

here m' is equipment mass, $\ddot{u}$ is mass centre acceleration and $\ddot{z}$ is earthquake acceleration. This may be written as

$$V = (m_i + m') \cdot S_e(T_i, \xi_i) + m_c \cdot S_e(T_c, \xi_c) \quad (12)$$

The overturning moment above the base plate at x=0

$$M = \Sigma\left[S_a(T_i, \xi_i) \bullet m_i h_i\right] = M_b \quad (13)$$

First this is expanded and next in calculations the equipment masses are neglected for simplicity.

$$M = (m_i h_i + m_{wall} h_{wall} + m_{roof} h_{roof}) S_e(T_i, \xi_i) + \\ + m_c h_c S_e(T_c, \xi_c) \quad (14)$$

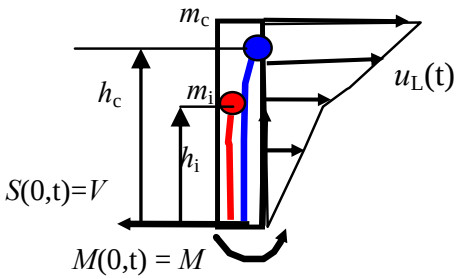


Figure 6. Base shear and overturning moment load on a vessel by seismic action

OPTIMUM DESIGN. MATERIAL DESIGN VARIABLE OPTIONS

The final success of engineering tasks is determined by the magnitude of customer's satisfaction on the delivered result. First condition of a success is optimal definition of goals and constraints. Second condition is choice of method. At the concept stage the essential design variables are few, discrete and their relationships are highly non-linear. Thus a fast enough search method is exhaustive learning search of optimum. Third condition is that all reasonable concepts are analysed and ranked in order of total satisfaction.

Options are shown in Table 2.One may also choose to use ecological merit and corrosion resistance as decision variables etc.

Table 2. Material design variables.Stress (MPa), cost (kg/m³), Elastic modulus (MPa),material cost (eur/kg).

material code	M$(1) = " Al "	M$(2) = " St "
allowed stress	$\sigma_{all}(1) = 100$	$\sigma_{all}(2) = 150$
material cost	cm(1) = 50	cm(2) = 20
density kg/m³)	$\rho(1) = 4000$	$\rho(2) = 8000$
Elastic modulus	E(1) = 60000	E(2) = 200000
ecological merit	eco(1) = .1	eco(2) = .7
Corr. resistance	corres(1) = .8	corres(2) = .15

UNIFIED FUZZY GOAL AND CONSTRAINT FORMULATION

Now all goals and constraints are formulated consistently by one flexible fuzzy function, as in [10] , [11]. This is illustrated in Figs.7 and 8 and Table 3. These functions depend on decision variables chose as most important for the customer, like safety factors, reliability cost etc. The customers and designers can together define the most satisfactory ranges and also left or right bias.

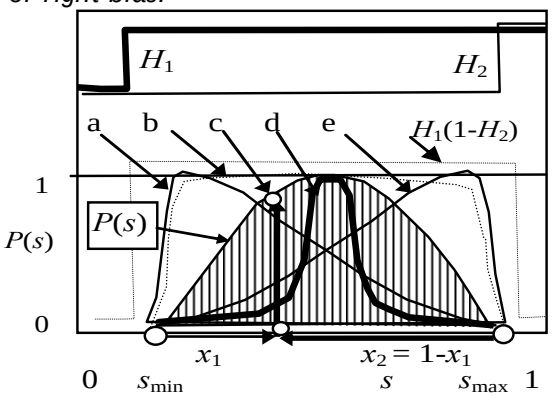


Figure 7. Definition of a typical fuzzy satisfaction function

In the design algorithm the satisfaction function is defined for each decision variable s by inputting the left and right limits and two bias parameters p. The left skewed option a is useful to get low cost designs. Flattening the shape increases indifference of choices of s. The call CALL pzz(s_{min}, s_{max}, p_1, p_2, s, P(s)) gives as output the satisfaction function P(s) which varies in the range 0...1. The decision variables s are changed to an internal dimensionless variable x_1

$$x_1 = \frac{s - s_{min}}{s_{max} - s_{min}} \Rightarrow x_2 = 1 - x_1 \quad (15)$$

The satisfaction function depends on one variable x_1

$$P(x_1) = (p_1 + p_2)^{p1+p2} \left(\frac{x_1}{p_1}\right)^{p1} \left(\frac{1-x_1}{p_2}\right)^{p2} H_{12} \quad (16)$$

Here

$$H_{12} = H_1(s)(1 - H_2(s)) \quad (17)$$

Two step functions are used to define the inner desired range of the decision variable

$$H_1(s) = \tfrac{1}{2}[1 + \mathrm{sgn}(s - s_{min})], H_2(s) = \tfrac{1}{2}[1 + \mathrm{sgn}(s - s_{max})] \quad (18)$$

Outside of the desired range a small non-zero seed value is added to the satisfaction function to promote search drive for improvement.

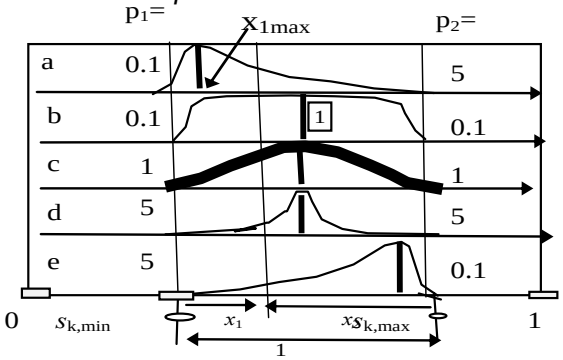


Figure 8. Satisfaction function examples

Table 3: Skewness parameter values.

	a	b	c	d	e
p_1	0.1	0.1	1	5	5
p_2	5	0.1	1	5	0.1
x_{1max}	0.02	0.5	0.5	0.5	0.98

The total design event G is junction of sub design events which are functions of decision variables

$$G(s) = G(s_1) \text{ and } G(s_2) \ldots \text{ and } G(s_n) \quad (19)$$

The design goal is to maximise the product

$$P(G(s)) \Rightarrow P(s) = P(s_1) \cdot P(s_2) \cdot \ldots \cdot P(s_n) \quad (20)$$

Here s_k is decision variable and $P(s_k)$ is satisfaction on it. The desired range for s_k is $R(s_k) = s_{kmin} < s_k < s_{kmax}$

ALGORITHM FOR OPTIMISATION

In engineering optimisation at concept stage most tasks are highly non-linear and also the design variables are few and discrete. For this reason, the exhaustive or learning enhanced search methods are deemed to be satisfactory. User can preselect the material from the list of available selections or leave it as one more design variable to the search algorithm to determine. Total satisfaction is first initialised to a low value

P_{gbest} = .0000001,
FOR ir = 1 TO N ' Radius R(ir)
FOR itt = 1 to N ' t(itt) wall thickness
FOR iH = 1 to N , H(iH) height of vessel
FOR itbot 1 to N , t_{bot}(itbot) wall thickness at bottom of the shell

Design variables for columns are preselected within feasible ranges

FOR irp = 1 to Nirp , $r_p = r_p$(irp) is column radius
FOR itp = 1 to Nitp, $t_p = t_p$(itp) is column wall thickness
FOR ilp = 1 to Nllp , $l_p = l_p$(ilp) is height of column

Each k = 1,2..13 decision variable s is calculated. The its range and bias pair p_1 and p_2 are given as inputs to get the satisfaction function P(s) by a call CALL pzz(s_{min}, s_{max}, p_1, p_2, s, P(s)).

The total satisfaction is product of partial satisfactions.

P_s = 1 , the initialisation first, before the loop

```
FOR i = 1 TO N
      Ps = Ps * Ps(i)
 NEXT i
```

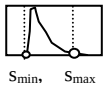
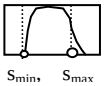
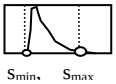
$P_g = P_s$

```
IF Pg > Pgbest THEN
  ' new optimum is better than previous
ELSE search is continued. END IF
NEXT indices
```

DECISION VARIABLES

An illustration of the use of decision variables is shown in Table 4.

Table 4. Typical definitions of the decision variable desired range limit s_{min}, s_{max} and biases p_1 and p_2

s_k decision variable	s_7= N Factor of safety	s_3=V Useful volume	s_5=M Cost of material
s_{min}	1,	1e-5	$0.1K_{max}$
s_{max}	7	0.002	$2K_{max}$
p_1, p_2	0.1 , 5	1,1	0.1, 4
satisfaction function curves			

One design goal is to shift the impulsive and the convection mass eigen periods away from the large seismic acceleration period range. For seismic action S(1) the choice the main parameters are
T_B = .12, T_C = .35, T_D = 2.4, a_g = 2.7.
Now ground acceleration is chosen conservatively rather high, a_g = 3.
The damping coefficients z are z = z_i = 0.02 for impulsive and z = z_c = 0.05 for convective motion.
Decision variable s_1= T_{imp} or impulsive mass period

$$s_1 = T_{imp}, \quad P_s(1) = P(s_1) \quad (21)$$

The aim is to constrain this into the safe range

$$Range: s_{\min} = 0.06, \quad s_{\max} = 0.48, \qquad Biases: p_1 = 0.1, p_2 = 0.1 \quad (22)$$

According to Malhotra [2]

$$T_{\text{imp}} = C_{\text{i}} \frac{H}{\sqrt{\frac{t}{R}}} \sqrt{\frac{\rho}{E}} \quad (23)$$

$$C_{\text{i}} = 7 \pm 1, \frac{H}{R} = 0.3\ldots,3$$

The eigenvalues are

$$\omega_{\text{i}} = \frac{2\pi}{T_{\text{imp}}}, k_{\text{i}} = \omega^2 m_{\text{i}}, c_{\text{i}} = 2\xi_{\text{i}}\omega_{\text{i}} m_{\text{i}}, \quad (24)$$

Then spectral acceleration corresponding to this $T=T_{imp}$ is calculated by CALL Se(T, z, SeT) giving as output SeTi(iv) = SeT
Decision variable s_{10}= SeTi or spectral acceleration at impulsive mass eigenperiod T_{imp}

$$s_{10} = SeTi, \quad P_s(10) = P(s_{10}) \quad (25)$$

Small value is desired and range is biased to the left

$$Range: s_{\min} = 1, \quad s_{\max} = 20, \qquad Biases: p_1 = 0.1, p_2 = 2 \quad (26)$$

Decision variable s_2 = T_{conv} or convective mass eigenperiod
Small value is desired

$$s_2 = T_{conv}, \quad P_s(2) = P(s_2) \quad (27)$$

$$Range: s_{\min} = 0.35, \quad s_{\max} = 7, \qquad Biases: p_1 = 2, p_2 = 0.1 \quad (28)$$

Malhotra [2] gives the simple model

$$T_{\text{conv}} = C_{\text{c}} \sqrt{R} \qquad C_{\text{c}} = 1.5, \frac{H}{R} = 0.3\ldots.3 \quad (29)$$

Eigenvalues are

$$\omega_{\text{c}} = \frac{2\pi}{T_{\text{conv}}}, k_{\text{c}} = \omega_{\text{c}}{}^2 m_{\text{c}}, c_{\text{c}} = 2\xi_{\text{c}}\omega_{\text{c}} m_{\text{c}} \quad (30)$$

The spectral acceleration corresponding to T= T_{conv} is calculated by CALL Se(T, z, SeT) giving as output SeTc() = SeT
Decision variable s_{11}= SeTc or spectral acceleration at convective mass eigenperiod T_{conv}

$$s_{11} = SeTc, \quad P_s(11) = P(s_{11}) \quad (31)$$

Range and bias are

$$Range: s_{\min} = 1, \quad s_{\max} = 10, \qquad Biases: p_1 = 0.1, p_2 = 4 \quad (32)$$

Decision variable s_3= V or useful volume
Large volume is now desired

$$s_3 = V = \pi R(ir)^2 H(ih),, P_s(3) = P(s_3) \quad (33)$$

Range and bias are

$$Range: s_{\min} = 1000, \quad s_{\max} = 6000,$$
$$Biases: p_1 = 5, p_2 = 0.1 \quad (34)$$

Decision variable s_4 = Mat(im) or mass of shell material of class im
Small mass of material class im is desired

$$s_4 = Mat(im) = \rho(im) V_m = \rho(im) 2\pi R t (R + H) \quad (35)$$
$$P_s(4) = P(s_4)$$

$$M_{\max} = 1 \cdot 10^5$$
$$Range: s_{\min} = 0.1 M_{\max}, \quad s_{\max} = 1 M_{\max} \quad (36)$$
$$Biases: p_1 = 0.1, p_2 = 2$$

Decision variable s_5 = Cost or cost of materials and construction
Low cost is now desired

$$Cost = c_m(im) \cdot Mat(im)$$
$$s_5 = Cost = K \quad , P_s(5) = P(s_5) \quad (37)$$
$$im = 2, steel$$

$$K_{\max} = 1 \cdot 10^6$$
$$Range: s_{\min} = 0.1 K_{\max}, \quad s_{\max} = 2 K_{\max} \quad (38)$$
$$Biases: p_1 = 0.1, p_2 = 2$$

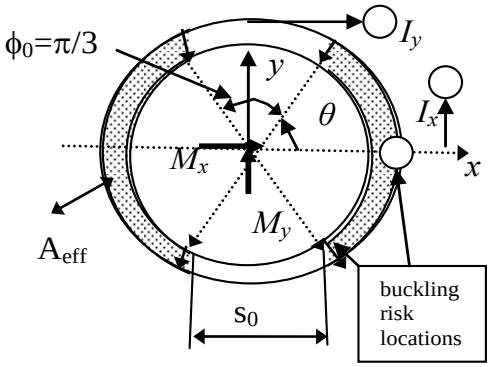


Figure 9. Skirt cross section at opening

Decision variable $s_7 = N_{skirt.cylinder}$ or skirt cylinder buckling safety factor
The buckling strength reduction factor

$$\alpha = \alpha_0$$
$$\alpha = \alpha_0 = \frac{0.83}{\sqrt{1 + 0.01\frac{R}{t}}} \quad IF, \quad \frac{R}{t} < 212 \quad (39)$$
$$\alpha = \alpha_0 = \frac{0.70}{\sqrt{0.1 + 0.01\frac{r}{t}}} \quad IF, \quad \frac{R}{t} > 212$$

The constraint becomes

$$\sigma \le \sigma_{buckl,ideal} = 0.6\frac{Et}{R} = \sigma_{cr} \quad (40)$$
$$\sigma_{buckl} = \alpha \sigma_{buckl,ideal}$$

the bending stress due to overturning moment $M_y = M_x = M_b$ is

$$\sigma_{bend} = \sigma_{Z,My} = \frac{M_y R}{I_y(\theta)} \quad (41)$$

The safety factor is of buckling endurance of the cylindrical shell parts of the skirt against both compressive loading and seismic bending loading is

$$N_{skirt.cylinder} = \frac{\sigma_{buckl}}{\sigma_z} = \frac{\alpha \sigma_{cr}}{\sigma_{z,P} + \sigma_{Z,My}} \quad (42)$$

$$s_7 = N_{skirt.cylinder} \quad , P_s(7) = P(s_7) \quad (43)$$

$$Range: s_{\min} = 1, \quad s_{\max} = 500,$$
$$Biases: p_1 = 0.1, p_2 = 1 \quad (44)$$

Decision variable s8 = $N_{hoop.bot}$ or safety factor for hoop tensile stress due to sloshing at root of the main vessel
Sloshing increases fluid height by increment Z. The critical location is at bottom.

$$\sigma_{\text{hoop}} = p\frac{R}{t_{bot}} \Rightarrow \sigma_{\text{hoop}} = \rho g(H + Z)\frac{R}{t_{bot}},$$
$$a \Rightarrow a_g = 3, g = 9.8 \quad (45)$$
$$\sigma_{\text{hoop}} = \left(1 + \frac{R}{H} \bullet \frac{a}{g}\right)\rho g H \frac{R}{t_{bot}} = x_{ag}\sigma_{\text{hoop,bot}}$$

The decision variable becomes

$$s_8 = N_{hoop.bot} = \frac{\sigma_{all}(steel)}{\sigma_{hoop}} \quad , P_s(8) = P(s_8) \quad (46)$$

A rather high value is desired

$$Range: s_{\min} = 0.5, \quad s_{\max} = 8,$$
$$Biases: p_1 = 2, p_2 = 0.1 \quad (47)$$

Decision variable s_9 = $N_{side.top}$ or safety factor for main shell upper side buckling
The model is shown in Fig.10. This buckling risk occurs close to the top. The dynamic movement of the fluid inside the vessel is assumed to push the wall forward while causing the top sides to cave in causing compressive stresses and a buckling risk.

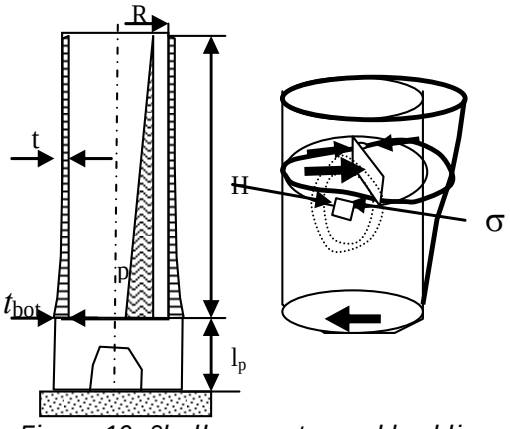


Figure 10. Shell geometry and buckling

While all other decision variable values were satisfactory this safety factor was below unity, typically only 0.03. This result predicts that some buckling probably occurs. But since this is an isolated location it is not considered as safety critical for the whole structure.

$$A_p = D \cdot \Delta h = 2R\Delta h,$$
$$\Delta h = x_H H = H, x_H = 1 \quad (48)$$

Safety factor is

$$N_{side.top} = \frac{\sigma_{buckl}}{\sigma} = \frac{0.6\dfrac{Et}{R}}{4.8\dfrac{V}{4t\Delta h}\left(\dfrac{H}{R}\right)^2} \qquad (49)$$

here V is base shear

$$V = M \cdot S_a = M 2.5g$$
$$M_w = \rho V_w = \rho\pi R^2 H$$
$$K = \frac{4\cdot 0.6}{4.8}\frac{x_H}{2.5\pi} = 0.064, \qquad (50)$$
$$p_{hydr} = \rho g H$$

Here M_w is mass of liquids H is height and p_{hydr} is hydrostatic pressure at bottom

$$s_9 = N_{side.top} = K\frac{E}{p_{hydr}}\left(\frac{t}{R}\right)^2\left(\frac{R}{H}\right) \quad , P_s(9) = P(s_9) \qquad (51)$$

Now a small value is allowed due to low criticality

$$Range: s_{min} = 001, \quad s_{max} = 1,$$
$$Biases: p_1 = 0.1, p_2 = 1 \qquad (52)$$

A stiffening ring may be used to limit the buckling amplitude. If wall thickness is about 3t then the safety factor is increased by factor of ten to a reasonable value.

Decision variable s_{12} = $N_{skirt.plate}$ is factor of safety for skirt opening sides using a plate model for sides of openings

Both direct and bending stress act on the fictive surrogate plate. The peripheral stress is small close to the edge of the opening.

For the reduced cross section the second areal moment about x axis is

$$I_x(\theta) = I_p\left[\frac{\theta}{\pi} - \frac{1}{2\pi}\sin 2\theta\right] \quad , \quad I_p = 2\pi R^3 t \qquad (53)$$

Second area moment around y- axis is larger due to openings

$$I_y(\theta) = I_p\left[\frac{\theta}{\pi} + \frac{1}{2\pi}\sin 2\theta\right] \qquad (54)$$

The compressive stress at the skirt is due to the load of the water in the vessel. The effective area is less than full area

$$\sigma_{z,P} = \frac{Mg}{A_{eff}} = \frac{\rho\pi R^2 H\cdot g}{2(\pi-\phi_0)Rt} = \rho g H\frac{R}{t}\frac{1}{2\left(1-\dfrac{\phi_0}{\pi}\right)} \qquad (55)$$

$$\sigma_{z,Mx} = \frac{M_x R}{I_x(\theta)} \le \sigma_{Z,cr} = 0.53E\left(\frac{t}{b}\right)^2 \qquad (56)$$

$$\sigma_{z,plate} = \sigma_{z,Mx} + \sigma_{z,P}$$

Here b is effective plate width in buckling.

