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C O N T E N T

REZUMATE

Torosyan G., Ghazi A. **Technological design of furfural adsorption from water solutions.** Furfurolul este o substanță organică larg răspândită, care se utilizează în industria petrochimică în calitate de solvent a produselor petroliere, precum și pentru curățirea lor. În lucrare se propune o variantă simplă de tratare a apelor uzate, care constă în folosirea a două dispozitive - un mixer, în care suspensia de zeolit în apă purificată este amestecată pentru a atinge echilibrul de adsorbție, și vasul pentru sediment, în care adsorbantul prelucrat este separat de apa purificată. Pentru proiectarea tehnologică a procesului de adsorbție a furfurolului se propune utilizarea schemelor de design a dispozitivului intersectiv în trepte sau contra-curent, care permit reducerea în mod semnificativ a consumului de adsorbant. Ambele scheme conțin un număr egal de unități de bază și, prin urmare, sunt aproape identice în investiții de capital necesare, dar prioritate se acordă schemei intersective în trepte.

Ieremia M. **Reconfigurarea Pieții Universității în baza unui plasament emblematic al Teatrului Național.** Construcțiile care alcătuiesc ansamblul Teatrului Național din București au fost proiectate în perioada 1963-1968. Nu s-au produs degradări semnificative ale elementelor de rezistență la cutremurul din anul 1977. La data de 17.08.1978, în Corpul Sălii Principale a izbucnit un incendiu, după care teatrul a fost refăcut complet la exterior și parțial la interior. Trebuia să dispară "*pălăria*" de beton armat și s-a acoperit total vechiul edificiu cu o carcasă, care îi dă forma actuală. În acest spirit, ca urmare a unor indicații ale conducerii Statului din acea vreme, în anul 1983, Institutul de Proiectări "*Carpați*" a elaborat un proiect de remodelare a clădirii Corp Sala Mare prin care structura de rezistență a fost semnificativ modificată. Astfel, s-a mărit capacitatea Sălii principale prin desființarea pereților structurali curbi, eliminându-se patru dintre cele opt diafragme de beton armat, s-a executat o nouă fațadă care încarcă nepermis elementele de structură ale Parcajului auto alăturat.

Profir A. **Modelarea funcțiilor celulare cu ajutorul transducerelor membranale temporizate.** În această lucrare sunt propuse două formalisme noi, numite transducer temporizat și transducer temporizat membranal pentru modelarea funcțiilor celulare, ce joacă un rol central în recepționarea, stocarea, procesarea și transmiterea informației de către celula vie.

Lupan O. **Analiza rețelor de nanobaghete cristaline de ZnO crescute pe *p*-Si (100) prin metoda hidrotermală fără catalizatori.** Aceasta lucrare comunica datele experimentale despre procedura de curățare a substraturilor de Si în scop de a depune ZnO la temperaturi relative joase (95-98°C). De asemenea, lucrarea comunică despre sinteza hidrotermală rapidă elaborată pentru creșterea rețelelor de baghete cristaline de ZnO pe *p*-Si în decursul a 15 min. Caracteristicile materialului au fost studiate și au fost găsite o calitate înaltă a materialului demonstrată de cercetările Micro-Raman și a fotoluminescenței. Aceste rezultate indică asupra posibilității de folosire a heterostructurilor în dispozitive optoelectronice noi.

Bostan V. **Argumentarea profilului hidrodinamic al palelor rotorului microhidrocentralei.** Cercetarea și elaborarea sistemelor de conversie a energiilor regenerabile ca obiectiv de cercetare prezintă un interes major. Colectivul de cercetare de la Universitatea Tehnică a Moldovei a propus o schemă conceptuală nouă de microhidrocentrală cu ax vertical și orientare individualizată a palelor hidrodinamice. Lucrarea prezintă rezultatele simulării numerice a dinamicii computaționale a fluidului (CFD) realizate în softul ANSYS CFX5.

Tonu V., Țuleanu C., Daud V. **Cercetarea omogenității a amestecului aer-gaz în arzătoare cu diferite tipuri de stabilizatoare.** În lucrare se prezintă standul experimental pentru simularea amestecului carburant destinat cercetării stabilității arderii cu diverse tipuri de stabilizatoare. În cadru cercetărilor au fost utilizate trei tipuri de stabilizatoare, unul dintre care a fost construit de autori. În baza prelucrării datelor experimentale s-au propus două ecuații obținute în cadru cercetărilor. Rezultatele cercetărilor sunt prezentate în formă de nomograme tridimensionale și circulare.

Evdochimov R. **Analiza comparativă a algoritmilor distribuiți de control al puterii în CDMA.** Prezenta lucrare conține rezultatele comparării diferitor algoritmi distribuiți de control al puterii prin modelarea lor în mediul de simulare MATLAB, pe baza relației semnal-interferența, după două criterii: după viteza de convergență și după posibilitățile de stagnare.

Siminiuc R. Metoda imunoenzimatică (ELISA) de determinare cantitativă a prolaminelor toxice din soriz. În acest articol sunt descrise particularitățile metodei ELISA de determinare a conținutului de gliadină în cereale, precum și rezultatele determinării cantitative a prolaminelor toxice din soriz.

Țurcanu T., Lozovanu C., **ABC-costing ca instrument de eficientizare a procesului de schimbări tehnologice și de dezvoltare a întreprinderilor IT.** În prezentul articol este arătă necesitatea schimbării în domeniul tehnologiilor informaționale. Se descrie și se analizează procesul schimbărilor tehnologice din întreprinderile IT locale, prin evidențierea punctelor slabe si puternice, precum și riscurile și oportunitățile pe care le aduce piața. pentru a beneficia de toate oportunitățile schimbării, întreprinderile trebuie să fie foarte receptive

la schimbările de pe piaţă, iar implementarea schimbării în întreprindere să fie cât mai scurtă, de aceea este necesar ca costurile să fie evaluate cât mai corect, astfel ca ele să furnizeze informaţii corecte pentru luarea deciziilor, astfel aducem argumente că utilizarea sistemului ABC este cel mai potrivit pentru aceste scopuri.

Nistor D. **Crearea serviciilor de consultanţă în Moldova: studiu de caz CAA/proconsulting**. Scopul articolului este de a analiza dezvoltarea serviciilor de consultanţă în management în Moldova. Piaţa serviciilor de consultanţă în Moldova este subdezvoltată. Piaţa comercială pentru serviciile de consultanţă în management a început cu servicii ghidate de firmele de consultanţă internaţionale pentru întreprinderi mari, cât şi anumite angajamente pentru IMM-uri. În scopul de a cunoaşte mai bine situaţia curentă pe piaţa serviciilor de consultanţă în Moldova s-a efectuat analiza activităţii unei firme de consultanţă, care a început activitatea în cadrul prestarea serviciilor ghidate de proiectele donatoare internaţionale. Rezultatele studiului de caz permit de a avea informaţie de bază pentru dezvoltarea procesului de consultanţă în Moldova.

Bodean G. **Verificarea microprocesoarelor prin generarea sintactic controlată a test-programelor.** În lucrare este analizată tehnica de sintetizare a algoritmilor de generare stilistic şi sintactic controlată a programelor de verificare a microprocesoarelor. Este prezentată dependenţa dintre lungimea programelor de testare (pt) şi repartiţia probabilităţilor asupra indicatorului (metrici) de calitate a verificării modelului microprocesorului (mp). A fost efectuată verificarea mp prin testarea deterministă, aleatoare şi controlată. rezultatele experimentelor de testare au demonstrat vădit avantajul tehnicii propuse în comparaţie cu alte metode competitive de generare a testelor de verificare a microprocesoarelor şi sistemelor ”*on-chip*”.

Cârstea C. **Proiectarea unui sistem de evaluare flexibil pentru managementul sistemelor informatice complexe.** Este cunoscut faptul ca luarea deciziilor fără a avea posibilitatea de a le controla este de cele mai multe ori ineficienta. Acelaşi lucru se poate spune si despre planificarea activităţilor sistemelor informatice complexe, care aduc puţine beneficii daca nu sunt controlate si supervizate. Controlul este o activitate continua a progresului realizat in administrarea proiectelor sistemelor informatice complexe., pe nivele de conducere. Gradul de complexitate al unui sistem informatic este un factor major ce determina metodele de control si raportare.