Thus the decision variable is

$$s_{12} = N_{skirt.plate} = \frac{\sigma_{z,cr,plate}}{\sigma_{z,plate}} = \frac{0.53\cdot E\cdot\left(\dfrac{t}{b}\right)^2}{\sigma_{z,Mx}+\sigma_{z,P}}$$
$$P_s(12) = P(s_{12}) \qquad (57)$$
$$\phi_0 = \tfrac{1}{2}\pi, \quad , t_{skirt} = t,$$

Now a wide range is allowed as reasonable.

$$Range: s_{min} = 1, \quad s_{max} = 7,$$
$$Biases: p_1 = 0.1, p_2 = 0.1 \qquad (58)$$

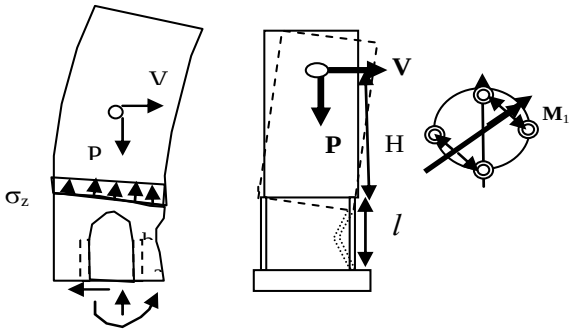


Figure 11. a) Skirt side buckling; b) Column support buckling

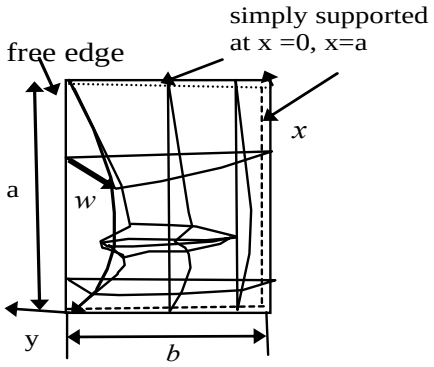


Figure 12. Plate buckling model

Decision variable s_{13} = N_{Euler} is safety factor for Euler buckling of columns

According to Case et al [5] it has been found from tests on mild-steel pin ended struts that failure of an initially curved member takes place when the yield stress is first attained in one of the extreme fibres. First the column cross section area is calculated

$$A_{col} = 2\pi r_p t_p \qquad (59)$$

The Euler buckling strength is calculated as stress

$$\sigma_{Euler} = E\frac{\pi^2}{2}\left(\frac{r_p}{l_p}\right)^2 \qquad (60)$$

The total load due to water on the struts is P

$$P = M_w g \quad V = M_w g\cdot x_v, \quad x_v = 2.5 \qquad (61)$$

Here V is seismic shear stress causing bending at height H lever. The strength reduction factor is

$$\eta = 0.003\left(\frac{l_p}{r_g}\right), \quad r_g = \tfrac{1}{2}r_p \qquad (62)$$

The radius of gyration of thin shelled columns is r_g = $r_p/\sqrt{2}$. The total column stress is due to normal and bending stress action

$$\sigma_{tot} = \frac{F_{tot}}{A_{col}} = \frac{1}{A_{col}}\left[\frac{1}{4}P + \frac{V(H+l_p)}{x_R R}\right], x_R = 2.8 \qquad (63)$$

The buckling instability strength of a strut

$$A_{strut} = \tfrac{1}{2}\sigma_y + (1+\eta)\sigma_{Euler} \quad ,$$
$$B_{strut} = \left[\tfrac{1}{4}A_{strut}^2 - \sigma_y\sigma_{Euler}\right]^{\frac{1}{2}} \qquad (64)$$
$$\sigma_{strut} = \tfrac{1}{2}A_{strut} - B_{strut}$$

The safety factor is

$$s_{13} = N_{Euler.column} = \frac{\sigma_{strut}}{\sigma_{tot}} \quad , P_s(13) = P(s_{13}) \qquad (65)$$

Where

$$Range: s_{\min} = 0.5, \quad s_{\max} = 5$$
$$Biases: p_1 = 2, p_2 = 0.1 \qquad (66)$$

RESULTS

Using this optimisation method the design goals are formulated just as the customer wishes using fuzzy ideas. In a case study the effect of emphasising simultaneously desire for very low cost and desire for very high useful volume and maintaining satisfaction of other goals is studied. The result is a trade off between the contradictory and non-contradictory requirements. Results are shown in Table 4. As expected, the cost and volume satisfactions were both low. Other goals were however satisfactory.

Table 4. Emphasis on very low cost and on high useful volume gave satisfaction $P_G = 3.8 \cdot 10^{-7}$. Constraint s_6 is not needed and passed by setting $P(s_6)=1$

properties for optimal model	numerical values	p_1 p_2
$P(s_1)$, s_1= T_{imp}, impulsive mass period	0.95, 0.0137	0.1 0.1
$P(s_2)$, s_2=T_{conv}, convective period	0.164, 2.6 3.1*,	2, 0.1
$P(s_3)$, s_3=V, Volume of inner fluid	0.005, 382	5, 0.1
$P(s_4)$, s_4=Mat, mass of material	0.58, 4750	0.1 2
$P(s_5)$, s_5 = cost of shell material	0.078, 95000	0.1 5
$P(s_6)$, not used	1,0.	-
$Ps(s_7)$, s_7= $N_{skirt.cylinder}$, skirt.cyl. buckling	0.997, 4e5	0.1 0.1
$P(s_8)$, s_8 = $N_{hoop.bot}$ tension at I bottom	0.567, 5.37	2 0.1
$P(s_9)$, s_9= $N_{side.top}$, buckling of shell	0.79, 0.032)	0.1 ,0.1
$P(s_{10})$, s_{10}= acceleration at T_{imp} period	0.343, 10.6	0.1 2
$P(s_{11})$, s_{11}=acceleration at T_{conv} period	0.993, 1.31	0.1 4
$P(s_{12})$, s_{12}= $N_{skirt.plate}$ skirt plate buckling	0.935, 1.5e4	0.1 0.1
$P(s_{13})$, s_{13}= $N_{Euler.column}$ column buckling	0.08, 1.56	2 , 0.1

** Convective mode period with FEM model T=3.1s*

The main shell geometry:Radius R = 4.5 wall in upper section t =0.002, height H = 6, wall at bottom t_{bot} =0.035,

The column geometry: radius R_p=0.08, wall thickness t_p = 0.003, height l_p = 2.

Some results are discussed to show the essential features in this design case study.

The critical decision variables are those with least satisfaction. Some decision variables have high level of satisfaction over the range of design variables. This means that they are not sensitive to changes and thus need no closer attention. The impulsive acceleration is over ten and the convective is somewhat over one. Thus it is much more critical.

Decision variable s_9 = $N_{side.top}$ or safety factor for buckling of main shell was small. The consequences to the overall structure can be determined by FEM. But by adding a stiffening ring the buckling factor of safety can be increased.

The satisfaction on s_7 = $N_{skirt.cylinder}$ or the skirt cylinder buckling safety factor was not high enough. Thus some strengthening is needed.

The satisfaction on s_{12}= $N_{skirt.plate}$ or skirt surrogate plate buckling at the sides of the opening was too small. Thus some strengthening is also needed.

The satisfaction on s_8 = $N_{hoop.bot}$ or safety factor on the hoop tensile stress at shell bottom was over five but according the set satisfaction function it was not high enough. Justification for desiring high safety factor was that the bottom shell is a safety critical area of a large vessel. However, this shows that some rational fine-tuning of desire levels is needed

Comparison of the skirt and column support choices. The simplified dynamical model of Fig.1 has one lumped mass and two effective springs

A. Skirt supported model. Eigenfrequency period is small T_{skirt} = 0.0026 s and damping z = 0.02 give the spectral acceleration is Se_{Tskirt} = 3.17

B. Column supported model. Eigenfrequency period is now long T_{column} = 0.036 s and damping z=0.02 gives for the spectral acceleration $Se_{Tcolumn}$ = 5.26.

Thus there is not very great difference in Se values and selection between them may be made using other criteria.

Simple dynamical model showed that the skirt supported structure is somewhat more satisfactory than the column supported model. The main reason is that the stiffness of the skirt support is high giving short eigenperiod and thus it generates a relatively small spectral acceleration. But the stiffness of column support is low causing long eigenperiod and spectral acceleration which is higher than for the cylindrical skirt. For both support types the safety factor against buckling is only about unity. This shows that more stiffening is needed.

FEM MODEL RESULTS

The main geometry of the FEM model is shown in Fig.13. Radius R = 4.5and height G = 6m are the same as obtained by optimum design. But now the advantage of FEM was used to choose different wall thickness which us structurally and also optimal to manufacture

Layer 1, z= 0…1m, wall is t=0.025.

Layer 2 ,z = 1…3m, wall is t=0.010.

Layer 3, z= 3…6m, wall is t=0.004.

Accurate convective mode period was obtained by standard (1) as T_2 = 3.1. The approximate model gave less 2.6. This accurate standard modelling gave the impulsive pressure on the projection area between heights z =0 to z=4.5 m and convective equivalent pressure extends from z= 6-4.116 to 6.

This means that they overlap. This pressure distribution is transferred to FEM model.

The deformation result is shown in Fig. 14.

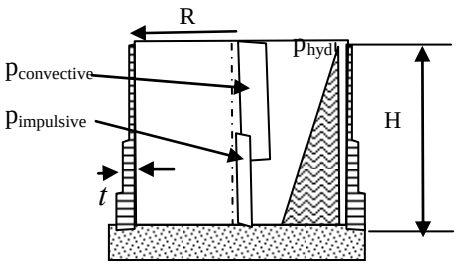


Figure 13. FEM model dimensions

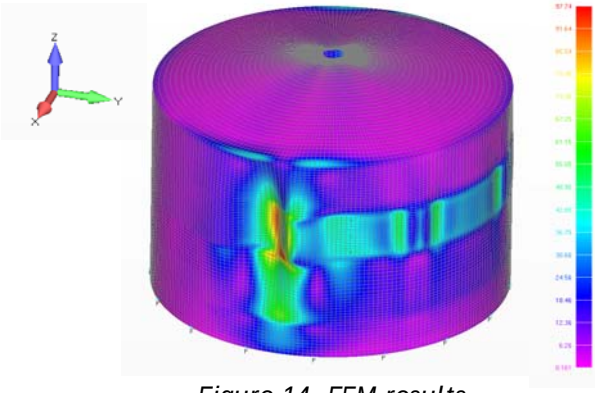


Figure 14. FEM results

By comparing the FEMin Fig. 14 it seems that the result resembles the prediction of shell theory for thebuckling risk of main shell upper side buckling in Fig. 15.

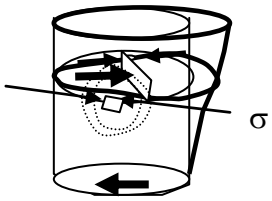


Figure 15. Buckling risk sketch for the shell theory prediction for main shell upper side buckling.

CONCLUSION

A preliminary optimal design of seismically loaded liquid containing vessels is essential get the main dimensions within correct ranges before detailed design by FEM. This methodology makes possible to consider the simultaneous interaction of various choices like loads, dimensions, materials and limit states on the result. All important design events like cost and limit states are expressed as decision variables and the fuzzy customer satisfaction function distribution on them. Then the total satisfaction is calculated as product of functions.

The optimisation method is composed of analytical probing of assumed risk locations with physical variable models.

The optimisation goal is to obtain optimal main dimensions and shapes, the critical locations using basic mechanics and simplified standard calculation. It showed that the impulsive seismic acceleration was more critical for optimality than the convective acceleration.

The suggested optimum result was checked by FEM modelling. Both models predict a buckling risk at upper sides of the vessel caused by to fluid motion against the wall.

The FEM results show reliably and graphically the behaviour of the structure under loads.

Both methods supplement each other by adding their strong points and compensating weaknesses by synergy.

The FEM methods is done is steps. First the main dimension of the vessel and seismic environments data is assembled. Most of this data is given by the customer. Next the relevant standards are used to get loading data for the FEM models.

Third the FEM model shows the deformations, stresses and eigen frequencies and modes for some parts. The fourth step is to make iterative optimising changes to the structure and rerun the model until result is satisfactory.

The future vision is to combine the three main design methods. First is the analytical concept innovation and optimisation to get main parameters. The second is fine-tuning with FEM. The third step is to use as guidelines in both steps the requirements of standards and global megatrends in ecology and technology.

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AUTHORS & AFFILIATION

[1] Heikki MARTIKKA,
[2] Ilkka PÖLLÄNEN

[1] HIMTECH ENGINEERING, UNIVERSITY OF OULU, JOUTSENO, FINLAND
[2] SAV ENGINEERING, UNIVERSITY OF OULU, KOUVOLA, FINLAND

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

A.P. SENTHIL KUMAR[1], V. Prabhu RAJA[2], P. KARTHIKEYAN[3],
M. RAMU[4], P. MANOJ KUMAR[5]

TEMPERATURE DISTRIBUTION STUDY OF VARIOUS INCLUSIONS FOR ESTIMATING THE EFFECTIVE THERMAL CONDUCTIVITY OF TWO PHASE MATERIALS

ABSTRACT:
In this article, the temperature distribution in the unit cell for various inclusion shapes at different conductivity ratios, contact ratios and concentration were carried out by ANSYS software with suitable boundary conditions. The software validation and mesh size has been carried out.

KEYWORDS:
Concentration; Conductivity ratio; various inclusions; Two-phase materials

INTRODUCTION

The importance of two-phase materials such as ceramics, metal foams, emulsion and suspended systems, granular materials lies in many of the applications in microelectronic chip cooling, spacecraft structures, catalytic reactors, heat recovery process, heat exchangers, heat storage systems, petroleum refineries, nuclear reactors, electronic packaging, and food processing. Many researchers have spent an enormous amount of effort on developing various analytical methods for modeling and calculating two-phase homogeneous materials with imbedded inclusions and surrounding inter phase. Moreover, this problem has importance because of its analogy with the general susceptibility of dispersed media such as dielectric constant, refractive index, magnetic permittivity, electrical conductivity, elastic modulus, and diffusion coefficient. The problem is one of the long standing issues and has been treated in many papers on the basic of unit cell approach by considering the primary parameters such as concentration of the dispersed phase (υ), conductivity ratio (a) and secondary parameters (contact resistance, heat transfer through radiation, Knudsen effect and geometrical configurations). Numerous models were developed to find out the effective thermal conductivity (ETC) of the mixtures, but one of the major limitations of the models is its suitability for specific applications. Maxwell's work (1) predicting the magnetic permittivity of a dilute suspension of spheres is the earliest reported work in the modeling of transport properties of two-phase media. But one of the limitations of the model is applicable for lower concentration of the dispersed phase. The Maxwell and phase inverted Maxwell (2) models are the minimum and maximum bounds for predicting the thermal conductivity of the two phase system. These are the most restrictive bounds proposed and every model should incorporate these bounds as a minimum and maximum. The upper and lower limits to the conductivity of two-phase materials based on parallel and series resistances were given by Wiener (3). Zehner and Schlunder (4) proposed a model considering the effect of particle contact as well as the effect of secondary parameters such as thermal radiation, pressure dependence, particle flattening, shape and size distribution for cylindrical unit cell containing spherical inclusions. An important deficiency in the model is that the deformation of the flux field is taken only as a function of concentration, not as a function of the conductivity ratio. Hsu, et al (5) obtained algebraic expressions for effective thermal conductivities of porous media by applying lumped parameter method, which is based on an electric resistance analogy. Models were developed to describe the effective thermal conductivity of randomly packed granular materials based on the unit cell method, by Crane and Vachon (6). A review of thermal conductivity of packed beds at no-flow condition was described by the Tsotsas and Martin (7). Bruggeman (8) extended Maxwell's result for lower concentration of the dispersed phase to the full range of concentration by assuming the mixture to be quasi-homogeneous. Raghavan and Martin (9) proposed a unit

cell model that agreed exactly with field solutions of Maxwell and provided the basis for a fundamentally correct approach in the modeling of conductivity. Numerical study for effective conductivity based on a model made up of spheres in cubic lattice has been carried out by Krupiczka (10). Krischer (11) described the unit cube thermal conductivity model. A review of conduction in heterogeneous systems was studied by Meredith and Tobias (12). The purpose of this work was correcting, modifying and extending the Rayleigh (13) formula for interactions of higher order between particles. Bauer (14) developed an analytical model for the effect of randomly distributed inclusions or pores on the solution of Laplace's heat conduction equation for prediction of thermal conductivity of packed beds. The effective thermal conductivity of packed beds based on field solution approach was carried out by Dietz (15). A review of various methods for predicting the effective thermal conductivity of composite materials was proposed Progelhof et al. (16). The thermal conductivity of a saturated porous medium was calculated for a two-layer model representing as electrical resistance in an electrical circuit (Deisser and Boregli; 17). Kunii and Smith (18) proposed a unit cell model. The electrical conductivity of binary metallic mixtures was investigated by Landauer (19). Samantray et al. [20] proposed a comprehensive conductivity model by considering the primary parameters based on unit cell and field solution approaches. Later, the validity of the model was extended to predict the effective conductivity of various binary metallic mixtures with a high degree of accuracy (21). Reddy and Karthikeyan (22) developed the collocated parameter model based on the unit cell approach for predicting the effective thermal conductivity of the two-phase materials. Tai [23] deduced mathematical expressions for the equivalent thermal conductivity of two and three-dimensional orthogonally fiber-reinforced composites in a one-dimensional heat flow model. In this regard, Tai applied the fundamental definitions of thermal conductivity and the simple rule of mixtures to a unit cell of an orthogonally fiber-reinforced material. Tai, showed that whether a square slab model or a cylindrical fiber model is used makes little difference to the heat flux; while the fiber volume fraction matters. Jones and Pascal [24] developed a three-dimensional numerical finite-difference to calculate the thermal conductivity of a composite with two or more constituents to better understand how the relative quantities and distributions of the component materials, within a sample, affect the whole sample conductivity. Graham and McDowell [25] estimated the transverse thermal conductivity of continuous reinforced composites containing a random fiber distribution with imperfect interfaces using finite-element analysis. Krach and Advani [26] investigated the effect of void volume and shape on the effective conductivity of a unidirectional sample of a 3-phase composite using a numerical approach consisting of a unit cell. Their findings clearly showed that the influence of porosity on thermal conductivity could not be described solely by the void volume. They found that the shape and distribution of the voids influence the effective thermal conductivity. Al-Sulaiman et al [27] developed correlations based on a finite element analysis that predict the thermal conductivity of fibers utilizing the easy to measure thermal conductivity of the Fiber Reinforced Composite Laminates (FRCL) and the other constituents. In their model, Al-Sulaiman et al considered the FRCL cured at high pressures such that it includes no air voids. Zou et al. [28] come up with an analytical expression for transverse thermal conductivities of unidirectional fiber composites with and without thermal barrier is derived based on the electrical analogy technique and on the cylindrical filament-square packing array unit cell model (C-S model).

MODELING FOR VARIOUS INCLUSIONS

SQUARE CYLINDER

The effective thermal conductivity of the two dimensional medium can be estimated by considering a square cylinder with cross-section 'a x a' having a connecting bar width of 'c' as shown in the Fig. 1. The effective thermal conductivity of the two-dimensional periodic medium is assumed to be depending on the finite contact between the inclusions. The two dimensionally spread inclusions are connected by connecting plates with 'c/a' denoting the contact parameter.

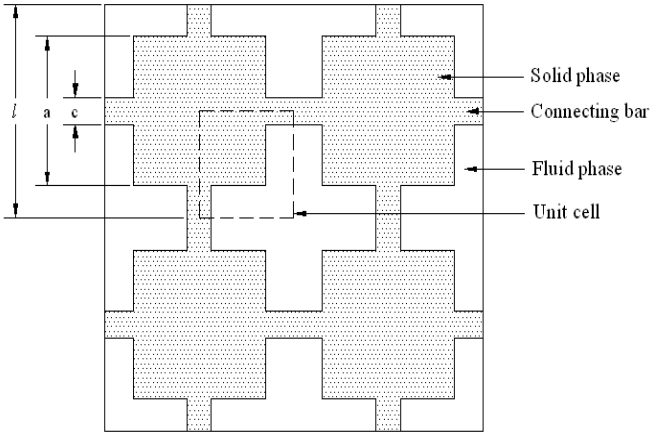


Fig. 1.Two-dimensional spatially periodic two-phase system (Touching square cylinder)

Because of the symmetry of the plates, one fourth of the square cross-section has been considered as a unit cell and is shown in Fig. 2.