Pleşca A. **Aspecte teoretice privind temperatura joncţiunii la semiconductoarele de putere.** În prezenta lucrare s-au determinat o serie de relaţii de calcul pentru temperatura joncţiunii în cazul dispozitivelor semiconductoare de putere, având ca punct de plecare impedanţa termică tranzitorie. S-a calculat diferenţa de temperatură dintre joncţiunea semiconductoare şi capsula dispozitivului pentru un impuls de flux termic, o variaţie liniar crescătoare, impuls rectangular, o serie de impulsuri dreptunghiulare, impulsuri de flux termic triunghiular crescătoare, respectiv descrescătoare, serie de impulsuri triunghiulare, trapezoidale şi fragmente de sinusoidă. O analiză termică exactă pentru dispozitivele semiconductoare de putere se poate realiza utilizând programe dedicate de modelare şi simulare termică.

Oprea D. **Moduri de conservare a energiei electrice în timpul producerii şi consumul acesteia.** În viitor, parte importantă a balanţei energetice pentru toate economiile naţionale va fi posibila economisire de energie. De exemplu, UE intenţionează să scadă cererea de energie cu 20% până în 2020 prin utilizarea eficientă a acesteia. În acelaşi timp au drept scop reducerea emisiei de gaze cu efect de seră. Articolul conţine modalităţile de conservare a energiei de către producători, transportatori, distribuitori şi consumatori de energie. Lucrarea este o contribuţie pentru rezolvarea problemei alimentării cu energie în viitor.

Yang B. **Lansarea aplicaţiei paralele pe clusterul de calculatoare.** Calculul de performanţă oferă facilităţi importante pentru modelarea sistemelor biologice. În lucrarea de faţă se descrie o interfaţă web pentru aplicaţia paralelă pe trei nivele, numită Visual Membrane Petri Nets, concepută pentru modelarea şi simularea sistemelor biologice membranale.

Ciobanu R. **Elaborarea şi cercetarea multiplicatorului planetar precesional.** Multiplicatorul este o parte indispensabilă a microhidrocentralelor şi turbine eoliene de putere înaltă. Acesta asigură majorarea vitezei reduse a rotorului limitată de vitezele mici de curgere a curenţilor de apă şi de diametrul relativ mare de plasament palelor, care participă la conversia energiei. Rezultatele cercetărilor teoretice ale multiplicatorului planetar precesional sunt prezentate în lucrarea de faţă.

Moraru C. **Exproprierea pentru cauza de utilitate publica.** In studiul dat autorul dezvăluie conţinutul instituţiei exproprierii pentru cauză de utilitate publică, a procedurilor legale necesare efectuării exproprierii. Unul din principalele obiective propuse a fost analizarea gradului de reglementare juridică a exproprierii în literatura de specialitate, diferenţierea noţiunii de expropriere, rechiziţie şi confiscare. S-au identificat şi totodată s-au analizat unele lacune, confuzii şi contradicţii legale din cadrul instituţiei exproprierii pentru cauză de utilitate publică. Importanţa ştiinţifică a prezentei lucrări este indiscutabilă, deoarece e dictată de necesitatea de a acorda protecţie juridică celui cărui îi este adusă cea mai „*gravă*’’ atingere dreptului de proprietate – exproprierea.

ABSTRACT

Torosyan G., Ghazi A. **Technological design of furfural adsorption from water solutions.** Furfural exists in significant percentage of petroleum products as solvent and refining agent. This organic compound entering soil and groundwater system is considered as a serious problem is that all have some acute and long term toxic effects. The elementary variant of waste water treatment design here is proposed the use of the block from two devices – the amalgamator in which zeolite suspension in cleared water mixes up before achievement of adsorptive balance, and sediment bowl in which fulfilled adsorbent separates from the cleared water. As technological design are offered cross-step or counter-flow schemes for waste water treatment process. At equal number of the basic devices in the considered schemes preference it is given counter - step scheme. As in both considered schemes at equal number of the basic devices and, hence, identical capital investments when economic feasibility is defined by operational expenses, preference, certainly, it is necessary to give counter flow-step scheme.