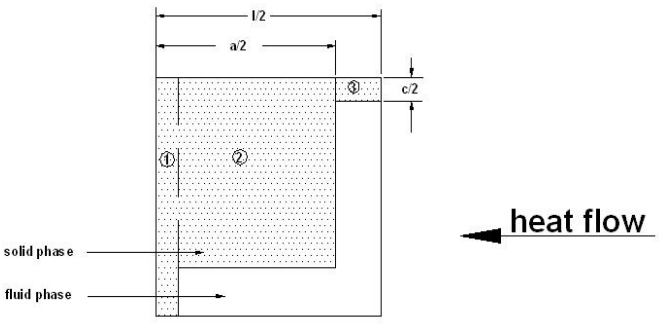


Fig.2. Unit cell of square cylinder

The unit cell consists of three rectangular solid layers (1), (2), (3) as shown in the Fig.2. The dimensions of the first, second and third rectangular solid layer is (l/2) (c/2), (a/2) ((a-c)/2) and c/2) ((l-a)/2) respectively. The model is based on the one dimensional heat conduction in the unit cell. The concentration for square cylinder is given as

$$\upsilon = [\varepsilon^2(1-2\lambda)+2\varepsilon\lambda] \qquad (1)$$

HEXAGON CYLINDER

The effective thermal conductivity of the two dimensional medium can be estimated by considering a Hexagon cylinder with cross-section 'a x a' having a connecting bar width of 'c' as shown in the Fig.3. The effective thermal conductivity of the two-dimensional periodic medium is assumed to be depending on the finite contact between the inclusions. The two dimensionally spread inclusions are connected by connecting plates with 'c/a' denoting the contact parameter

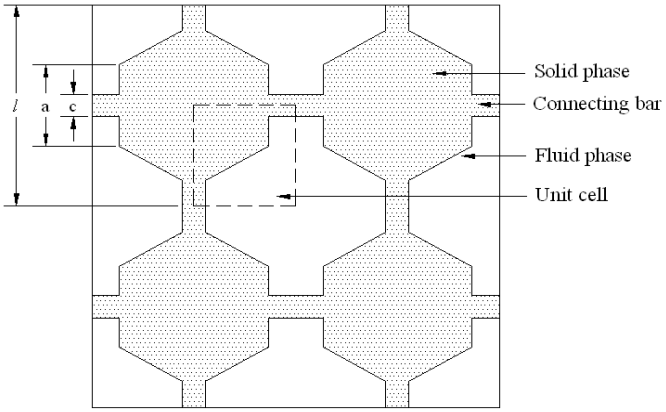


Fig.3.Two-dimensional spatially periodic two-phase system (Touching hexagon cylinder)

Because of the symmetry of the plates, one fourth of the hexagon cross-section has been considered as a unit cell and is shown in Fig.4

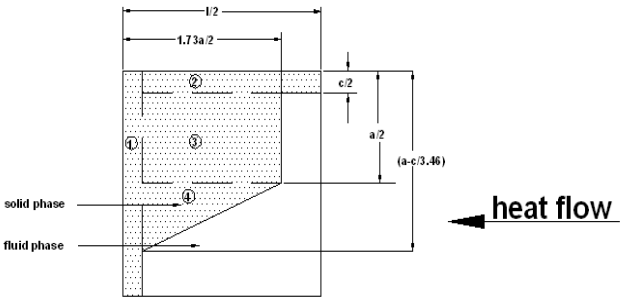


Fig.4. Unit cell of hexagon cylinder

The unit cell consists of three rectangular solid layers (1), (2), (3) and one triangular solid layer (4) as shown in Fig.4. The dimensions of the first, second and third rectangular solid layer is (l/2) (c/2), (c/2) ((l-c)/2) and ((a√3-c)/2) ((a-c)/2) respectively. The dimension of triangular solid layer is ((a√3-c)/2) ((a/2)-(c/2√3)). The concentration for hexagon cylinder is given as

$$\upsilon = (2a\lambda) + [(3\sqrt{3}-(3+\sqrt{3})\lambda)\,a^2]/l^2 \qquad (2)$$

OCTAGON CYLINDER

The effective thermal conductivity of the two dimensional medium can be estimated by considering a Octagon cylinder with cross-section 'a x a' having a connecting bar width of 'c' as shown in the Fig.5. The effective thermal conductivity of the two-dimensional periodic medium is assumed to be depending on the finite contact between the inclusions. The two dimensionally spread inclusions are connected by connecting plates with 'c/a' denoting the contact parameter

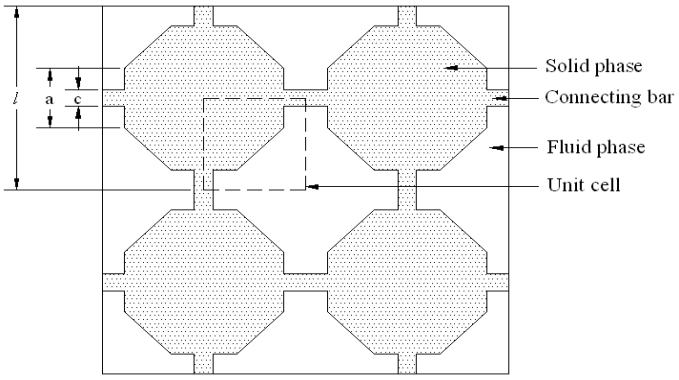


Fig.5.Two-dimensional spatially periodic two-phase system (Touching octagon cylinder)

Because of the symmetry of the plates, one fourth of the octagon cross-section has been considered as a unit cell and is shown in Fig.6.

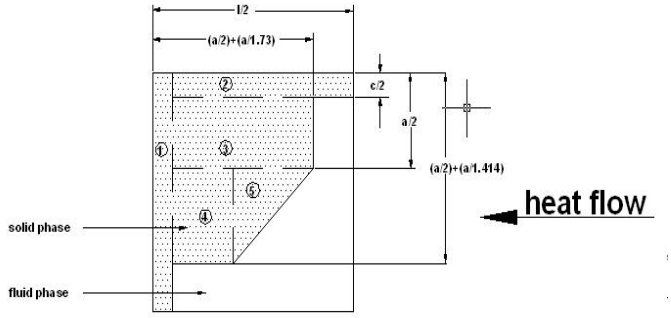


Fig.6. Unit cell of octagon cylinder

The unit cell consists of four rectangular solid layers (1), (2), (3), (4) and one triangular solid layer (5) as shown in Fig.6. The dimensions of the first, second, third and fourth rectangular solid layer is (l/2) (c/2), (c/2) ((l-c)/2), ((a+a√2-c)/2) ((a-c)/2) and (a/√2) ((a-c)/2) respectively. The dimension of triangular solid layer is (a/√2) (a/√2). The concentration for octagon cylinder is given

$$\upsilon = 2\varepsilon^2\left[\left(1+\sqrt{2}\right)(1-\lambda)\right] + 2\varepsilon\lambda \qquad (3)$$

CIRCULAR CYLINDER

The effective thermal conductivity of the two dimensional medium can be estimated by considering a Circular cylinder of diameter 'a' having a connecting bar width of 'c' as shown in the Fig.7. The effective thermal conductivity of the two-dimensional periodic medium is assumed to be depending on the finite contact between the inclusions. The two dimensionally spread inclusions are connected by connecting plates with 'c/a' denoting the contact parameter.

Because of the symmetry of the plates, one fourth of the circular cross-section has been considered as a unit cell and is shown in Fig.8.

The unit cell consists of two rectangular solid layers (1), (2) and one quarter circular solid layer (3) as shown in the Fig.8.

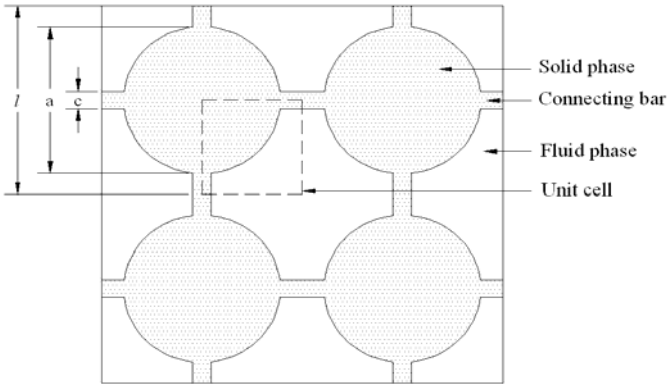


Fig.7.Two-dimensional spatially periodic two-phase system (Touching circular cylinder)

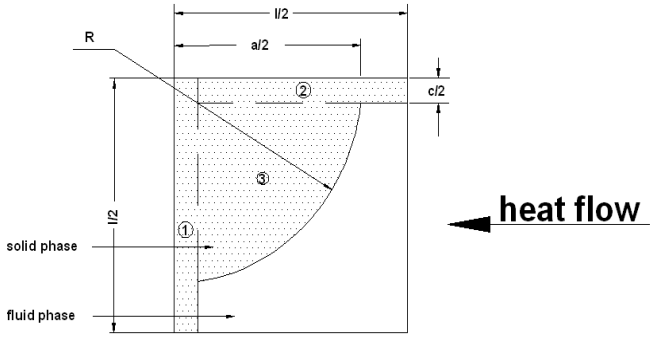


Fig.8. Unit cell of circular cylinder

The dimensions of the first and second rectangular solid layer is (l/2) (c/2), (c/2) ((l-c)/2) respectively. The radius of circular solid layer is (a/2)-(c/√2).The concentration for circular is given as

$$\upsilon = [\{\pi [(1/2)-(\lambda/\sqrt{2})]^2-\lambda^2\} (a/l)^2]+(2a\lambda)/l \qquad (4)$$

NUMERICAL ANALYSIS FOR VARIOUS INCLUSIONS

Numerical heat transfer analysis of the unit cell for various inclusion shapes (square, hexagon, octagon and circular cylinders) has been carried out to estimate the Effective Thermal Conductivity of the two-phase materials via the Finite Element simulation. For this heat transfer analysis ANSYS11.0, a finite element software package is used.

Boundary condition

One face of the unit cell is subjected to constant temperature and the opposite face is subjected to convective thermal environment. All other faces are kept as adiabatic in order to achieve 1D heat transfer.

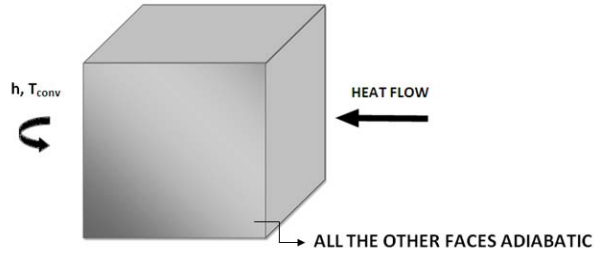


Fig 9.The Thermal boundary condition applied on the unit cell

The boundary condition imposed on the unit cell is shown in the Fig.9.

Determination of Effective Thermal conductivity

From the results of the finite element analysis, the average surface temperature on the convection wall of the unit cell is computed. Once the temperature of the convective side is known, the effective thermal conductivity across the two walls can be calculated using the following simple heat balance equation

$$hA(T_{wall2}-T_{conv}) = \frac{K_{eff}\,A(T_{wall1}-T_{wall2})}{L} \qquad (5)$$

A - Wall area (m^2)

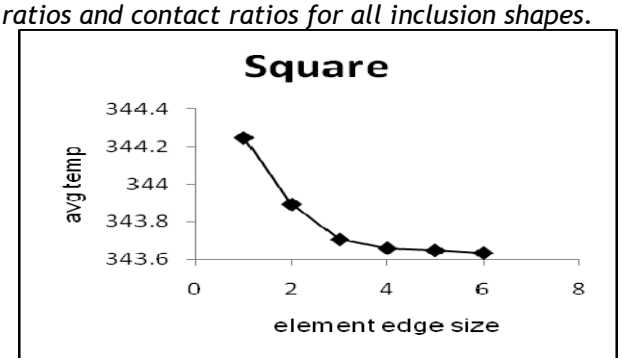
h - Heat transfer coefficient ($W/m^2.K$)

T_{conv}-bulk temperature of the fluid at the convection side (K)

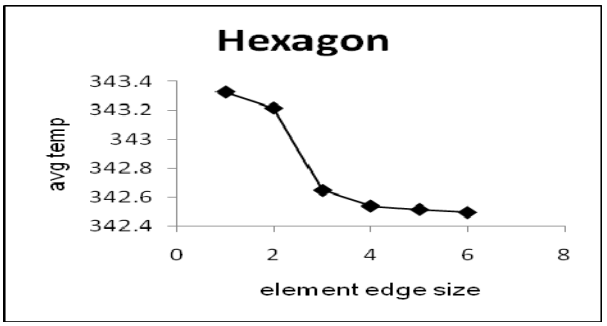
T_{wall1} - fixed wall temperature (K)

T_{wall2}-convective wall temperature (K)

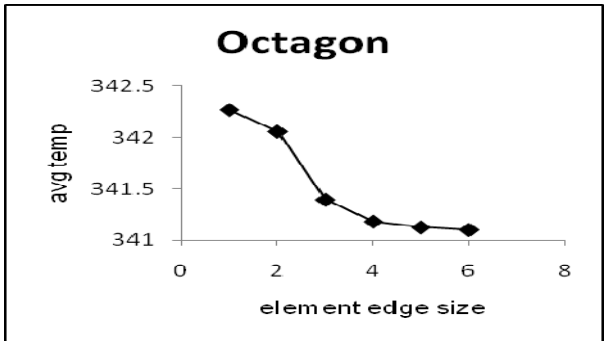
Several simulations were done for a wide spectrum of possible variation in the concentrations, conductivity ratios and contact ratios for all inclusion shapes.



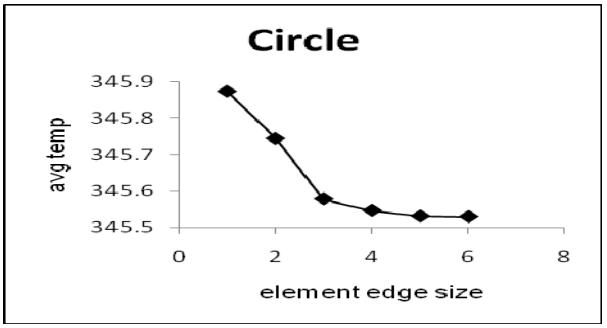
(a)



(b)



(c)



(d)

Fig10. (a)-(d) Element edge size Vs Average temperature for square, hexagon, octagon & circular cylinders

Mesh sensitivity test

This model has been first tested for mesh-independent solution. In this regard, six runs have been conducted for the case of two-phase material with conductivity ratio=800, concentration=0.5 and contact ratio=0.02. In these six runs, the finite element edge size was changed from very coarse to very fine element. In each of these six runs, the average temperature at the convective wall of the two-phase material was calculated.

Table1. Mesh Sensitivity Test

Element edge size	Square cylinder	Hexagon cylinder	Octagon cylinder	Circular cylinder
0.2	344.248	343.3291	342.2664	345.8729
0.1	343.8929	343.2161	342.0569	345.7442
0.05	343.7064	342.6477	341.3922	345.5785
0.03	343.6591	342.538	341.1802	345.5469
0.025	343.6472	342.5136	341.1242	345.5315
0.02	343.6339	342.4941	341.1	345.5225

Table.1.gives a summary of the output of these six runs indicating the element edge size and the corresponding average wall temperature obtained for various inclusions. A graph (Fig.10) is plotted between the element edge size and the corresponding average wall temperature for various inclusions. From the graph it is seen that after an element edge size of 0.03 the average wall temperature remains almost constant indicating the convergence of the solution. Looking for high accuracy and reasonable CPU simulation time, it is decided to use a medium element edge size of 0.03. This reflects clearly that the numerical solution obtained via this FE simulation is mesh size independent.

Software validation

The Finite element simulation has been bench-marked to obtain the numerical temperature distribution along the thickness of the unit cell by simulating a simple non-linear 1D analysis with thermal contact resistance. The problem chosen for validation consists of three layers of different thermal conductivity and different wall thickness. Both face of the wall is subjected to convective environment. An internal contact thermal resistance is given between each layer. The ANSYS code for the above problem is developed. The results obtained from the ANSYS software package is compared with the available analytical solution. This comparison is shown in the Fig.11.

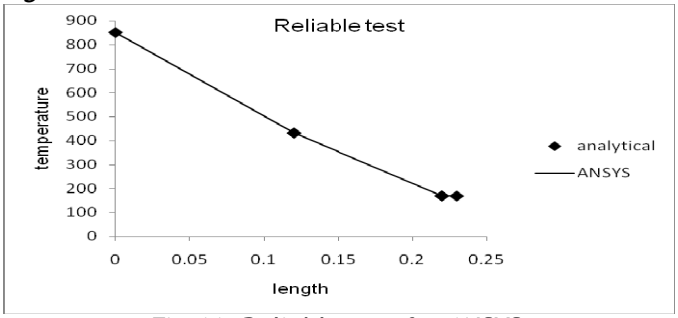
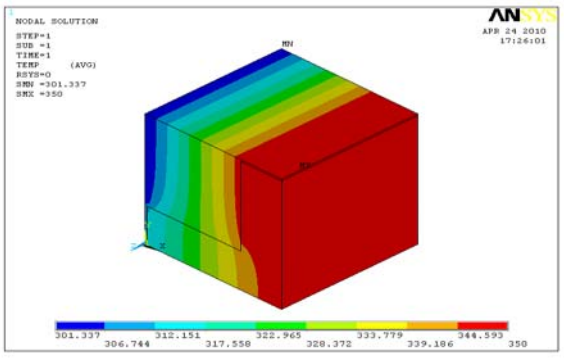


Fig.11. Reliable test for ANSYS

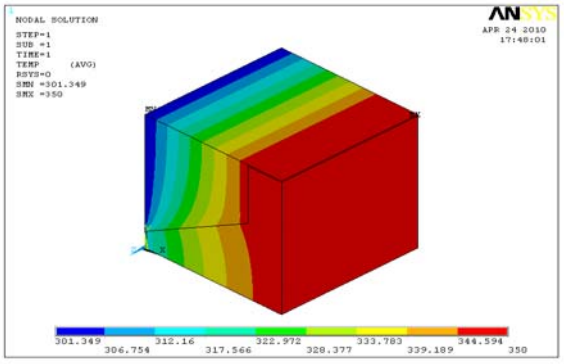
This figure reveals an excellent agreement between the analytical and the numerical solution obtained via ANSYS. This is considered as an excellent validation of the ANSYS software package.

Temperature Distribution In The Unit Cell For Various Inclusion Shapes

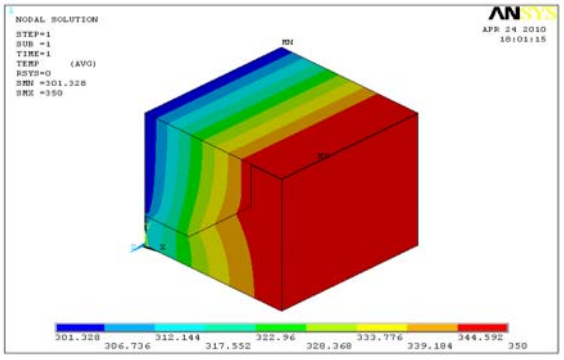
The temperature distribution in the unit cell for various inclusion shapes at different conductivity ratios and contact ratios for concentration=0.5 is shown in the Figs12-17.



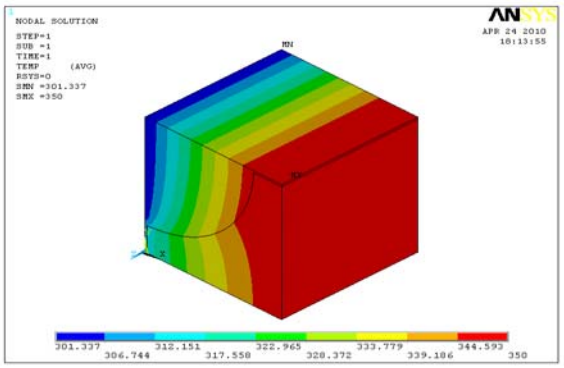
(a)



(b)

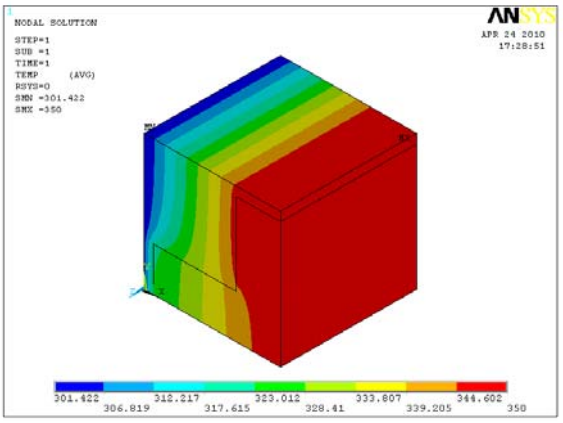


(c)

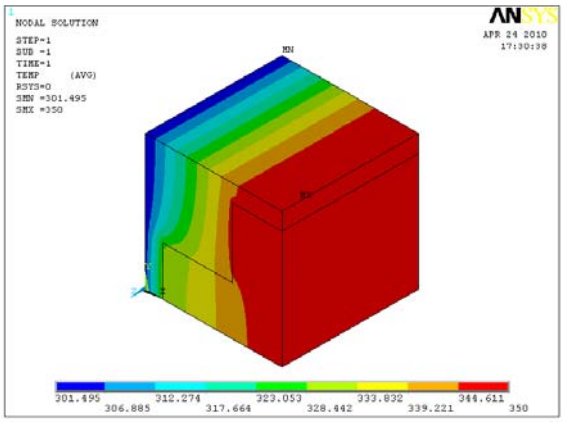


(d)

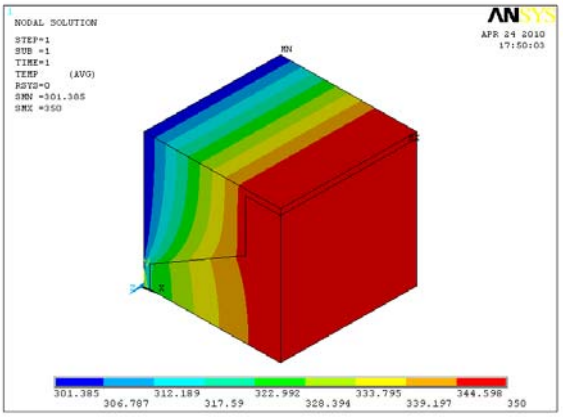
Fig12. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=0.1, υ=0.5 and λ=0.02.