Ieremia M. **Reconfiguration of the University Square based on an emblematic placement of the National Theatre.** The buildings that compose The National Theatre of Bucharest assembly were designed between 1963 and 1968. There weren't any significant degradations of the structural elements after the 1977 earthquake. On 17.08.1978, a fire burst in the Main Hall building and after that the theatre was totally rebuilt on the outside and partially on the inside. The reinforced concrete "hat" had to disappear and the old edifice was totally covered with a carcass, which gives its actual shape. Following the State's directions in that period, in 1983, The Institute of Design "*Carpați*" elaborated a remodelation model of the Section A building – Main Hall – which changed the stress structure of the building. In this way the Main Hall's capacity was increased, by removing 4 from the 8 curved reinforced concrete walls, and it had been created a new facade that places an excessive load on the structural elements of the adjacent parking lot.

Profir A. **Modelling of cellular functions by means of timed membrane transducers.** In this paper we propose two new formalisms, named deterministic finite timed transducer and timed membrane transducer to model the molecular machinery, which plays a central role in receiving, storing, processing and transmitting information by the living cell.

Lupan O. **Analysis of ZnO-nanorods grown on *p*-Si (100) via catalyst-free hydrothermal deposition.** This work reports a detailed cleaning procedure for Si to get deposited ZnO at low temperature (95-98°C). Also, it is reported on rapid hydrothermal synthesis technique used to growth ZnO nanorod arrays on *p*-Si in 15 min. Their

characteristics has been studied and found a high quality material demonstrated by micro-Raman and photoluminescence measurements. Also, fabricated heterostructures by this method shows feasibility as a new optoelectronic device structure.

Bostan V. **Argumentation of the hydrodynamic profile of the micro-hydro PowerStation rotor's blades.** Research and elaboration of the systems for conversion of renewable energy sources (RSE) as a research objective presents great interest and importance. A new design and functional concept of a micro-hydro power station with vertical axis and individualized orientation of the hydrodynamic blades was proposed and elaborated by the research team from the Technical University of Moldova. This paper presents the results of computational fluid dynamics (CFD) numerical simulation performed in the general purpose viscous flow solver ANSYS CFX.

Tonu V., Țuleanu C., Daud V. **Research of homogeneity of fuel mixture in burners with different types of stabilizers.** This paper work presents the experimental stand for simulation of fuel mixture for research of combustion stability with different types of stabilizers. During the performed researches three types of stabilizers have been used, one of which was designed by authors. On base of processing the experimental data, there have been proposed two equations obtained during the researches. The research results are presented as tridimensional and circular monograms.

Evdokimov R. **The comparative analysis of distributed power control algorithms in CDMA.** In given article results of comparison of the various distributed power control algorithms, through their modelling in the environment of MATLAB, on the basis of the Carrier to Interference Ratio (CIR), by two criteria: on speed of convergence and whenever possible idle time.

Siminiuc R. **Enzyme Linked Immuno Sorbent Assay for the quantitative analysis of prolamins of soryz (ELISA).** In this article are described the features of ELISA method for determining the content of gliadin in cereals, also and the quantitative determining results for toxic prolamins of soryz.

Țurcanu T., Lozovanu C., **ABC – costing as tool to efficient the process of technological changes and development of IT-enterprises.** In this paper we argue the necessity of changes in the field of informational technology. The paper describes and analyzes the process of technological changes made in IT domestic enterprise, by highlighting the strength and the weakness of process, and the threats and the opportunities brought by the market. In order to use all benefits brought by the

change the enterprises should be very receptive to market changes, so the period of implementing changes should be the shortest one possible, so it is very important to evaluate correctly the costs, in order to provide right data for decision making, so we argue the use of ABC – costing to these purposes.

Nistor D. **Creating consulting services in Moldova: case study CAA/proconsulting.** The aim of the paper is to analyze the development of the management consulting services in Moldova. The market management consultancy services in Moldova is still under developed. the commercial market for management consulting services slowly is starting up with services rendered by international consulting firms to the largest companies and small engagements to SMES. In order to get acquainted with the current situation in the moldovan consulting companies we decided to get familiar with the activity in one of the consulting company that started its activity under the donor projects. The results of the case study can give the useful information on the consulting process development in Moldova.

Bodean G. **Microprocessor verification by syntactically controlled generation of the test programs.** This paper presents an approach to synthesis of stylistically and syntactically controlled generator of the microprocessor test verification programs. The dependence of test length of the confidence level and the probabilities repartition of coverage metric is stated. It is developed the procedure of synthesis of a test program generator, represented by a stochastic grammar for a known microprocessor. Deterministic, random and controlled verification test experiments were performed. the obtained results clearly demonstrate the advantages of the proposed syntactic approach in comparison with others competitive methods of generation stimuli for verification of microprocessors and systems-on-chip.

Cârstea C. **Design of a flexible and generic system of evaluation for complex informatics systems.** It is a well - known fact that making the decisions without having the target to make them work, is usually without effect. The same can be said about the planning activity, which will bring lesser benefits if it is not controlled and supervised. The control is a continuous evaluation of the progresses made in the making of the project, in relationship with certain criteria divided on targets levels. The degree of complexity of the project is a major factor, which determines the method of control and report. When we are dealing with complex projects, which involve a period of two-three years and more than 20 persons, flexible and control tools are necessary. A complex project strictly implies intermediate levels of leadership and report.

Pleşca A. **Theoretical aspects related to junction temperature at power semiconductors.** Thermal response of power semiconductor devices for a variety of one-shot and repetitive pulse inputs have been computed with the aim to offer valuable formulae for power circuit designers. It has been computed the temperature variation between junction of power semiconductor device and its case for step, slope, rectangular pulse input power, rectangular pulse series input power, increasing and decreasing triangle pulse series input power, triangle and trapezoidal pulse series input power and in the case of partial sinusoidal pulse series input power. A more exactly thermal calculation of power semiconductors can be done using modelling and simulation software.

Oprea D. **The ways for energy conservation by energy production and consumption of electric energy.** The important part of future energy balance for all national economies represents the possible saving of energy. For example, the EU plans to reach by effective use of energy the decreasing of energy demand by 20 % until 2020. Together with the energy conservation is that manner the way for decreasing of greenhouse gases production. The paper deals about the ways for energy conservation by production, transport and distribution and consumption of electric energy, and describes main methods for decreasing energy consumption of process energy supply. The paper is a contribution for solving the energy supply in future.

Yang B. **Parallel application launching on computer cluster.** Using computer cluster is a great solution to practice parallel computing. We describe a web interface for parallel three level application, named Visual Membrane Petri Nets, designed for modelling and simulation of biological membrane systems.

Ciobanu R. **Elaboration and research of planetary precessional multiplier.** The multiplier is an indispensable part of the micro hydropower plant and high power wind turbine. It helps to increase rotor low speeds limited by the water flow small velocity and by the relative big placement diameter of the blades that participate in the energy conversion. The research results of the planetary precessional multiplier are presented in the present paper.

Moraru C.. **Public utility expropriation.** In this study the author like to reveal the institution of expropriation contents for public use, the necessary legal procedures making the expropriation. One of the main objectives is: to analyze the degree of regulatory expropriation special literature, differentiate the concept of expropriation, requisition and confiscation. There were identified and analyzed some gaps, the confusions and contradictions of the legal expropriation institution for the public use. Scientific importance of this work is unquestionable, because is caused by the need to provide legal protection of what is brought to the main serious prejudice to the right of ownership - expropriation.