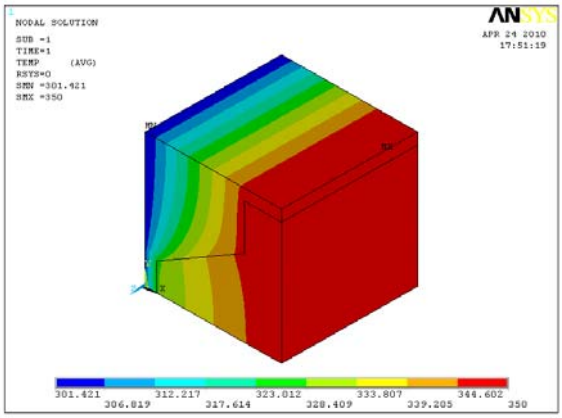
(a)



(a)



(b)



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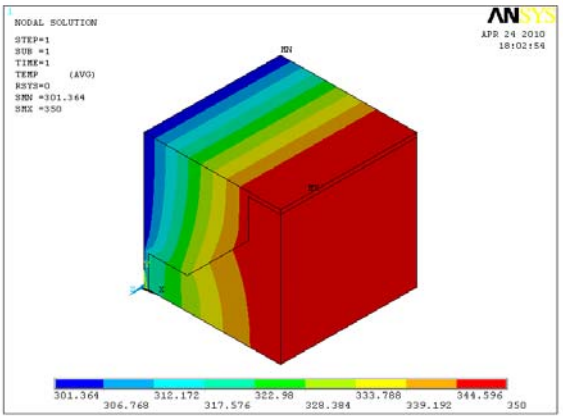

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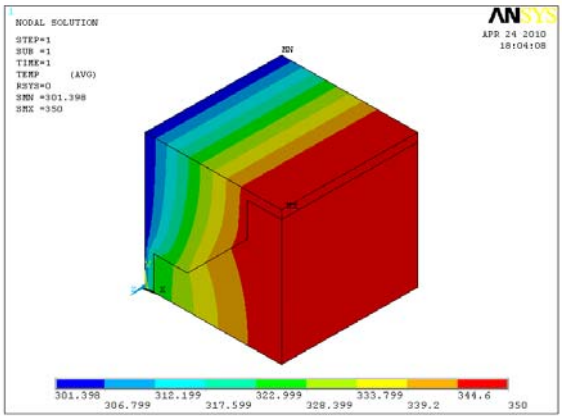

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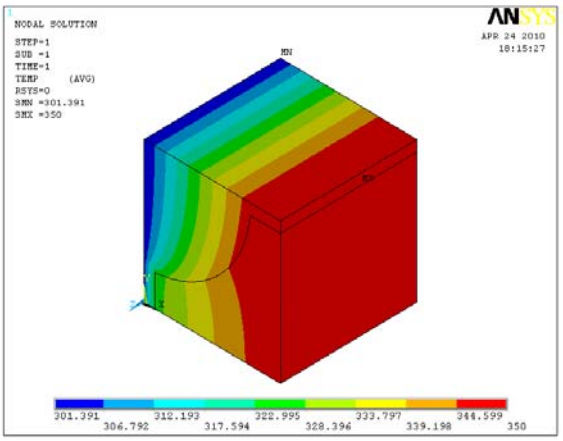

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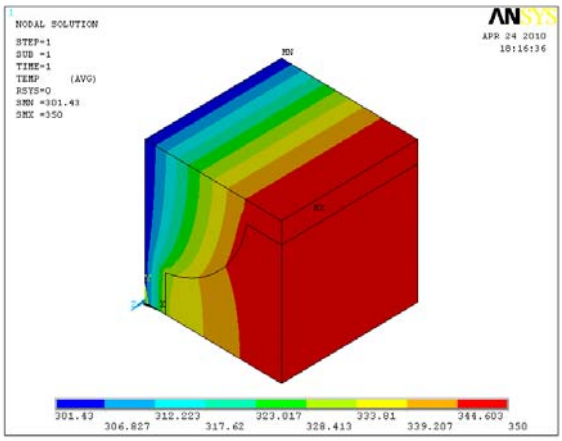
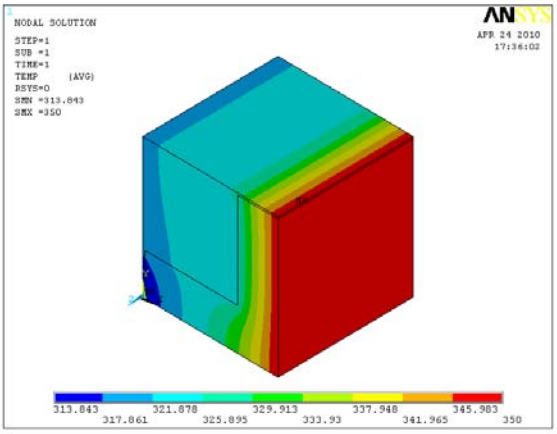


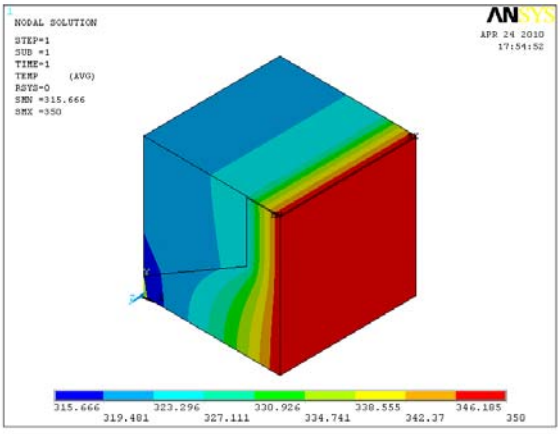
(d)

Fig13. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=0.1, υ=0.5 and λ=0.1

Fig14. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=0.1, υ=0.5 and λ=0.2



(a)



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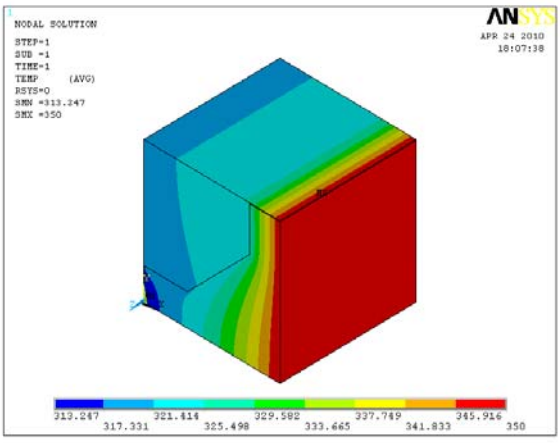

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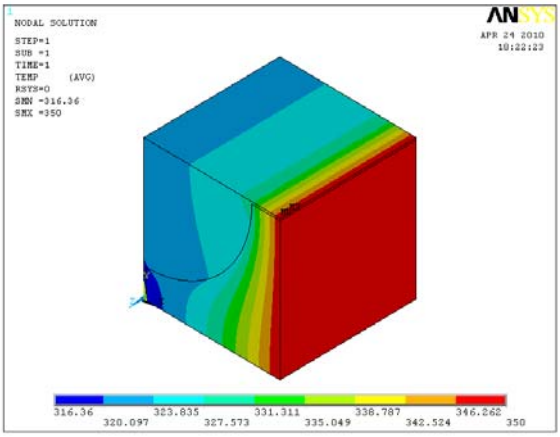
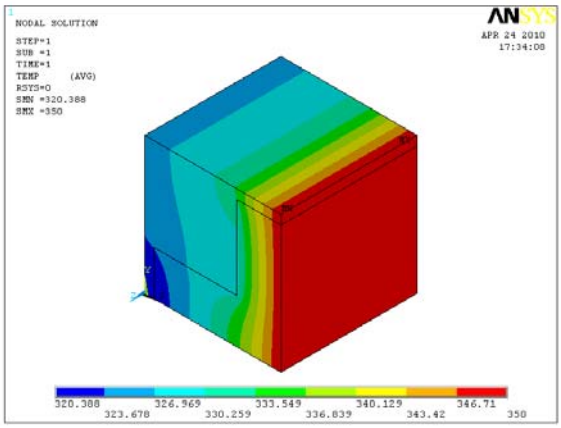
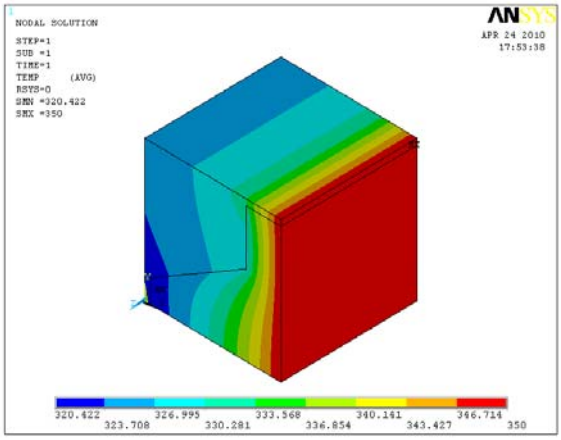


(d)

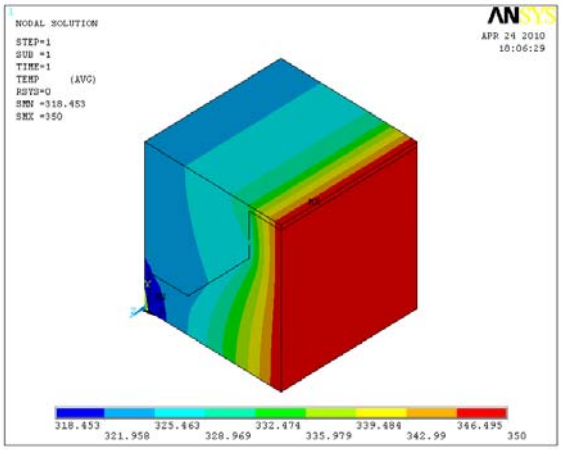
Fig15. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=20, υ=0.5 and λ=0.02.



(a)



(b)



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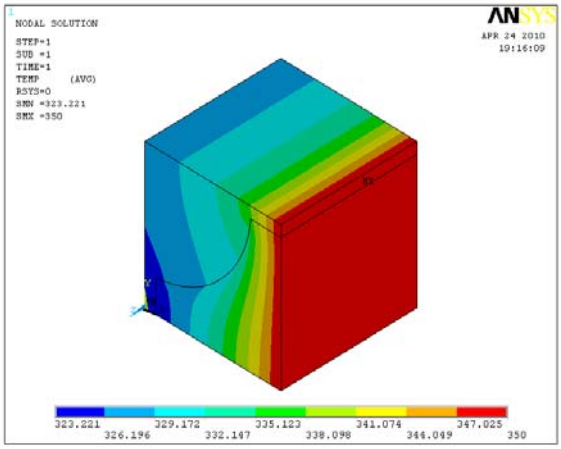

(d)

Fig16. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=20, υ=0.5 and λ=0.1

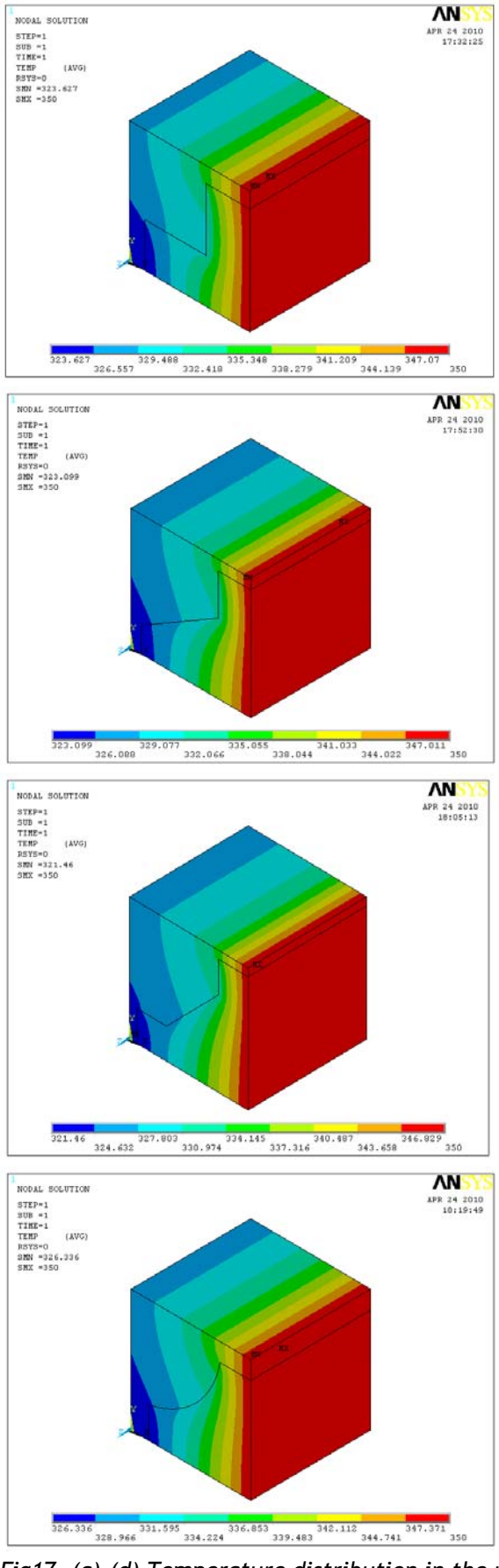

Fig17. (a)-(d) Temperature distribution in the unit cell for various inclusion shapes at a=20, υ=0.5 and λ=0.2

CONCLUSION

The circular shaped inclusion has largest non-dimensional effective thermal conductivity followed by square, hexagon and octagon shaped inclusions respectively. For the same concentration and contact ratio, hexagon shaped inclusion has largest heat transfer area followed by circular, octagon and square shaped inclusions respectively. Since hexagon has the largest heat transfer area it is expected to have larger non-dimensional effective thermal conductivity than other inclusion shapes. But the geometry of hexagon and octagon shapes are not symmetric about its mutual perpendicular axis i.e., hexagon and octagon shapes exhibits anisotropic property. This is the reason for the hexagon shaped inclusion to have lower non-dimensional effective thermal conductivity than circular and square shaped inclusions.

SYMBOLS

a - Conductivity ratio(k_s/k_f)
υ - Concentration
λ - Contact ratio(c/a)
ε - Length ratio(a/l)

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AUTHORS & AFFILIATION

A.P. SENTHIL KUMAR[1],
V. Prabhu RAJA[2],
P. KARTHIKEYAN[3],
M. RAMU[4],
P. Manoj KUMAR[5]

[1,2,4] FACULTY OF MECHANICAL ENGINEERING, PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004, INDIA
[3] FACULTY OF AUTOMOBILE ENGINEERING, COIMBATORE - 641 004, INDIA
[5] FACULTY OF PSG INSTITUTE OF ADVANCED STUDIES, COIMBATORE - 641 004, INDIA

ACTA TECHNICA CORVINIENSIS
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

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8-10 June 2011,

Bol, Island Brac, CROATIA

INVITATION

INTERNATIONAL CONFERENCE "MANAGEMENT OF TECHNOLOGY - STEP TO SUSTAINABLE PRODUCTION" (MOTSP 2011), will take place from 8-10 June 2011, Bol, Island Brac as a joint project organized by the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Faculty of Graphical Arts, Croatia, Faculty of Management, University of Primorska, Koper and University of Maribor, Faculty of Mechanical Engineering, Slovenia.

The main objective of this International Conference (MOTSP 2011) is to gather international experts from academic entities, research laboratories and industries related to the field of Management of Technology and Sustainable Production. The Conference will also provide a platform for sharing knowledge, ideas and results between science and industry. The management of technology, the stimulation of innovation and invention and the transfer of technology are considered important challenges of the developed countries and countries in transition.

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General Information

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Presentations should take 15 minutes. The authors will have the possibility of using computers for the presentations (Power Point).All the accepted papers will be published in the Conference Proceedings to be distributed during the Conference. According to the Scientific Committee recommendations, the authors of the selected papers will be invited to extend their papers for publication in the following journals (some of them are included in databases CC, SCI, SCI - Expanded):

- Strojarstvo, Journal for Theory and Application in Mechanical Engineering (Current Contens)
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- International journal of Transitions and Innovation systems

Correspondence address

Faculty of Mechanical Engineering and Naval Architecture,
University of Zagreb, Ivana Lučića 5, 10 000 Zagreb, Croatia
E-mail: motsp2011@fsb.hr
URL: motsp2011.info

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

4TH INTERNATIONAL CONFERENCE FOR ENTREPRENEURSHIP, INNOVATION AND REGIONAL DEVELOPMENT
From Entrepreneurial Learning to Innovation and Regional Development
5 – 7 May 2011
Ohrid, MACEDONIA

OBJECTIVE OF THE CONFERENCE

The objective of the conference is to gather together decision makers (government, ministries and state agencies), innovation experts (universities, research and development centers, technology transfer centers, start-up centers) and practitioners (SMEs, business incubators and business support organizations) to generate discussion and exchange on the potential of entrepreneurship promotion and innovation to national and regional competitiveness.

ORGANIZER & PATRONS

- *National Centre for Innovation and Entrepreneurial Learning - www.ncdiel.mk*
- *European Academy of Sciences and Arts - www.euro-acad.eu*
- *Macedonian Academy of Sciences and Arts - www.manu.edu.mk*
- *European Council for Small Business and Entrepreneurship - www.ecsb.com*

The International Conference for Entrepreneurship, Innovation and Regional Development (ICEIRD) Consortium was formally established in 2008. It is a multi - disciplinary and cross-sectoral network crossing several streams of theory and practice, namely entrepreneurship, innovation, regional economic development and information systems. The ICEIRD Consortium was set-up with members from institutions jointly researching and collaborating in strategising/organising the annual ICEIRD conference and managing joint projects focused on the theory, policy and practice of entrepreneurship and innovation in particular as it pertains to information technologies.

One of the higher concern features of the so-called European Innovation Paradox is the divide between academic research and policy-making, between thinkers and doers. The ICEIRD can become an authoritative reference in bridging this gap by developing analysis in the field of innovation and regional policy, based on high-level academic research, but without neglecting the lessons learnt by policy makers and professionals in the field. Thus establishing experiential feedback learning loops and cross fertilization among two communities which have lived too far away from each other for far too long, and in the European Union in particular.

President of ICEIRD 2011: Radmil Polenakovik, NCDIEL, Skopje, Macedonia,

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MAIN TOPICS

Entrepreneurship: as a process of identifying opportunities and putting useful ideas into practice

- *Corporate entrepreneurship / intrapreneurship*
- *Entrepreneurial Finance and Venture Capital*
- *Entrepreneurial Process: From Creation to Growth*
- *Entrepreneurial university and the role of universities*
- *International Entrepreneurship*
- *Linking Intellectual Capital, Strategy and Entrepreneurship*
- *Models of Entrepreneurial learning at all levels of education*
- *Technological entrepreneurship, social entrepreneurship, green entrepreneurship*
- *Young and Female entrepreneurship*
- *Global Entrepreneurship Monitor (GEM) related experiences*

Innovation: as the driver of national, regional and global economy

- *Develop the enabling environment for innovative entrepreneurship*
- *National and regional policies on entrepreneurship and innovation*
- *Green Innovation*
- *Human Resource Practices for promoting innovation for SMEs*
- *Innovation training & education*
- *Innovative processes and models (SCM, ERP, BPR, e-business models, …)*
- *Intellectual Property Management in Higher Education and Research Institutions*
- *Intellectual property rights*
- *International cooperation and national innovation policies to face global challenges*
- *Methods and tools for innovation*
- *Open innovation strategies and models from universities and research centers*
- *The conditions for developing sustainable systems of innovation*
- *European Innovation Scoreboard (EIS) related experiences*

Regional development: and the possibilities and barriers for closer cooperation between South East European economies, EU and beyond

- *Cross-border cooperation – best practices towards regional development*
- *Entrepreneurship and Regional Open Innovation Systems*
- *ICT and Regional competitiveness*
- *Intelligent regions*
- *Networks and clusters of innovation*
- *Regional competitiveness and development*
- *Support infrastructure for entrepreneurial ventures and business incubation*
- *Territorial cooperation as a driver of regional growth*
- *The benefit of knowledge zones, business start-up centers and incubators in the region*

DEADLINES & SUBMISSION INFORMATIONS

Registration: After 20 March 2011
Conference dates: 5-7 May 2011

CORRESPONDENCE ADDRESS

NATIONAL CENTRE FOR DEVELOPMENT OF INNOVATION AND ENTREPRENEURIAL LEARNING, FACULTY OF MECHANICAL ENGINEERING
Karpos II bb., POBox 464, 1000 Skopje, MACEDONIA
E-mail: info@ncdiel.mk, 2011@iceird.org
www.ncdiel.mk, www.iceird.org

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

8th INTERNATIONAL CONGRESS "MACHINES, TECHNOLOGIES, MATERIALS"

Topic: „Innovative Solutions for Product and Process Development"

18 – 21.09.2011

Varna, BULGARIA

ORGANIZERS & CO-ORGANIZERS

- SCIENTIFIC-TECHNICAL UNION OF MECHANICAL ENGINEERING BULGARIA
- FEDERATION OF THE SCIENTIFIC-TECHNICAL UNIONS IN BULGARIA
- TECHNICAL UNIVERSITY – SOFIA
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- TODOR KABLESHKOV UNIVERSITY OF TRANSPORT, BULGARIA
- ASSOCIATION OF POLISH MECHANICAL ENGINEERS AND TECHNICIANS – POLAND

with the support of:

1. *NATIONAL SCIENTIFIC -TECHNICAL SOCIETIES:*

- SOCIETY OF FOUNDRY
- METAL SCIENCE AND HEAT TREATMENT SOCIETY
- AUTOMATION OF DISCRETE PRODUCTION SOCIETY
- BULGARIAN SOCIETY OF NON-DESTRUCTIVE TESTING
- GEAR TRANSMISSIONS AND DRIVING SOCIETY
- PLASTIC DEFORMATION SOCIETY
- PLASTICS IN MECHANICAL ENGINEERING SOCIETY
- SOCIETY OF POWDER METALLURGY AND COMPOSITE MATERIALS
- MANAGEMENT AND ENGINEERING SOCIETY
- ERGONOMICS AND INDUSTRIAL DESIGN

2. BULGARIAN WELDING SOCIETY

3. BULGARIAN SOCIETY OF ROBOTICS AND MECHATRONICS

4. BULGARIAN SOCIETY OF TRIBOLOGY

INVITATION

*The Eight International Congress "**MACHINES, TECHNOLOGIES, MATERIALS '11 - INNOVATIONS FOR THE INDUSTRY**" will be carried out on 18th – 21st September, 2011 in the resort "St. St. Konstantin and Elena", region Varna, as a comprehensive scientific-technical manifestation, which includes **three main topics** and five special congress sub-sections: GEAR TRANSMISSIONS, ERGONOMIC AND ENGINEERING DESIGN, BULTRIB, INDUSTRIAL INFORMATIC, NANOMATERIALS*

*We invite scientists and researchers to present to their colleagues and to the industry representatives the results of their researches and to publish them in the web-based International scientific-technical journal **"MACHINES, TECHNOLOGIES, MATERIALS"**, which is issued in print and on CD.*

We invite the companies to take part with their presentations in the congress meetings and with advertisement in the congress materials to present their machines, equipment, technologies, materials and services, which are currently on the market.

We hope that in this way the Congress will become a bigger innovation mediator between scientific research and industry and we offer you to take advantage of this opportunity.

*The pre-congress program for the weekend before the opening of **MTM'11** will give you the possibility to rest, to have fun and to learn about landmarks, cultural and historical sightseeing on the north coast of the Black Sea.*

MAIN TOPICS

MACHINES:

***KINDS**: Treatment Machines; Machining Machines, Processing Machines, Connecting Machines, Casting Machines, Packaging Machines, Driving Machines, Transporting Machines, Manipulation Machines, Automation Machines,Measurement and Testing Machines.*

TOOLS AND MEASUREMENT DEVICES STORAGE. TRAINING.

***ACTIVITIES**: Designing and Construction. Rapid Prototyping. Manufacturing. Research and Testing. Repair, Operation and Maintenance. Recycling and Utilization. Life Cycle Engineering. Re-Engineering. Training.*

Special Sub-Congress Sections:

1. GEAR TRANSMISSIONS 2011

2. ERGONOMIC AND ENGINEERING DESIGN 2011

TECHNOLOGIES:

COLD AND HOT SHAPEFORMING: Metal Casting, Plastic Deformation, Welding, Soldering and Adhesive Bonding, Machining. SURFACE TECHNOLOGIES. SURFACE TREATMENT. SURFACE MACHINING. CHANGING OF PROPERTIES. TESTING, MEASUREMENT AND CONTROL. AUTOMATION. INFORMATION TECHNOLOGIES. LOGISTIC. LOAD TRATEMENT. MANAGEMENT ENGINEERING. INDUSTRIAL DESIGN. ENERGY SAVING AND ENVIRONMENT FRIENDLY TECHNOLOGIES. TRAINING

Special Sub-Congress Sections:

1. BULTRIB 2011

2. INDUSTRIAL INFORMATIC 2011

MATERIALS:

KINDS: Metal Materials, Non-Metal Materials, Tool Materials, Structural Materials, Accessory Material.

MATERIALS SCIENCE. TRAINING

Special Sub-Congress Section: NANOMATERIALS 2011

IMPORTANT TERMS

The full text of the papers, payments and Participation Form "B" or online registration should be sent: ***30.04.2011***

Announcement of the plenary and sectional session's program on our web page: www.mech-ing.com/mtm: ***31.07.2011***

The Organizing Committee will receive posters up to: ***01.09.2011***

Receiving of the application for transfer and Pre Congress Program: ***01.09.2011***

Registration of the participants: ***19.09.2011***

Opening of the congress: ***20.09.2011***

REGISTRATION

Online registration** and the whole information about Honorary Committee, International Program Committee, National Organizing Committee, instructions for making papers and posters, fees, payments, visas and transfers on:* ***http://www.mech-ing.com/mtm/index.html

*For participants in the Congress and accompanying persons for the weekend before the opening of **MTM'11** will give you the possibility to rest, to have fun and to learn about landmarks, cultural and historical sightseeing on the north coast of the Black Sea. You can find more information about the Pre-Congress Program here: **Pre-CP1**, **Pre-CP2**, **Pre-CP3***

PUBLICATION

- *Detached issue of the web based International Scientific-Technical Journal **"MACHINES, TECHNOLOGIES, MATERIALS"** (ISSN 1313-0226).*
- *In **CD**, containing all papers.*

CORRESPONDENCE ADDRESS

SCIENTIFIC-TECHNICAL UNION OF MECHANICAL ENGINEERING
108 Rakovski str., 1000 Sofia
tel./fax (+359 2) 986 22 40, tel. (+359 2) 987 72 90
nts-bg@mech-ing.com , www.mech-ing.com/mtm

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

RIM 2011

8TH INTERNATIONAL SCIENTIFIC CONFERENCE ON PRODUCTION ENGINEERING
DEVELOPMENT AND MODERNIZATION OF PRODUCTION

September 26th – 30th
Praha, CZECH REPUBLIC

ORGANIZERS

FACULTY OF TECHNICAL ENGINEERING FROM BIHAC, and
SOCIETY FOR ROBOTIC OF BOSNIA AND HERZEGOVINA

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THEMATICALLY AREAS

A. RESEARCH AND DEVELOPMENT OF MECHANICAL ENGINEERING PRODUCTION SYSTEMS AND TECHNOLOGIES
MACHINING, NONCONVENTIONAL MACHINING, TOOLS, RAPID PROTOTYPING, MANUFACTURING PROCESSES, WELDING PROCESSES, PLASTIC FORMING PROCESSES, MATERIALS, CAP TECHNOLOGIES, CIM, ENGINEERING OF POLYMERS, POWDER METALLURGY, MEASURING, THIN & THICK COATINGS, SURFACE ENGINEERING, MOLDING PROCESSES, CAM TECHNOLOGIES

B. RESEARCH AND DEVELOPMENT OF WOOD - INDUSTRY PROCESSING
WOOD PRODUCTS, WOODWORKING, WOOD INDUSTRY, PROCESSES, FURNITURE AND FURNITURE COMPONENTS, MANUFACTURING, WOOD MATERIALS, ENGINEERED WOOD, VENEERS, LUMBER

C. TECHNOLOGIES AND TECHNIQUES IN ELECTRICAL ENGINEERING AND ELECTRONICS
MODERN DEVELOPMENTS, TOOLS, POWER, CONTROL, MICROELECTRONICS, TELECOMUNICATIONS, COMPUTERS, ELECTRICAL ENGINEERING, POWER SYSTEMS, ENERGETICS, HARDWARE AND SOFTWARE, SIGNAL PROCESSING, NETWORKING, NEURAL NETWORK, ARTIFICIAL INTELLIGENCE

D. ENGINEERING IN CONSTRUCTION INDUSTRY AND INDUSTRY OF CONSTRUCTION MATERIALS
BUILDING CONSTRUCTION, MATERIALS, MACHINES, INDUSTRIAL CONSTRUCTION, HEAVY AND CIVIL CONSTRUCTION, CONSTRUCTION PROCESSES, EXPERTISES, PROCUREMENTS, DESIGN AND BUILD, ENVIRONMENTAL ENGINEERING, MUNICIPAL ENGINEERING

E. MODERN TECHNIQUES AND TECHNOLOGIES IN TEXTILE AND GARMENT INDUSTRY
ADVANCEMENT IN GARMENT MANUFACTURING, DEVELOPMENT IN TEXTILE MACHINERY, FIBRE PHYSICS AND TEXTILE MECHANICS, NANOTEXTILES, TEXTILE DESIGN AND FASHION, MODELLING AND SIMULATION, MANUFACTURING, MATERIALS

F. HIGH TECHNOLOGIES OF WIDE APPLICABILITY
INDUSTRIAL ROBOTS, MICROROBOTICS, PROGRAMMING, SIMULATION, VIRTUAL MANUFACTURING, AUTOMATION, AEROSPACE TECHNOLOGIES, NANOTECHNOLOGY, NUCLEAR PHYSICS

G. MANAGEMENT, ENTREPRENEURSHIP, ECONOMIC DEVELOPMENT.
KNOWLEDGE MANAGEMENT, PROJECT MANAGEMENT, PRODUCTION MANAGEMENT SYSTEMS

H. QUALITY MANAGEMENT, MANAGEMENT OF HUMAN AND NATURE RESOURCES, VIABLE DEVELOPMENT
QUALITY MANAGEMENT, TQM, MAINTENANCE, QUALITY IMPROVEMENT, QUALITY STANDARDS, QUALITY TERMS

IMPORTANT TERMS

- *Submission of abstracts and full papers .....May 1th 2011.*
- *Registration fee payment.....June 1th 2011.*
- *Final Programme .....September 1th 2011.*
- *RIM 2011 .....September 26th - 30th 2011.*

CORRESPONDENCE ADDRESS

FACULTY OF TECHNICAL ENGINEERING BIHAC
Tel.: +387 226 271, +387 226 273
Fax: +387 37 226 270, +387 226 273
E-mail: tfb@bih.net.ba
tfb.rim@gmail.com

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

The 7th International Scientific Conference
RESEARCH AND DEVELOPMENT OF MECHANICAL ELEMENTS AND SYSTEMS
IRMES 2011

April 27th - 28th, 2011
Zlatibor, REPUBLIC OF SERBIA

CONFERENCE PURPOSE

New technologies, globalization and individualization of customer demands, as well as high quality of modern products, are forcing industrial enterprises to improve their processes of product development. This implies the support of enterprise processes throughout the product lifecycle, from the product idea through product development, manufacturing, improvement and quality assurance to maintenance during operation. Processes of product development are more than just usual engineering. A product portfolio must be analyzed and product concept must be examined from the aspect of its realization. This requires linking internal domain with external teams. New products must be introduced to market with high quality and low development costs.

The prerequisite for development of high quality products and high productivity manufacturing is to master the knowledge, which is a result of research in science and technology.

Satisfaction and success of a development engineer is reflected primarily in discovering and designing new construction solutions, despite numerous constraints and problems, and in experiencing the seamless operation and high market penetration of the products being developed.

The aim of the Conference is:

- *to gather experts and researchers in the field of scientific research and industrial product development;*
- *to present new design solutions related to energy efficiency, application of available resources, product price reduction,*
- *to exchange knowledge and experience, through presentations of research results and expert information, with the aim of stimulating industrial activities in the region.*

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Prof. Dr.-Ing. Vojislav Miltenović, Full professor, Department for mechanical constructions, development and engineering, Mechanical Engineering Faculty, University of Niš, Serbia

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TOPICS

1. *DEVELOPMENT OF MECHANICAL SYSTEMS AND COMPONENTS*
2. *INDUSTRIAL AND ECO-DESIGN*
3. *CAD AND EXPERT SYSTEMS*
4. *MODELING AND SIMULATION*
5. *MECHANICAL LOADS AND STRESS CONDITIONS*
6. *SAFETY, QUALITY AND RELIABILITY*
7. *MODERN MATERIALS, THERMAL TREATMENT, COATINGS AND FRACTURE*
8. *TRIBOLOGY*
9. *NOISE AND VIBRATIONS IN MECHANICAL SYSTEMS*
10. *TESTING OF MECHANICAL SYSTEMS*
11. *MONITORING AND MAINTENANCE OF MECHANICAL SYSTEMS*
12. *TRANSMISSION OF POWER AND MOTION (GEARS, SHAFTS, BEARINGS, COUPLINGS, ...)*
13. *MECHANICAL JOINTS (BOLTED, SLOTTED, HINGES, WELDED, PRESS FIT, ...)*
14. *MECHANICAL ELEMENTS FOR FLUIDS (VESSELS, PIPE CLOSURES, PISTON PAIRS, ...)*
15. *EDUCATION OF DEVELOPMENT ENGINEERS*

CORRESPONDENCE ADDRESS

IRMES
MECHANICAL ENGINEERING FACULTY, UNIVERSITY OF NIŠ
Aleksandra Medvedeva 14
18000 Niš Republic of Serbia
web: www.irmes.com
email: info@irmes.com

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

11th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEO - CONFERENCE & EXPO – SGEM 2011
MODERN MANAGEMENT OF MINE PRODUCING, GEOLOGY AND ENVIRONMENTAL PROTECTION
19 – 25 June 2011
Congress Centre "Flamingo Grand", Albena Resort, BULGARIA

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under the auspices of MINISTRY OF ENVIRONMENT AND WATER
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LATVIAN ACADEMY OF SCIENCES
POLISH ACADEMY OF SCIENCES
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&
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AIM & SCOPE

International Multidisciplinary Scientific GeoConference & EXPO – SGEM strengthened its position as one of the largest and successful geoscientific forums in Europe, with popularity exceeding the boundaries of the European Union. This exceptional success was achieved due to the efforts of all SGEM participants from 2001 to this day. They all created the best Scientific Conference in the European Union - SGEM by their scientific contribution, hearty selflessness and distinguished participation during the years.

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TOPICS

1. SECTION „GEOLOGY"
2. SECTION „HYDROGEOLOGY, ENGINEERING GEOLOGY AND GEOTECHNICS"
3. SECTION „EXPLORATION AND MINING"
4. SECTION „MINERAL PROCESSING"
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21. SECTION „RECYCLING"
22. SECTION „ENVIRONMENTAL ECONOMICS"
23. SECTION „EDUCATION AND ACCREDITATION"
24. SECTION „ENVIRONMENTAL LEGISLATION, MULTILATERAL RELATIONS AND FUNDING OPPORTUNITIES"

IMPORTANT TERMS

Full paper Submission: 1 May 2011
Poster Submission: 20 May 2011
Registration and payment for participants WITH papers: 10 May 2011
LATE Registration and payment for participants WITH papers /you should pay registration fee +10% in addition, if NOT your paper/s will be excluded from the proceedings and the programme: 11 - 20 May 2011
Registration and payment for DELEGATES & other participants: 30 May 2011
LATE Registration and payment for DELEGATES & other participants /after that date you should pay registration fee +10% in addition: after 30 May 2011

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Tome IV (Year 2011). ISSN 2067-3809

7th RESEARCH / EXPERT CONFERENCE WITH INTERNATIONAL PARTICIPATION QUALITY 2011

01 - 04 June 2011

Neum, BOSNIA AND HERZEGOVINA

ORGANIZED BY:

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CONFERENCE TOPICS

The Research/Expert Conference will be performed as follows: plenary session (Key papers concerned, global topics), symposium (papers according to the conference topics) and workshops, when needed. We would like to inform all the potential authors to prepare papers in the following topics:

1. QUALITY IN BUSSINES
   - Quality management (Concept, Principles, Tools and Philosophies);
   - System and Process Performance Measurements;
   - Metrology;
   - Quality of product and process;
   - Quality in maintenance;
   - Supply chain management;
   - Environment protection quality;
   - Quality Engineering;
   - Quality Economics;
   - Risk Control;
2. QUALITY IN EDUCATION
   - Pedagogical standards and norms;
   - Methods and procedures of students knowledge accompany and control;
   - Methods and procedures of educational staff quality control;
   - Occupational institutions self evaluation;
   - Bologne process and quality;
   - IWA2;
   - Education programs and institutions accreditation and certification;
   - Law regulation in educational field;
3. QUALITY IN PUBLIC SECTOR
   - Quality in public institutions;
   - Quality in health institutions;
   - Quality in community enterprises;
   - Quality in Agriculture;
   - Quality in Food Processing Industry;
   - Aspect of Quality in Process Accesion BiH in EU
4. STANDARDS REGULATION IN QUALITY
   - International standards ISO 9000 - Quality Management System;
   - International standards ISO 14000 - Environmental Management System;
   - International standards ISO 18000 - Occupational Health and Safety Zone;
   - HACCP,
   - ISO 16949,
   - ISO 22000-Food safety management system,

- *ISO 27000-Information security management standards,*
- *SA 8000-Social Accountability,*
- *Status and trends in development standards;*
- *Quality information systems;*
- *Quality awards;*
- *Standardization;*
- *State quality programs;*
- *TQM models and their evaluation*

IMPORTANT TERMS

Submission of the full paper: April 15th 2011
Registration fee payment: May 10th 2011
Final programme: May 15th 2011
Quality 2011: June 1st to 4th 2011

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BOSNIA & HERZEGOVINA
E-mail: sjasarevic@mf.unze.ba; sabahudinjasarevic@yahoo.com; sbrdarevic@mf.unze.ba
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

10TH ANNIVERSARY INTERNATIONAL CONFERENCE ON ACCOMPLISMENTS IN ELECTRICAL AND MECHANICAL ENGINEERING AND INFORMATION TECHNOLOGY DEMI 2011

26th - 28th May 2011

Banja Luka, Republic of Srpska, BOSNIA & HERZEGOVINA

ORGANIZED BY:

University of Banja Luka,
Faculty of Mechanical Engineerin

ABOUT THE CONFERENCE

Traditionally, the Faculty of Mechanical Engineering of the University of Banja Luka, has been organizing the International Conference on Accomplishments in Electrical and Mechanical Engineering and Information Technology, DEMI, every two years. DEMI 2011 is the 10th Anniversary Conference, which indicates that this conference has a significant place and role in connecting scientists and professionals in electrical and mechanical engineering, as well as computer science.

The aim of the Conference is to indicate the state of research in mechanical engineering and information and communication technologies in the region and present a realistic picture of the industry in terms of the global economic crisis. We are hoping that the results of scientific investigations and research institutions, and research results from the industry, will make a significant contribution to the integration of new technologies in production processes and induce the competitiveness of domestic industry.

We would like to invite all academics and researchers, and experts from the industry, to take part in the Conference DEMI 2011 and exchange experiences, present the latest results of their research, to propose new forms of cooperation between scientific institutions and the economy and the challenges of contemporary business conditions.)

THEMATIC FIELDS

PRODUCTION TECHNOLOGIES AND ENGINEERING

Production technologies, conventional and unconventional processes, production systems and computer integrated manufacturing, quality, safety at work, standards, information systems, management

MECHANICS AND DESIGN

Mechanics of rigid and deformable body, fluid mechanics, hydraulics and pneumatics, design methods, stability of structures, designing of products, analysis and synthesis of construction

TRAFFIC MEANS

Engines, vehicles, railway vehicles, traffic systems modeling, modern transportation means & systems, logistics

THERMOTECHNIQUE AND ENERGETICS

Thermal Engineering, heating, air conditioning, ventilation, refrigeration, energy efficiency, renewable energy sources

MAINTENANCE OF TECHNICAL SYSTEMS

The methods and techniques of maintenance, design and managing of maintenance systems, maintenance versus new technologies, maintenance versus protection of the environment

MECHATRONICS

Industrial automation, automatic control systems, proportional and servo technology, robotics

IMPORTANT TERMS

Final paper: 15.04.2011.
Conference agenda: 15.05.2011.
The Opening Ceremony: 26.05.2011

TIME & VENUE

Venue: Banja Luka,
Faculty of Mechanical Engineering
Time: 26-28 May 2011

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TECHNICAL PRESENTATIONS AND EXHIBITIONS

The Conference organizer is planning marketing and commercial presentations of companies for conference participants. We would like to invite all companies to take this opportuniy and present their products and services to the Conference participants.
Companies that would like to sponsor the Conference will be provided with location and time for technical presentations.

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REPUBLIC OF SRPSKA, BiH
www.demi.rs.ba
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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

INTERNATIONAL CONFERENCE ON INNOVATIVE TECHNOLOGIES IN-TECH 2011

01- 03 September 2011
Bratislava, SLOVAKIA

WELCOME TO WEBSITE OF IN-TECH 2011

Conference runs from 01.09.2011 to 03.09.2011 in BRATISLAVA, the capital of SLOVAKIA. As the capital of Austria, Vienna is only 80 km from Bratislava, the special trip on 04.09.2011 to Vienna, Austria will be organized.

Authors are invited to submit their abstracts (half page in A4 format) in Microsoft Word or Adobe PDF format via e-mail: info@in-tech.info.

Last International Conference on Innovative Technologies IN-TECH 2010 was organized In Prague (Czech Republic) by the World Association for Innovative Technologies - WAIT and the Center for Surface Treatment Prague. The conference was held in the famous Prague Hotel Pyramid, which is located near the Prague Technical University. IN-TECH 2010 conference was attended about 300 participants from 40 countries.

SPECIAL EXCURSION

The special excursion 04.09.2011 to Vienna, Austria will be organized.

SCOPES OF THE CONFERENCE

- MECHANICAL ENGINEERING
- ELECTRONICS ENGINEERING
- MEDICAL INNOVATIVE TECHNOLOGIES
- BIOTECHNOLOGY AND BIOENGINEERING
- AGRICULTURE INNOVATIVE TECHNOLOGIES
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- MANUFACTURING ENGINEERING
- PRODUCTION ENGINEERING
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- OPTIMAL SHAPE DESIGN
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- INTELLIGENT MANUFACTURING SYSTEMS
- MECHATRONICS/ROBOTICS
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- MEASUREMENT AND INSPECTION
- METALLURGY
- AUTOMOTIVE INDUSTRY
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- SIGNAL, IMAGE, AND INFORMATION PROCESSING
- MODELING & OPTIMIZATION OF SYSTEMS AND PROCESSES
- AUTOMATION AND ROBOTICS
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- TRIBOLOGY
- ENVIRONMENTALISTICS
- ENERGY, ENERGY PLANTS, THERMAL ENGINEERING
- RENEWABLE AND NON CONVENTIONAL ENERGY SOURCES, ENERGY SYSTEMS
- PRODUCTION MANAGEMENT
- QUALITY MANAGEMENT
- MAINTENANCE, LOGISTICS

IMPORTANT DATES

Final Paper/Poster: before June 10. 2011
Registration fee: before July 10. 2011

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Ing. JAN KUDLÁČEK, Ph.D.
CTU - CZECH TECHNICAL UNIVERSITY IN PRAGUE
e-mail: info@in-tech.info

Ing. MATEJ LAZANJA.
UNIVERSITY OF RIJEKA
e-mail: info@in-tech.info

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

9th IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT SYSTEMS AND INFORMATICS SISY 2011

September 8-10, 2011
Subotica, SERBIA

ORGANIZED BY:

ÓBUDA UNIVERSITY, BUDAPEST, HUNGARY
SUBOTICA TECH, SERBIA
UNIVERSITY OF NOVI SAD, SERBIA

INVITATION

Authors are welcome to submit original and unpublished paper and attend the 9th IEEE International Symposium on Intelligent Systems and Informatics (SISY 2011) to be held on September 8-10, 2011 in Subotica, Serbia.
SISY 2011 Call for Papers can be downloaded as a pdf file.
Papers are going to be included into IEEE Xplore database after the symposium.
IEEE reserves the right to exclude a paper from distribution after the conference (e.g., removal from IEEE Xplore), if the paper is not presented at the conference.

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TECHNICAL PROGRAM COMMITTEE
Bernard de Baets, Ghent, Belgium
Péter Baranyi, BME, Hungary
György Bárdossy, Hungarian Ac. of Sci.

Authors' Schedule

Full paper submission: July 1, 2011
Notification: August 1, 2011
Final paper submission: August 15, 2011

Official Language

The official language of the Symposium is English. All the camera-ready manuscripts should be submitted in English, and presentations should be made in English.

Paper Presentation

All paper must be presented either in oral session or in poster session. If a paper, included into the proceedings, fails to be presented any way at the conference, all authors of the paper will be bar out from paper submission to conferences of the organizers in the future.

Oral Presentation

Presentations can be made by using OHP or data projector. All authors are kindly asked to take their presentation on CD or USB drive. To present the paper it is not allowed to use own computer. Conference room is supplied with OHP and data projector with PC.

Poster Presentation

If you choose to present your paper in a poster session, not in an oral session, please prepare the presentation into 9 A4 sheets or 1 large (70x100 cm) sheet, bring it with you to the conference and post it to the chart. Poster presentation does not mean just to print out your final paper, but it should be edited to make it scenic.

Secretary General

Anikó Szakál
Óbuda University
szakal@uni-obuda.hu

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

15th IEEE INTERNATIONAL CONFERENCE ON INTELLIGENT ENGINEERING SYSTEMS 2011
INES 2011
June 23-25, 2011
Poprad, SLOVAKIA

SPONSORED BY:

- IEEE Computational Intelligence Chapter, Hungary
- IEEE Joint Chapter of IES and RAS, Hungary
- IEEE SMC Chapter, Hungary
- IEEE Industrial Electronics Society
- Óbuda University, Budapest, Hungary
- Technical University of Košice, Slovakia
- John von Neumann Computer Society, Hungary
- Hungarian Fuzzy Association

INVITATION

Authors are welcome to submit original and unpublished papers and attend the 15th IEEE International Conference on Intelligent Engineering Systems 2011 (INES 2011) to be held on June 23-25, 2011 in Poprad, High Tatras, Slovakia.

TOPICS

TOPICS include but not limited to:

Artificial Intelligence in Engineering: Reasoning, Learning, Decision Making, Knowledge Based Systems, Expert Systems
CAD/CAM/CAE Systems: Product Modeling, Shape Modeling, Manufacturing Process Planning
Communications Software and Systems in Engineering: Design Methodologies and Tools, Object-oriented, UML, Software Engineering
Computational Intelligence in Engineering: Machine Learning, Genetic Algorithms, Neural Nets, Fuzzy Systems, Fuzzy and Neuro-fuzzy Control
Intelligent Manufacturing Systems: Production Planning and Scheduling, Rapid Prototyping, Flexible Manufacturing Systems, Collaborative Engineering, Concurrent Engineering
Intelligent Mechatronics and Robotics Systems: Control, Perception and Recognition, Sensing and Sensor Data Fusion, Intelligent Sensors, Intelligent Motion Control, Service Robots
Intelligent Signal Processing
Intelligent Transportation Systems: Navigation Systems, On-board Systems, Real-time Traffic Control
Man-Machine Systems: Human Computer Interaction, Multimedia Communications, Advanced Computer Graphics, Virtual Reality
Ontologies and Semantic Engineering: Ontology, Thesaurus, Disambiguation, Semantic Inference, Natural Language Interaction
Systems Engineering: Systems Analysis, Systems Methodology, Self-Organizing Systems, Systems Integration, Large Scale Systems, Systems Simulation, Diagnosis and Performance Monitoring

ORGANIZING COMMITTEE

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AUTHORS' SCHEDULE

Full paper submission: April 15, 2011
Notification: May 12, 2011
Final paper submission: May 26, 2011

GENERAL INFORMATION

Date and Place
INES 2011 will take place on June 23-25, 2011, in AquaCity, Poprad, the High Tatras, Slovakia.
Official Language
The official language of the conference is English. All presentations, including discussions and submissions, must be made in the official language. No translation will be provided.
Proceedings
Each accepted paper reaching us in time will be published in CD proceedings, and it will be distributed at the registration desk.
Presentation
Presentations can be made by using OHP or data projector. All authors are kindly asked to take their presentation on CD or USB. To present the paper it is not allowed to use own computer. All conference rooms are supplied with OHP and data projector with PC.
INES 2011 Paper Submission
The official language of the symposium is English. Authors should submit IEEE standard double-column paper with the maximum pages of 6. Authors are kindly asked to submit their paper through electronic paper submission system. Papers sent by email are not acceptable.

SECRETARY GENERAL

Anikó Szakál
Óbuda University
szakal@uni-obuda.hu

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

3rd IEEE INTERNATIONAL SYMPOSIUM ON LOGISTICS AND INDUSTRIAL INFORMATICS
LINDI 2011
August 25-27, 2011
Budapest, HUNGARY

ORGANIZED BY:

Óbuda University, Budapest, Hungary

INVITATION

Authors are welcome to submit original and unpublished papers and attend the 3rd IEEE International Symposium on Logistics and Industrial Informatics (LINDI 2011) to be held on August 25-27, 2011 in Budapest, Hungary.

TOPICS

TOPICS include but not limited to:

- INDUSTRIAL CONTROL AND MANAGEMENT SYSTEMS
- INTELLIGENT MANUFACTURING SYSTEMS
- CAD/CAM/CAE SYSTEMS
- DISTRIBUTED AND NETWORK-BASED CONTROL
- EMBEDDED SYSTEMS
- FAULT-TOLERANT SYSTEMS
- NETWORK MANAGEMENT AND DIAGNOSTICS
- TRANSPORT AND LOGISTICS SYSTEMS
- COMMUNICATION PLATFORMS AND APPLICATIONS
- ENTERPRISE MANAGEMENT SYSTEMS
- INTELLIGENT INFORMATION SYSTEMS
- PROCESS AND WORKFLOW MANAGEMENT SYSTEMS

GENERAL INFORMATION

Date and Place

The symposium will take place on August 25-27, 2011, in Budapest, Hungary.

Official Language

The official language of the Symposium is English. All the camera-ready manuscripts should be submitted in English, and presentations should be made in English. No translation is provided.

Presentation

All paper must be presented either in oral session or in poster session. If a paper, included into the proceedings, fails to be presented any way at the conference, all authors of the paper will be bar out from paper submission to conferences of the organizers in the future.

Oral Presentation

Presentations can be made by using OHP or data projector. All authors are kindly asked to take their presentation on CD or USB drive. To present the paper it is not allowed to use own computer. Conference room is supplied with OHP and data projector with PC.

Poster Presentation

If you choose to present your paper in a poster session, not in an oral session, please prepare the presentation into 9 A4 sheets or 1 large (70x100 cm) sheet, bring it with you to the conference and post it to the chart. Poster presentation does not mean just to print out your final paper, but it should be edited to make it scenic.

Paper Submission

The official language of the symposium is English. Authors should submit IEEE standard double-column paper with the maximum pages of 6. Authors are kindly asked to submit their paper through electronic paper submission system. Papers sent by email are not acceptable.

ORGANIZING COMMITTEE

AUTHORS' SCHEDULE

Full paper submission: May 27, 2011
Notification: July 1, 2011
Final paper submission: July 29, 2011

CORRESPONDENCE

ANIKÓ SZAKÁL
ÓBUDA UNIVERSITY
szakal@uni-obuda.hu

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

12th IEEE INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE AND INFORMATICS CINTI 2011

November 21-22, 2011 Budapest, HUNGARY

ORGANIZED BY:

Óbuda University, Budapest, Hungary
Hungarian Fuzzy Association
IEEE Hungary Chapter of Computational Intelligence Society
IEEE Hungary Chapter of SMC Society
IEEE Hungary Joint Chapter of Industrial Electronics and Robotics and Automation Societies
John von Neumann Computer Society, Hungary

INVITATION

Authors are welcome to submit original and unpublished papers and attend the 12th IEEE International Symposium on Computational Intelligence and Informatics to be held on November 21-22, 2011 in Budapest, Hungary.

OBJECTIVES

The Symposium is organized with the focus of bringing together scientists from any country working on computational intelligence and its applications with the aims at providing an opportunity for sharing and discussing the recent research developments in this field. The idea is to have a small number of lecturers and participants in a relaxed and informal atmosphere.

GENERAL INFORMATION

Official Language

The official language of the Symposium is English. All the camera-ready manuscripts should be submitted in English.

Registration

Only one paper can be included into the proceedings by paying one registration fee. For including any paper into the proceedings, it is necessary for at least one co-author to be registered and the registration fee has to be paid in advance until October 28.

All paper must be presented either in oral session or in poster session. If a paper, included into the proceedings, fails to be presented any way at the conference, all authors of the paper will be bar out from paper submission to conferences of the organizers in the future.

Paper Submission

Authors are asked to submit electronically a full paper until September 30, 2011 through electronic paper submission system.

The official language of the symposium is English.

Authors should submit IEEE standard double-column paper with the maximum pages of 6.

Authors are kindly asked to submit their paper through electronic paper submission system. Papers sent by email are not acceptable.

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AUTHORS' SCHEDULE

Full paper submission: September 30, 2011
Notification: October 10, 2011
Final manuscript submission: October 28, 2011
All accepted papers which meet IEEE requirements are going to be included into IEEE Xplore database after the symposium. IEEE reserved the right to exclude a paper from distribution after the conference (e.g., removal from IEEE Xplore), if the paper is not presented at the conference.

CORRESPONDENCE

ANIKÓ SZAKÁL
ÓBUDA UNIVERSITY
szakal@uni-obuda.hu

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS – FedCSIS 2011

19 - 21 September, 2011
Szczecin, POLAND

INVITATION

This multi-conference is still very much in the making, but it is already shaping up as the largest (and hopefully the best) computing and information systems conference staged in Poland.
The FedCSIS multi-conference consists of a significant number of Events, but the Call for Events is open in all areas of computer science and information systems and new proposals for associated Events (conferences, symposia, workshops, special sessions, etc.) are cordially invited until 1-May-2011.

EVENT PROPOSALS

The organizers of FedCSIS 2011 invite proposals for associated Events (conferences, symposia, workshops, special sessions). The Events can run over any span of time within the conference dates, i.e. from half-day to three days.
Event proposals should include the following information (within a maximum length of 2 pages):

1. *The nature of the Event.*
2. *The title the Event and a clear description of the topic including a brief justification.*
3. *The complete contact information of the Event organizers, including a link to their personal websites, and an overview of previous experiences with organization of scientific events.*
4. *Indication of the expected number of papers/attendees to attend the Event.*
5. *Information of expected post-event publications, of extended and revised papers in high-quality journals, edited volumes, etc.*

EVENTS OF FedCSIS 2011

- ***AAIA 2011*** *– 6th International Symposium Advances in Artificial Intelligence and Applications - http://aaia.fedcsis.org*
  - ***AIMA 2011*** *- International Workshop on Artificial Intelligence in Medical Applications - http://aima.fedcsis.org*
  - ***ASIR 2011*** *- 1st International Workshop on Advances in Semantic Information Retrieval - http://asir.fedcsis.org*
  - ***WCO 2011*** *- Workshop on Computational Optimization - http://wco.fedcsis.org*
- ***ABICT 2011*** *- International Workshop on Advances in Business ICT - http://abict.fedcsis.org*
- ***CANA 2011*** *- Computer Aspects of Numerical Algorithms - http://cana.fedcsis.org*
- ***IHS 2011*** *- The 1st International Workshop on Interoperable Healthcare Systems - Challenges, Technologies, and Trends - http://ihs.fedcsis.org*
- ***ISSS 2011*** *- International Symposium on Services Science - http://isss.fedcsis.org*
- ***JAWS 2011*** *- Joint Agent-oriented Workshops in Synergy - http://jaws.fedcsis.org*
  - ***ABC:Mi 2011*** *- Workshop on Agent Based Computing: from Model to Implementation VIII - http://abcmi.fedcsis.org*
  - ***MAS&S 2011*** *- 5th International Workshop on Multi-Agent Systems and Simulation - http://mass.fedcsis.org*
  - ***SOCASE 2011*** *- Service-Oriented Computing: Agents, Semantics, and Engineering - http://socase.fedcsis.org*
- ***MMAP 2011*** *- International Symposium on Multimedia Applications and Processing - http://mmap.fedcsis.org*
  - ***MHCI 2011*** *- Special track dedicated to Multimedia Human-Computer Interaction - http://mhci.fedcsis.org*
- ***SSSS 2011*** *- Summer School Service Science and Research Methods 2011 - http://ssss.fedcsis.org*
- ***TAMoCo 2011*** *- Techniques and Applications for Mobile Commerce - http://tamoco.fedcsis.org*
- ***WAPL 2011*** *- 3rd Workshop on Advances in Programming Languages - http://wapl.fedcsis.org*
- ***WoSS 2011*** *- 3rd Workshop on Software Services: Semantic-based Software Services - http://woss.fedcsis.org*

FEDCSIS GENERAL CHAIRS

Ganzha, Maria- *Systems Research Institute, Polish Academy of Sciences, Warsaw and University of Gdansk, Poland*
Maciaszek, Leszek A. - *Wroclaw University of Economics, Poland and Macquarie University ~ Sydney, Australia*
Paprzycki, Marcin *- Systems Research Institute, Polish Academy of Sciences, Warsaw and Management Academy, Warsaw, Poland*

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Rodan Systems S.A., Warsaw, Poland
Szyjewski, Zdzislaw *Local Arrangements Co-Chair*
University of Szczecin, Poland

IMPORTANT DATES

- *Submissions of Event Proposals:* ***May 1, 2011***
- *Paper Submissions:* ***May 31, 2011***
- *Authors Notifications:* ***June 30, 2011***
- *Final Submissions and Registrations:* ***July 31, 2011***
- *The Conference Dates:* ***September 19 - 21, 2011***

PUBLICATIONS

Papers accepted and presented at any Event will be published digitally in the IEEE Xplore Digital Library proceedings and on USB memory stick given to FedCSIS participants. The IEEE proceedings will be entitled "2011 Federated Conference on Computer Science and Information Systems (FedCSIS)" and will be published under an ISBN number and under nonexclusive copyright. The nonexclusive copyright implies that Events' organizers can and, indeed, are strongly encouraged to invite extended and revised papers for post-conference publications in high-quality journals, edited volumes, etc.

GOALS

The organizers of FedCSIS 2011 invite proposals for associated Events (conferences, symposia, workshops, special sessions). The Events can run over any span of time within the conference dates, i.e. from half-day to three days.
The FedCSIS Events are expected to provide a platform for bringing together researchers, practitioners, and academia to present and discuss ideas, challenges, and potential solutions on established or emerging topics related to research and practice in computer science and information systems.
The Events will be selected based on the scientific/technical interest and/or their relevance to practitioners in their topics, the clarity of the proposal in addressing the requested information, the innovativeness of the Event topics, and the capacity in the FedCSIS conference program.

CORRESPONDENCE

Faculty of Economics and Management
University of Szczecin
ul. Mickiewicza 64
71-101 Szczecin, POLAND

- *Email:* secretariat@fedcsis.org
- *Web:* http://www.fedcsis.org

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

3rd INTERNATIONAL SCIENTIFIC AND EXPERT CONFERENCE (TECHNICS, EDUCATION, AGRICULTURE & MANAGEMENT) – TEAM 2011 & 17th INTERNATIONAL SCIENTIFIC CONFERENCE – CO-MAT-TECH 2011

19 – 21 October, 2011
Trnava, SLOVAKIA

INVITATION

The International TEAM Society in cooperation with Slovak University of Technology, Faculty of Materials Science and Technology in Trnava is honored to invite you to the 3rd International Scientific and Expert Conference TEAM 2011 in the city of Trnava.
We hope that you will participate and benefit from this event. We also wish all authors a lot of success in finding new contacts and partnerships in order to transfer knowledge and best practices to your countries as well as to find new scientific discoveries. Feel free to join us and find new possibilities and trends in modern age.
Beside the conference and technical background, Trnava offers a lot of cultural and historical monuments that could make your stay more pleasant. We are looking forward to meet you in Trnava.

AIM AND SCOPE

- *Transfer of Knowledge and Dissemination of Achievements*
- *Mobility of Teachers and International Cooperation*
- *Interdisciplinary Approach on Development*

ORGANIZED BY:

The Conference is organized under the auspices of the International TEAM Society and

- *University of Applied Sciences of Slavonski Brod, Slavonski Brod, Croatia*
- *Mechanical Engineering Faculty in Slavonski Brod, University Josip Juraj Strossmayer in Osijek, Slavonski Brod, Croatia*
- *Kecskemét College, Faculty of Mechanical Engineering and Automation (GAMF), Kecskemét, Hungary*
- *Slovak University of Technology, Faculty of Materials Science and Technology, Trnava, Slovakia*

TOPICS

Section 1: PRODUCTION ENGINEERING

- *ADVANCED MANUFACTURING TECHNOLOGIES*
- *INDUSTRIAL LOGISTICS*
- *MATERIAL SCIENCE*
- *PRODUCT DESIGN AND PRODUCT DEVELOPMENT*

Section 2: KNOWLEDGE TRANSFER

- *COMPUTER TECHNOLOGIES AND APPLICATIONS*
- *EDUCATION, ENGINEERING, PEDAGOGY AND DIDACTICS*
- *KINESIOLOGIC EDUCATION IN THE FUNCTION OF HEALTH PREVENTION*
- *MOBILITY IN EDUCATION*

Section 3: BIOTECHNOLOGY IN AGRICULTURAL ENVIRONMENT

- *ADVANCED TECHNOLOGY AND TECHNICS IN AGRICULTURE*
- *AGROECOLOGY AND ORGANIC FARMING*
- *LANDSCAPE ARCHITECTURE AND DECORATION*
- *PLANT PROTECTION*
- *WINE AND FRUIT PRODUCTION*

Section 4: MARKET-ORIENTED MANAGEMENT

- *COST MANAGEMENT*
- *KNOWLEDGE MANAGEMENT*
- *INNOVATION MANAGEMENT*
- *EU FUNDING*
- *NEW OPPORTUNITIES IN FINANCIAL ENTREPRENEURSHIP*

DEADLINES:

30.04.2011 - End of the registration, deadline for sending abstracts
21.05.2011 - Response to authors with paper acceptance
15.06.2011 - Deadline for payments
31.07.2011 - Deadline for sending of full papers

SCIENTIFIC COMMITTEE CHAIRMAN

Prof. Dr. Jozef Peterka
Slovak University of Technology, Faculty of Materials Science and Technology in Trnava

SCIENTIFIC COMMITTEE

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Prof. Dr. sc. Stoić, Antun - Josip Juraj Strossmayer University of Osijek, Strojarski fakultet, Slavonski Brod
Prof. Dr.sc. Vlado Guberac- Faculty of Agriculture in Osijek, Croatia,
Assoc. Prof. Darko Kiš , PhD.- Faculty of Agriculture in Osijek, Croatia,
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Prof. Peter Grgač, CSc.- Slovak University of Technology, Faculty of Materials Science and Technology in Trnava
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CALL FOR PAPERS

All authors are invited to apply for papers relevant to specified fields that can be found under "Sections" menu button. Paper acceptance procedure is divided in following three steps:

1. Step: Participants Registration

Registration for the conference will be performed by sending the e-mail with registration form to martin.bajcicak@stuba.sk together with abstract. Registration forms can be downloaded from the "Registration" section of official page.

2. Step: Abstract Submission

Papers should be up to date and based on original work of the authors. Abstracts will be submitted via conference system which will forward the abstract to responsible reviewer who will consider the suitability of the paper. Please make a registration in this system so we can identify your abstract and paper (co-authors are registered by the author and they do not need to register by themselfs). Abstract of 200 to 300 words should provide clear information on paper content.

Poster Section

In order to ensure the fluency of the conference, organising committee can propose some articles for poster section in case of having too many papers in particular sections. In case that author would like to apply for publishing the poster, they should clearly provide this information in abstract submission phase.

3. Step: Paper Acceptance

After positive reply from section chair, authors will be asked to send complete paper in given deadline and paper will be registered for the conference. All papers should be written according to the Manuscript template. Paper should contain information on current state of the paper subject, experimental, main results, outcome of the study and references.

CORRESPONDENCE

Ing. Jozef Bárta, PhD.
J. Bottu 25, 917 24 Trnava
+421 905 574 596
+421 906 086 305
jozef.barta@stuba.sk
http://www.team2011.eu/

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

INTERNATIONAL CONFERENCE DEFORMATION AND FRACTURE IN PM MATERIALS DFPM 2011

November 6 –9, 2011

Stará Lesná, High Tatras, SLOVAKIA

ORGANIZED BY:

INSTITUTE OF MATERIALS RESEARCH, SLOVAK ACADEMY OF SCIENCES IN KOŠICE, SLOVACIA
and
VIENNA UNIVERSITY OF TECHNOLOGY, AUSTRIA

AIM AND SCOPE

The established orientation of DFPM international conferences is on fundamentals of material properties. The aim of the Conference is to promote information exchange between scientists, researchers and industrial engineers with the aim of improving the properties, lifetime and reliability of PM materials. Furthermore, a closer international cooperation in the field of deformation and fracture behaviour of these materials will be promoted.

GENERAL INFORMATION

The Conference represents a continuation of the International Conferences on Powder Metallurgy organized in the former Czecho-Slovakia at regular intervals since 1962. It directly follows the International PM Conferences, held in Stará Lesná in 1996, 2002, 2005, 2008 and in Piešťany in 1999.

MAIN TOPICS

- MICROSTRUCTURE, PHYSICAL PROPERTIES, FAILURE, FRACTURE MICROMECHANISM
- APPLICATION OF PM MATERIALS UNDER COMPLEX STRESS AND EXPLOITATION CONDITIONS
- MODELLING
- ADVANCED PM TECHNOLOGIES AND MATERIALS

DEADLINES:

- Acceptance Notification:
May 31, 2011
- Submitting Draft of Manuscript:
July 15, 2011
- Final Manuscript and Payment:
August 31, 2011

MATERIALS OF INTEREST:

All types of powder metallurgy materials, such as ferrous and non-ferrous metals, ceramics and composites, low and high porosity materials, nanomaterials, intermetallics, superalloys, metal foams and gradient materials.

CALL FOR PAPERS:

The conference includes oral and poster presentations. Presented contributions, after the peer review, will be published in journal Powder Metallurgy Progress. For publishing the contribution, sending the final manuscript to the conference organizer's address and payment of the conference fee will be required.

CORRESPONDENCE

DFPM 2011
IMR SAS
Watsonova 47
040 01 Košice
Slovak Republic
Email: dfpm2011@imr.saske.sk
Tel: +421-55-7922 452 or 411
Fax: +421-55-7922 408

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

12th INTERNATIONAL FOUNDRY TRADE FAIR with WFO TECHNICAL FORUM – GIFA 2011

June 28 – July 2, 2011
Düsseldorf, GERMANY

INVITATION

The 12th INTERNATIONAL FOUNDRY TRADE FAIR (GIFA) will take place in Düsseldorf between 28 June and 02 July 2011. And, once again, you can use the top location of the most important trade fair for foundry technology in the world to optimally position your company.

Size, competence and rating by visitors and exhibitors had all already received top marks in 2007. The GIFA was the platform for excellent Business activities and is the indicator for the innovations which will orientate the future – and all this against the background of impressive facts and figures.

Also in 2011, we are inviting you to come and convince, with your innovative technologies at the epicenter of the foundry industry, a high caliber and investment inclined trade audience.

GIFA – the INTERNATIONAL FOUNDRY TRADE FAIR – will be giving a comprehensive insight into foundry technology issues in more than five different halls. In addition to registrations by the big players from the industry, Messe Düsseldorf has also been noting increased interest from companies that will be participating in the trade fair for the first time next year.

An extensive, attractive side programme with numerous seminars and trade symposia, special shows and technical forums as well as international congresses and lecture series is being organised again for the four metal trade fairs in 2011. Great interest is already being shown here too: there is tremendous demand for the METEC Congress and the European Metallurgical Conference (EMC), for example.

Trade visitors will be able to buy their ticket to GIFA, METEC, THERMPROCESS and NEWCAST online from the spring of 2011 onwards. Companies that would like to present their products and services in the context of the "BRIGHT WORLD OF METALS" will find all the registration documents they need in the exhibitor section of the individual websites. www.gmtn.de and/or www.gifa.de, www.metec.de, www.thermprocess.de and www.newcast.de also provide up-to-the-minute news about the trade fairs as well as the latest information from the industry.

THE BRIGHT WORLD OF METALS. TECHNOLOGIES - PROCESSES - APPLICATIONS - PRODUCTS

Foundry technology remains a cornerstone of industrial activity, and the last staging of GIFA in 2007 once again proved its high innovation potential and efficiency against a background of increasing demands in terms of quality, flexibility, cost management, environment and links with modern technologies.

In light of current economic uncertainties, export business is now playing an ever more important role in the industry's development and survival.

As the global No.1 event, GIFA 2011 will provide a complete overview of advances in the foundry practice. Düsseldorf will again be the venue for the world's leading manufacturers of foundry machinery and plant construction, suppliers of foundry-related materials and auxiliaries, manufacturers of measurement and testing devices for quality assurance, plus engineering companies.

METEC (8th International Metallurgical Technology Trade Fair with Congress), THERMPROCESS (10th International Trade Fair and Symposium for Thermo Process Technology), and NEWCAST (3rd International Castings Trade Fair with Forum) will again be staged parallel to GIFA 2011.

ANCILLARY PROGRAMME

- *THERMPROCESS SYMPOSIUM*
- *EUROPEAN METALLURGICAL CONFERENCE 2011*
- *METEC InSteelCon 2011*
- *4rd CONFERENCE REFRACTORY AND CHIMNEY ENGINEERING*
- *NEWCAST - 3rd INTERNATIONAL TRADE FAIR FOR PRECISION CASTINGS*

THERMPROCESS SYMPOSIUM

The international trade fair THERMPROCESS takes place from June 28 to July 02, 2011 in Düsseldorf. As in the previous exhibition years, the accompanying THERMPROCESS Symposium will be held from June 29 to July 01, 2011.
The VDMA Thermo Process Technology Association is the ideal supporter of THERMPROCESS as well as host and organizer of the Symposium. GIFA, METEC and NEWCAST are being held concurrently to THERMPROCESS.
The Symposium will take place in Hall 9 of Messe Düsseldorf. Participation is free of charge for visitors of the four trade fairs so that even a short-term attendance is possible. In addition, each participant will receive a CD-ROM containing all lectures.
The THERMPROCESS Symposium focuses on enhancements and up-to-date technical expertise throughout the branch, being presented by expert technicians. Visitors from all over the world will thus get the opportunity to gather information on the industry and the latest developments while visiting the trade fair.
This year, main topics of the THERMPROCESS Symposium are:
– Energy efficiency of thermo process plants
– Heating and burner technology
– Special processes, components and applications
– Cooling, chilling, heat recovery
The lectures will be held in German or English language.
Further information can be found at www.vdma.org/thermoprocessing

EUROPEAN METALLURGICAL CONFERENCE 2011

The 6th international European Metallurgical Conference, EMC 2011, will be held in Düsseldorf at the Congress Center Düsseldorf (CCD) in June 2011.
Organized by the GDMB, the German Society for Mining, Metallurgy, Resource and Environmental Technology, the conference will be focused on the efficiency improvements for resources and energy in the non-ferrous industry based on the primary and recycling metals industry.
The increasing energy costs, the more complex resources and scraps leads to the point, that the new as well as the existing material and energy flows has to be optimized or new designed. Therefore the process efficiencies and the energy recoveries and savings are the major topics of this conference.
These themes are quiet interesting for the metals-producer, equipment manufactures, engineering companies and consulting business and manufacturers of heat and energy system.
Over three days EMC 2011 will deal with the following topics:

- *01 COPPER*
- *02 ZINC AND LEAD*
- *03 LIGHT METALS*
- *04 SUSTAINABLE TECHNOLOGIES / SUSTAINABILITY OF NON-FERROUS METALS PRODUCTION*
- *05 PRECIOUS METALS*
- *06 GENERAL HYDROMETALLURGY*
- *07 GENERAL PYROMETALLURGY / VESSEL INTEGRITY / PROCESS GAS TREATMENT*
- *08 RECYCLING / WASTE TREATMENT AND PREVENTION*
- *09 WASTE EFFLUENT TREATMENT / BIOHYDROMETALLURGICAL APPLICATIONS*
- *10 PROCESS CONTROL / PROCESS MODELLING*
- *11 PHYSICAL METALLURGY / PROCESS FUNDAMENTALS*
- *POSTERS*

There will be a dedicated poster session, at which each of the presenters will have the opportunity to outline the topic of their poster during a short time of approximately five minutes. The posters will also be displayed during the entire period of the venue, enabling further direct contacts with the conference delegates. In order to promote the presentation of posters, the Organizing Committee has decided to provide a money award to the best poster, the amount of which will be communicated in the next EMC 2011 circular and on the EMC web page. Selection of the best poster will be done by members of the Scientific Committee.

METEC InSteelCon 2011

All new developments from the world of steel, at a single time and place – that is the reach of METEC InSteelCon 2011. It unites four international conferences under one roof: the 6th EUROPEAN COKE AND IRONMAKING CONGRESS (ECIC), the 7th EUROPEAN CONTINUOUS CASTING CONFERENCE (ECCC), the 4th INTERNATIONAL CONFERENCE ON MODELLING AND SIMULATION OF METALLURGICAL PROCESSES IN STEELMAKING (STEELSIM) and the 1st INTERNATIONAL CONFERENCE ON ENERGY EFFICIENCY AND CO_2 REDUCTION IN THE STEEL INDUSTRY (EECRsteel).

These events take place as accompanying congresses and conferences to the leading metallurgical trade fair METEC and the trade fairs GIFA, THERMPROCESS and NEWCAST. More than 70,000 visitors are expected.

THE 6th EUROPEAN COKE AND IRONMAKING CONGRESS 2011

Following the success of two independent congresses – the INTERNATIONAL COKEMAKING CONGRESS (ICMC) and the EUROPEAN IRONMAKING CONGRESS (EIC) – the EUROPEAN COKE AND IRONMAKING CONGRESS (ECIC) will seamlessly combine both worlds of coke and ironmaking. After taking place in Aachen (1st EIC 1986), Essen (1st ICMC 1987), Glasgow (2nd EIC 1991), London (2nd ICMC 1992), Gent (3rd ECIC 1996), Paris (4th ECIC 2000) and Stockholm (5th ECIC 2005), now Düsseldorf will be the location of this outstanding event.

http://www.ecic2011.com/

THE 7th EUROPEAN CONTINUOUS CASTING CONFERENCE

The 7th EUROPEAN CONFERENCE ON CONTINUOUS CASTING (ECCC 2011) continues the tradition of the successful series of events which were organised in Florence (1990), Düsseldorf (1994), Madrid (1998), Birmingham (2002), Nice (2005) and Riccione (2008). Now Düsseldorf will again be the location of this outstanding event.

http://www.eccc2011.com/

THE 4th INTERNATIONAL CONFERENCE ON MODELLING AND SIMULATION OF METALLURGICAL PROCESSES IN STEELMAKING

Modelling and Simulation of metallurgical processes has gained large significance in the continual efforts to optimise technological processes, reduce production costs and increase steel quality.

At relatively low cost, physical and numerical modelling may be employed to effectively analyse the fundamentals of the metallurgical processes as well as to visualise them. Use of modern computer technology simulating the technological conditions present in the metallurgical processes is necessary to guarantee significant progress in this field.

http://www.steelsim2011.com/

THE 1st ENERGY EFFICIENCY AND CO_2 REDUCTION IN THE STEEL INDUSTRY

The steel branch plays an important role in global industrial energy consumption and CO_2 emissions. Because of the dynamic growth of energy prices and the commitment of governments to decrease CO_2 emissions, the reduction of specific energy consumption is a top priority for steel companies.

The objective of the 1st INTERNATIONAL CONFERENCE AND EXHIBITION ON ENERGY EFFICIENCY AND CO_2 REDUCTION IN THE STEEL INDUSTRY (EECRsteel 2011) is to provide an overview on state-of-the-art developments in progress, latest results and outlook on this important issue.

http://www.eecr2011.com/

METEC InSteelCon 2011 conferences and congresses offer participants a uniquely varied program with practice-oriented presentations on iron and steel production, the latest technologies in coke, sinter, pellet, hot metal, DRI production as well as continuous casting, energy efficiency, CO2 reduction, modelling and simulation. By registering for METEC InSteelCon 2011, participants have the opportunity to visit all four leading trade fairs: METEC, GIFA, THERMPROCESS and NEWCAST.

THE 4rd CONFERENCE REFRACTORY AND CHIMNEY ENGINEERING

Sessions:

- *RESEARCH AND DEVELOPMENT*
- *NEW MATERIAL DEVELOPMENTS AND APPLICATION SECTORS*
- *NEW IN CONSTRUCTION AND DESIGN*
- *CURRENT TOPICS*

NEWCAST - 3rd INTERNATIONAL TRADE FAIR FOR PRECISION CASTINGS

NEWCAST is an international trade exhibition for cast products, iron castings and steel castings, where designers, production managers and buyers can inform themselves about the latest technical developments in castings and metal parts. The scope of NEWCAST is not only to cast products but will include with the NEWPART INNOVATION PARK also forged and sintered parts. The fair is accompanied by NEWCAST FORUM as well as an extensive program with seminars and conferences. NEWCAST is held together with the technology fairs GIFA (foundry technique), METEC (metallurgy) and THERMPROCESS (thermal processes).

EVENT PROFILE

Organizing by Messe Dusseldorf GmbH, the GIFA Germany is a renowned foundry trade fair. Held at Dusseldorf Exhibition Centre, Nordrhein-Westfalen, Germany, it is 5 days event which will offer a pivotal base for fostering relations across the world.
Profile for exhibit include foundry technology, raw materials, auxiliary materials, die casting technology, process materials, machining & processing technology, foundry chemistry, measuring, controlling, regulating technology, data communication, environment & safety technology, industrial safety etc.

ORGANIZER

Messe Düsseldorf GmbH
Messeplatz
D-40474 Düsseldorf
Postal Address:
PO Box: 10 10 06
40001 Düsseldorf
Telephone: +49 (0)211 45 60 01
Infoline: +49 (0)211 45 60 900
Fax: +49 (0)211 45 60-668
Internet: http://www.messe-duesseldorf.de/

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

THE 19th ANNUAL INTERNATIONAL CONFERENCE ON COMPOSITES/NANO ENGINEERING – ICCE-19

July 24 - 30, 2011
Shanghai, CHINA

MESSAGE FROM ICCE CHAIRMAN

The ICCE conference is unique in that while it is an engineering conference, it has attracted numerous chemists, physicists and scientists from diverse fields in our efforts to promote interdisciplinary research on composites. Of particular concern is the challenge for materials engineers to understand the wide diversity of length scales ranging from nano to micro to macro and full scale and to question the validity of the theories or models which are known to be valid only in certain length scales. The ICCE is among the first composite materials conferences which take a leading vital role to bridge the gap between nano-chemistry and nano-engineering, and attracted hundreds of papers in this existing relatively new field of nano-composites engineering.

The ICCE conference will provide a forum for the exchange of information and ideas in virtually all areas composite materials research. The goals of the ICCE conference are:

1. *To BRIDGE THE GAP between Materials Science, Mechanics and manufacturing of Composite Materials;*
2. *To ENCOURAGE INTERDISCIPLINARY research bridging the gap between aerospace technology, bio-materials, chemistry, electronics, fluid mechanics, infrastructures, magnetic materials, nanotechnology, physics, powder metallurgy, sensors/actuators, among others and*
3. *To ENCOURAGE LEVERAGING of composite materials research resources through joint research between participants and writing joint research proposals.*

ICCE-19 SCIENTIFIC COMMITTEE AND REVIEW BOARD

B.I. Yakobson	*Kazuhiro Endo*	*Nora F. Savage*	*Tai-Yan Kam*
Bohua Sun	*Keith Kedward*	*Ramon Artiaga*	*Tony Nanni*
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ICCE-19 Advisory Board

Major Topics of ICCE-19

- Aging, Flammability
- Bio-Composites
- Mathematical Modeling
- Chemistry of Materials
- Coatings and Wear
- Metal Matrix Composites
- Ceramics Composites
- Micromechanics
- Packaging Barrier
- Electronic/Magnetic Materials
- Particulate Composites
- Engineering Science and Structures
- Metals Research
- Powder Metallurgy
- Textile Composites
- Functionally Graded Materials
- Impact Engineering
- Vibration
- Infrastructures Composites
- Computational Materials
- Durability
- Natural Fibers
- Processing
- Biology
- Physics of Materials

Major Symposium of ICCE-19

- Nano Bio Materials
- Nano Devices and Actuators
- Inorganic Nanowires
- Nano-Fabrication,
- NanoLithography
- Nanosensors
- Magnetic Materials
- Thin Films
- Surface-Coating
- Processing/Characterization
- Durabilty of Composites

Detailed Two Pages Short Paper Preparation Guidelines

Detailed two pages short papers that contains enough results to clearly convey the approach of your research is required.
Presentation Type – Preference for ORAL or POSTER presentation should be indicated in your submission.
Language: All detailed short papers are to be written in English.
Format: Please refer to the ICCE-19 Short Paper Sample to prepare your detailed short paper.

1. Authors' names, affiliations, corresponding author's mailing address and e-mail address should be included.
2. The manuscript must be in two-column and saved in PDF or MS-Word format.
3. 2 pages will be allotted to each short paper and last page should be filled up. Page numbering should NOT be set in the electronic file.
4. The electronic file of each manuscript should not exceed 1 MB in file size.

Detailed Two Pages Short Paper Submission Guidelines

1. The ICCE-19 conference proceedings will consist of detailed short papers.
2. Short papers must be submitted by email (please do not submit short papers by postal mail.
3. Please underline the name of the presenter. Whenever possible, please put presenter as first author and corresponding person, since we file all short papers by first author.
4. Short papers will be reviewed and published in World Journal of Engineering. Short papers must be full of details and results, thus, please include as many figures as possible.
5. Short papers should be emailed immediately, or as soon as possible, but before June 1, 2011. After this date we will gladly continue to receive short papers if there are vacancies.
6. Interested authors should email IMMEDIATELY (do not assume email comes through until you receive the acknowledgement) the tentative PAPER TITLES and a suggested subject category

Full Length Paper Preparation Guidelines

Language: All full length papers are to be written in English.
Format: Please refer to the ICCE-19 Full Length Paper Sample to prepare your full length paper. Authors' names, affiliations, corresponding author's mailing address and e-mail address should be included.

1. *The manuscript must be in two-column and saved in PDF or MS-Word format*
2. *The minimum length for manuscript is 4 pages. There is no maximum page limit for full length paper. Page numbering should NOT be set in the electronic file.*
3. *The electronic file of each manuscript should not exceed 3 MB in file size.*

Full Length Paper Submission Guidelines

1. *The full length papers originating from ICCE-19 Shanghai, should be much more than four pages (two columns per page). They will be quickly reviewed and published in World Journal of Engineering. Quickly review means that the response reactions of the audience, during your oral presentations is counted as one review, and the recommendation of the session chair is another review, along with at least one other reviewer (two or three reviews).*
2. *The submission of full-length paper should best be done by changing the paper title of the short paper (different paper title and thus, count as different paper in your vita), add more figures, and more in depth analysis, more focus on specific usefulness or applications, and pave the way for future exciting research on nano or composites materials.*
3. *If the author prefers to submit to other journals, they can do this on their own. We, as conference organizer will not interfere with the editorial decisions of these journals, except mention that it was presented at ICCE.*
4. *Full-length papers should be emailed as soon as possible or before July 17, 2011*

Important Dates

Submission	
Deadline for Submission of Short Paper	*June 1, 2011*
Deadline for Full Length Paper	*July 17, 2011*
Registration Fee Payment	
Deadline for Early Bird Registration 1	*Received Before May 24, 2011*
Deadline for Early Bird Registration 2	*Received Before June 24, 2011*
Deadline for Early Bird Registration 3	*Received Before July 17, 2011*
On-site Registration	*Received On-sit*
Reduced Registration Fee	
Deadline for Early Bird Registration 1	*Received Before May 24, 2011*
Deadline for Early Bird Registration 2	*Received Before July 17, 2011*
On-site Registration	*Received On-site*

Special Timely Symposiums

Solar Cells and Optoelectronic Materials
Professor Huisheng Peng (Chair)
Associate Professor Jinhu Yang (Co-chair)
Nano Biomedicine
Associate Professor Chao Lin (Chair)
Assistant Professor Yongyong Li (Co-chair)
Biomaterials and Neural Engineering
Dr Jiayi Zhang (Chair)
Dr Lei Yang (Co-chair)
Multi-Scale and Multi-Phase Modelling in Composite Materials
Dr Longyuan Li (Chair)
Oxide Nanocomposites and Heterostructures
Professor Tamio Endo (Chair)
Professor Kazuhiro Endo (Co-chair)
Natural Fibre Composites
Dr Karen Cheung (Chair)
Professor Alan K. T. Lau (Co-chair)
Novel Catalysts and Support Materials For Fuel Cells
Dr Petra Bele (Chair)
Assembly of Composites Components
Dr Chensong Dong (Chair)
Professor David Hui (Co-chair)
Virtual Research Infrastructures Supporting Translational Research in Nanotechnology
Dr Simon Grange (Chair)
Materials For Nuclear Application
Dr Celine Hin (Chair)
Dr Liuming Yan (Co-chair)

Small-Scale Solid Mechanics and Its Application
Professor C.Q. Ru (Chair)
Professor W.Q. Chen (Co-chair)
Materials Chemistry
Associate Professor Atsushi Mori (Chair)
Dr Masanori Kikuchi (Co-chair)
Nanomaterials for Energy Applications
Professor Zhiyong Fan (Chair)
Professor Johnny C. Ho (Co-chair)

ORGANIZER

Professor David Hui
Department of Mechanical Engineering
University of New Orleans, New Orleans, LA 70148
Tel: (504) 280 6652; Fax: (504) 280 6192
E-mail: dhui@uno.edu
Welcome to Shanghai and to ICCE-19 July 24-30, 2011!

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

ACADEMIC CONFERENCES WORLDWIDE IN 2011 – UPCOMING EVENTS IN ENGINEERING, MANAGEMENT AND RELATED FIELDS

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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering. Fascicule 2 [April-June]

- *INTERNATIONAL CONFERENCE "MANAGEMENT OF TECHNOLOGY - STEP TO SUSTAINABLE PRODUCTION" - (MOTSP 2011), 8 - 10 June 2011, Bol, Island Brac, CROATIA*
- *THE 4th INTERNATIONAL CONFERENCE FOR ENTREPRENEURSHIP, INNOVATION AND REGIONAL DEVELOPMENT - FROM ENTREPRENEURIAL LEARNING TO INNOVATION AND REGIONAL DEVELOPMENT, 5 - 7 May 2011, Ohrid, MACEDONIA*
- *THE 8th INTERNATIONAL CONGRESS "MACHINES, TECHNOLOGIES, MATERIALS". TOPIC: „INNOVATIVE SOLUTIONS FOR PRODUCT AND PROCESS DEVELOPMENT", 18 - 21 September, Varna, BULGARIA*
- *THE 8th INTERNATIONAL SCIENTIFIC CONFERENCE ON PRODUCTION ENGINEERING, DEVELOPMENT AND MODERNIZATION OF PRODUCTION, 26 - 30 September, Praha, CZECH REPUBLIC*
- *THE 7th INTERNATIONAL SCIENTIFIC CONFERENCE RESEARCH AND DEVELOPMENT OF MECHANICAL ELEMENTS AND SYSTEMS - IRMES 2011, 27 - 28 April, 2011, Zlatibor, SERBIA*
- *THE 11th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEO - CONFERENCE & EXPO SGEM 2011, MODERN MANAGEMENT OF MINE PRODUCING, GEOLOGY AND ENVIRONMENTAL PROTECTION, 19 - 25 June, Congress Centre "Flamingo Grand", Albena Resort, BULGARIA*
- *THE 7th RESEARCH / EXPERT CONFERENCE WITH INTERNATIONAL PARTICIPATION - QUALITY 2011, 1 - 4 June 2011, Neum, BOSNIA & HERZEGOVINA*
- *THE IXth INTERNATIONAL CONFERENCE - PREPARATION of CERAMIC MATERIALS, 14 - 16 June, 2011, Herlany, SLOVAKIA*
- *INTERNATIONAL CONFERENCE ON INNOVATIVE TECHNOLOGIES - IN-TECH 2011, 1 - 3 September 2011, Bratislava, SLOVAKIA*
- *THE 9th IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT SYSTEMS AND INFORMATICS - SISY 2011, 8 - 10 September, 2011, Subotica, SERBIA*
- *THE 15th IEEE INTERNATIONAL CONFERENCE ON INTELLIGENT ENGINEERING SYSTEMS 2011 - INES 2011, 23 - 25 June, 2011, Poprad, SLOVAKIA*
- *THE 3rd IEEE INTERNATIONAL SYMPOSIUM ON LOGISTICS AND INDUSTRIAL INFORMATICS - LINDI 2011, 25 - 27 August, 2011, Budapest, HUNGARY*
- *THE 12th IEEE INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE AND INFORMATICS - CINTI 2011, 21 - 22 November, 2011, Budapest, HUNGARY*
- *THE 4th INTERNATIONAL CONFERENCE ON ADVANCED MATERIALS AND STRUCTURES - AMS '11, 27 - 28 October 2011, Timişoara, ROMANIA*

- *THE 6th IEEE INTERNATIONAL SYMPOSIUM ON APPLIED COMPUTATIONAL INTELLIGENCE & INFORMATICS - SACI 2011, 19 - 21 May, 2011, Timisoara, ROMANIA*
- *THE 10th ANNIVERSARY INTERNATIONAL CONFERENCE ON ACCOMPLISMENTS IN ELECTRICAL AND MECHANICAL ENGINEERING AND INFORMATION TECHNOLOGY - DEMI 2011, 26 - 28 May 2011, Banja Luka, Republic of SRPSKA, BOSNIA AND HERZEGOVINA*
- *THE 13th INTERNATIONAL SCIENTIFIC CONFERENCE ON PRODUCTION ENGINEERING - CIM 2011, 16 - 18 June, 2011, Biograd, CROATIA*
- *FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS - FedCSIS 2011, 19 - 21 September, 2011, Szczecin, POLAND*
- *THE 3rd INTERNATIONAL SCIENTIFIC AND EXPERT CONFERENCE - TEAM 2011 (TECHNICS, EDUCATION, AGRICULTURE & MANAGEMENT) & 17th INTERNATIONAL SCIENTIFIC CONFERENCE - CO-MAT-TECH 2011, 19 - 21 October, 2011, Trnava, SLOVAKIA*
- *INTERNATIONAL CONFERENCE ON ELECTRIC AND ELECTRONICS - EEIC 2011, 20 - 22 June, 2011, Nanchang, CHINA*
- *INTERNATIONAL CONFERENCE ON MANAGEMENT SCIENCE AND ENGINEERING - EEM 2011, 25 - 26 June, Xiamen, CHINA*
- *THE 1st CENTRAL AND EASTERN EUROPEAN CONFERENCE ON THERMAL ANALYSIS AND CALORIMETRY - CEEC-TAC, 7 - 10 September, 2011, Craiova, ROMANIA*
- *THE 19th ANNUAL INTERNATIONAL CONFERENCE ON COMPOSITES or NANO ENGINERING - ICCE-19, 24 - 30 July, 2011, Shanghai, CHINA*
- *THE 12th INTERNATIONAL FOUNDRY TRADE FAIR WITH WFO TECHNICAL FORUM - GIFA 2011, 28 June - 02 July, 2011, Düsseldorf, GERMANY*
  - *METEC InSteelCon 2011 - 6th EUROPEAN COKE AND IRONMAKING CONGRESS, 27 June - 01 July, 2011, Düsseldorf, GERMANY*
  - *METEC InSteelCon 2011 - 7th EUROPEAN CONTINUOUS CASTING CONFERENCE, 27 June - 01 July, 2011, Düsseldorf, GERMANY*
  - *METEC InSteelCon 2011 - 4th INTERNATIONAL CONFERENCE ON MODELLING AND SIMULATION OF METALLURGICAL PROCESSES IN STEELMAKING, 27 June - 01 July, 2011, Düsseldorf, GERMANY*
  - *METEC InSteelCon 2011 - 1st INTERNATIONAL CONFERENCE ON ENERGY EFFICIENCY AND CO2 REDUCTION IN THE STEEL INDUSTRY, 27 June - 01 July, 2011, Düsseldorf, GERMANY*
  - *THERMPROCESS SYMPOSIUM, 29 June - 02 July, 2011, Düsseldorf, GERMANY*
  - *THE 4rd CONFERENCE REFRACTORY AND CHIMNEY ENGINEERING, 28 June, 2011, Düsseldorf, GERMANY*
  - *EUROPEAN METALLURGICAL CONFERENCE - EMC-2011, 26 - 29 June, 2011, Düsseldorf, GERMANY*
  - *NEWCAST - 3rd INTERNATIONAL TRADE FAIR FOR PRECISION CASTINGS, 28 June - 2 July 2011, Düsseldorf, GERMANY*
- *INTERNATIONAL CENTRE OF ENVIRONMENTAL PROTECTION AND FOOD QUALITY CONTROL - B.EN.A. CONFERENCE - ENVIRONMENTAL ENGINEERING AND SUSTAINABLE DEVELOPMENT, 26 - 27th May, 2011, Alba Iulia, ROMANIA*
- *THE 11th INTERNATIONAL CONFERENCE ON THE MECHANICAL BEHAVIOR OF MATERIALS - ICM11, 5 - 9 June, 2011, Milano, ITALY*
- *THE 8th INTERNATIONAL PhD FOUNDRY CONFERENCE, 7 - 8 June, 2011, Brno, CZECH REPUBLIC*
- *INNOVATIONS, TECHNOLOGIES, MACHINES - ITM Poland 2011, 14 - 17 June, 2011, Poznan, POLAND*
- *THE 1st INTERNATIONAL CONFERENCE "ECONOMICS AND MANAGEMENT BASED ON NEW TECHNOLOGIES" - EMoNT 2011, 12 - 15 June, 2011, Kladovo, SERBIA*
- *INTERNATIONAL CONFERENCE ON ADVANCES IN MATERIALS AND PROCESSING TECHNOLOGIES - AMPT 2011, 13 - 16 July, 2011, Istanbul, TURKEY*
- *THE VIIth INTERNATIONAL CONFERENCE ON MECHANOCHEMISTRY AND MECHANICAL ALLOYING - INCOME 2011, August 31 - September 3, 2011, Herceg Novi, MONTENEGRO*
- *THE 11th INTERNATIONAL CONFERENCE "RESEARCH AND DEVELOPMENT IN MECHANICAL INDUSTRY" - RaDMI 2011, 15 - 18 September, 2011, Soko Banja, SERBIA*
- *INTERNATIONAL SYMPOSIUM ON LIQUID METAL PROCESSING AND CASTING - LMPC 2011 25 - 28 September, 2011, Nancy, FRANCE*

- *THE 2nd INTERNATIONAL CONFERENCE AND EXHIBITION ON CLEAN TECHNOLOGIES IN THE STEEL INDUSTRY, 26 - 28 September, 2011, Budapest, HUNGARY*
- *INTERNATIONAL EXHIBITION OF MACHINERY AND SUPPLIES FOR CASTING, FORGING, ROLLING AND SURFACE TREATMENT - TRASMET 2011, 27 - 30 September, 2011, Bilbao, SPAIN*
- *THE 34th INTERNATIONAL CONFERENCE ON PRODUCTION ENGINEERING - ICPE 2011, 28 - 30 September, 2011, University of Nis, Nis, SERBIA*
- *THE 48th FOUNDRY DAYS 2011, WITH ACCOMPANYING EXHIBITION, 11 - 12 October, 2011, Brno, CZECH REPUBLIC*
- *THE 14th INTERNATIONALE TRADE FAIR FOR MATERIALS APPLICATIONS, SURFACE TECHNOLOGY AND PRODUCT ENGINEERING - MATERIALICA 2011, 18 - 20 October, 2011, Munich, GERMANY*
- *INTERNATIONAL FAIR FOR STEEL, NON-FERROUS METALS, TECHNOLOGIES AND PRODUCTS - SteelMET 2011, 18 - 20 October, 2011, Sosnowiec, POLAND*
- *THE 9th INTERNATIONAL TRADE FAIR FOR INDUSTRIAL PARTS AND SURFACE CLEANING, 25 - 27 October, 2011, Stuttgart, GERMANY*
- *INTERNATIONAL CONFERENCE ON DEFORMATION AND FRACTURE IN PM MATERIALS - DFPM 2011, 6 - 9 November, 2011, Stará Lesná, High Tatras, SLOVAKIA*
- *THE 6th EUROPEAN OXYGEN STEELMAKING CONFERENCE - EOSC 2011, 7 - 9 September, 2011, Stockholm, SWEDEN*
- *THE 8th INTERNATIONAL WORKSHOP ON PROGRESS IN ANALYTICAL CHEMISTRY & MATERIALS CHARACTERISATION IN THE STEEL AND METALS INDUSTRIES, 17 - 19 May 2011, LUXEMBURG*
- *MINING - METALLURGY - METALWORK: NON-FERROUS METALS - THE CULTURAL HISTORY IN STOCKHOLM, 5 - 7 May, 2011, Stockholm, SWEDEN*
- *THE 2nd INTERNATIONAL CONFERENCE ON MATERIAL AND MANUFACTURING TECHNOLOGY - ICMMT 2011, 8 July 2011, Xiamen, CHINA*
- *INTERNATIONAL CONFERENCE ON MICROELECTRONICS, OPTOELECTRONICS AND NANOELECTRONICS - ICMON 2011, 10 June 2011, Chengdu, CHINA*
- *THE 7th INTERNATIONAL CONFERENCE ON ADVANCES AND TRENDS IN ENGINEERING MATERIALS AND THEIR APPLICATIONS - AES-ATEMA'2011, 4 - 8 July 2011, Milan, ITALY*
- *THE 8th INTERNATIONAL CONFERENCE ON ADVANCES AND TRENDS IN ENGINEERING MATERIALS AND THEIR APPLICATIONS - AES-ATEMA'2011 - RIGA'2011, 11 - 15 July 2011, Riga, LATVIA*
- *THE 9th INTERNATIONAL CONFERENCE ON ADVANCES AND TRENDS IN ENGINEERING MATERIALS AND THEIR APPLICATIONS, AES-ATEMA'2011, 1 - 5 August 2011, Montreal, Quebec, CANADA*
- *INTERNATIONAL SYMPOSIUM ON ADVANCED COMPLEX INORGANIC NANOMATERIALS, 11 - 14 September 2011, Namur, BELGIUM*
- *NANOMECHANICAL TESTING IN MATERIALS RESEARCH AND DEVELOPMENT, 9 - 14 October 2011, Lanzarote, Canary Islands, SPAIN*
- *INTERNATIONAL CONFERENCE ON MECHATRONICS AND MATERIALS PROCESSING - ICMMP2011, 18 - 20 November, 2011, Guangzhou, CHINA*
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- *THE INTERNATIONAL CONFERENCE IN NANOTECHNOLOGY ICWEN - EGYPT 2011, 10 - 12 July, 2011, Cairo, Giza, EGYPT*
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- *THE 8th INTERNATIONAL CONFERENCE ON ELECTROMECHANICAL AND POWER SYSTEMS - SIELMEN 2011, 11 - 15 October, 2011 (Craiova, Iasi, 11 - 13 October 2011 and Chisinau, 13 - 15 October), ROMANIA*
- *THE 19th INTERNATIONAL CONFERENCE ON APPLIED MODELLING AND SIMULATION - IASTED 2011, 22 - 24 June 2011, Crete, GREECE*
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- *INTERNATIONAL CONFERENCE ON ENGINEERING TRIBOLOGY AND ADVANCED MATERIALS - ICETAM 2011, 25 - 27 October, 2011, Cairo, EGYPT*

- *COMPUTATIONAL MECHANICS AND VIRTUAL, 20 - 22 October, 2011, Brasov, ROMANIA*
- *INTERNATIONAL CONFERENCE ON ENGINEERING MATHEMATICS AND PHYSICS - ICEMP 2011, 10 - 12 June 2011, Chengdu, CHINA*
- *THE 8th JOINT MEETING - THE EUROPEAN SOFTWARE ENGINEERING CONFERENCE & THE ACM SIGSOFT SYMPOSIUM ON THE FOUNDATIONS OF SOFTWARE ENGINEERING - ESEC/FSE 2011, 5 - 9 September, Szeged, HUNGARY*
- *THE 5th INTERNATIONAL CONFERENCE INNOVATIVE TECHNOLOGIES FOR JOINING ADVANCED MATERIALS - TIMA'11, 16 - 17 June, 2011, Timișoara, ROMANIA*
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- *THE 33rd INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY INTERFACES - ITI, 27 - 30 June 2011, Dubrovnik, CROATIA*
- *GLOBAL SUSTAINABLE DEVELOPMENT CONFERENCE, 2 - 4 June 2011, Debrecen, HUNGARY*
- *THE 10th INTERNATIONAL CONFERENCE - RoEduNet 2011 - NETWORKING IN EDUCATION AND RESEARCH, 23 - 25 June 2011, Iasi, ROMANIA*
- *KNOWLEDGE ENGINEERING: PRINCIPLES AND TECHNIQUES CONFERENCE - KEPT 2011, 4 to 6 July 2011, Cluj-Napoca, ROMANIA*
- *THE 5th INTERNATIONAL CONFERENCE SMALL AND MEDIUM SIZED ENTERPRISES IN A GLOBALIZED WORLD, 22 - 24 September 2011, Cluj-Napoca, ROMANIA*
- *THE 8th INTERNATIONAL CONGRESS IN MATERIALS SCIENCE AND ENGINEERING - ISSIM 2011, 26 - 29 May 2011, Iasi, ROMANIA*
- *INTERNATIONAL CONFERENCE ON MANUFACTURING SYSTEMS, 20 - 21 October 2011, Iasi, ROMANIA*
- *PROCESSING OF INDUSTRIAL MINERALS & COAL '12 — PIMC '12, 05 - 06 Jun 2012, Istanbul, TURKEY*
- *THE 3rd INTERNATIONAL CONFERENCE FOR PROMOTING THE APPLICATION OF MATHEMATICS IN TECHNICAL AND NATURAL SCIENCES — AMiTaNS'11, 20 - 25 Jun 2011, Albena, BULGARIA*
- *THE 5th INTERNATIONAL CONFERENCE ON ENGINEERING SURVEYING* - INGEO 2011, *22 - 24 September, 2011, Brijuni, CROATIA*
- *THE 13th CIRP CONFERENCE ON MODELING OF MACHINING OPERATIONS, 12 - 13 May 2011, Sintra-Lisbon, PORTUGAL*

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ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome IV (Year 2011). ISSN 2067-3809

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A nonmathematical abstract, not exceeding 200 words, is required for all papers. It should be an abbreviated, accurate presentation of the contents of the paper. It should contain sufficient information to enable readers to decide whether they should obtain and read the entire paper. Do not cite references in the abstract.

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The manuscript should be organized in the following order: Title of the paper, Authors' names and affiliation, Abstract, Key Words, Introduction, Body of the paper (in sequential headings), Conclusion, Acknowledgements (where applicable), References, and Appendices (where applicable).

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Equation numbers should appear in parentheses and be numbered consecutively. All equation numbers must appear on the right-hand side of the equation and should be referred to within the text.

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ACKNOWLEDGMENT

An acknowledgement section may be presented after the conclusion, if desired. Individuals or units other than authors who were of direct help in the work could be acknowledged by a brief statement following the text.

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References should be listed together at the end of the paper in alphabetical order by author's surname. List of references indent 10 mm from the second line of each references. Personal communications and unpublished data are not acceptable references.

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AUTHORS & AFFILIATION

1. NAME SURMANE 1ST AUTHOR
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1. 2. COMPLETE AFFILIATIONS OF THE AUTHOR(S)

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ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

http://acta.fih.upt.ro

ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

University Politehnica Timisoara,
Faculty of Engineering Hunedoara,
5, Revolutiei,
331128, Hunedoara,
ROMANIA
http://acta.fih.upt.ro

ACTA TECHNICA CORVINIENSIS
BULLETIN OF ENGINEERING

ISSN: 2067-3809

fascicule 2
[April-June]

TOME IV
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