SOMMAIRE

Torosyan G., Ghazi A. **Elaboration technologique du procès de l'adsorption furfural pour traitement des eaux d'égout.** Furfural la matière organique largement répandue, est utilisée aussi dans la pétrochimie à titre du dissolvant des produits pétroliers et ainsi que pour leur nettoyage. On propose ici la variante simple du traitement des eaux d'égout ayant lieu à l'utilisation du bloc de deux installations – le mélangeur, dans qui la suspension de la zéolithe dans l'eau nettoyée se mélange avant l'acquisition absorptive les équilibres, et l'appareil pour stationnements dans qui l'adsorbant récupéré se sépare de l'eau nettoyée. Pour la présentation technologique du procès de l'adsorption furfural l'utilisation le croisé degrés et le contre courant des schémas de la présentation d'équipement que permet aussi considérablement de réduire la dépense de l'adsorbant permet. Les deux schémas examinés contiennent le nombre égal des appareils principaux et, donc, sont pratiquement identiques selon les investissements demandés et les dépenses d'exploitation, cependant la préférence, se donne- le contre courant au schéma à degrés.

Ieremia M. **Reconfiguration de la Place de l'Université sur la base d'un placement emblématique du Théâtre National.** Les constructions qui forment l'ensemble du Théâtre National de Bucarest ont été projetées a partir de 1963 jusqu'en 1968. Les éléments de structure n'ont pas subis des destructions majeures après le tremblement de terre de 1977. En aout 1978 le corps principal a été détruit par un incendie et le théâtre a du être reconstruit en totalité a l'intérieur et partiellement a l'extérieur. Le «chapeau» de béton arme a disparu, et le vieux édifice a été couvrit par une carcasse qui donne sa forme d'aujourd'hui. Après une décision d'état prise en 1983, l'Institut de Projection «*Carpati*» a élaboré un projet nouveau pour la Section A de cette construction – le Hall principal - qui a changé complètement la structure de résistance de l'ensemble, en donnant, par conséquence, une capacité augmentée du Hall principal: 4 des 8 murs courbes de béton armé ont été extraits et la nouvelle façade pose maintenant une charge excessive sur les éléments de structure du parking adjacent.

Profir A. **Modélisation des fonctions cellulaires au moyen de transducteurs à membrane temporisé**. Dans ce papier nous proposons deux nouveaux formalismes, nommé transducteur déterministe temporisé et transducteur temporisé à membrane pour la modélisation des fonctions cellulaires, qui joue un rôle central dans la réception, le stockage, le traitement et la transmission d'informations par la cellule vivante.

Lupan O. **Analyses de nanofils de ZnO déposés sur *p*-Si (100) par dépôt hydrothermal sans catalyseur.** Ce travail présente une procédure détaillée pour le nettoyage du silicium en prévision d'un dépôt de ZnO à basse température (95-98°C). En outre, une technique de synthèse hydrothermale rapide (15 min) de croissance d'un réseau de nanofils de ZnO sur le *p*-Si est rapportée. Les caractéristiques de ces nanofils ont été étudiées et ont montré qu'il s'agissait d'un matériau de haute qualité comme le démontre les analyses micro-Raman et les mesures de photoluminescence. De plus, les hétérostructures fabriquées par cette méthode peuvent être utilisées dans de nouveaux dispositifs optoélectroniques.

Bostan V. **Argumentation du profil des pales hydrodynamique du rotor de la centrale micro-hydraulique.** Des recherches et élaboration de systèmes pour la conversation des sources d'énergie renouvelables (ENR) comme un objective de recherche présente un grand intérêt et d'importance. Un nouveau design et conception fonctionnelle d'une centrale micro-hydraulique a axe verticale et l'orientation individualisée des pales hydrodynamique a été propose et élaboré par l'équipe de recherche de l'Université Technique de Moldova. Ce travail présent les résultats de la simulation numérique de la dynamique computationnelle des fluides dans le soft ANSYS CFX.

Tonu V., Țuleanu C., Daud V. **Recherche de l'homogénéité du mélange de arburant dans les brûleurs de différents types de stabilisateurs.** Dans le travail se présent le stand expérimental pour la simulation du mélange de la matière inflammable destiné à l'investigation de la stabilité du brûlage avec les divers types de stabilisateurs. Dans le cadre des investigations ont été utilisé trois types de stabilisateurs, un duquel a été construit par les auteurs. Sur la base du traitement des données expérimentales, il a été proposé deux équations obtenues lors des recherches. Les résultats des investigations sont présentés en forme de monogramme tridimensionnel et circulaire.

Evdokimov R. **L'analyse comparative des algorithmes distribués de contrôle du pouvoir à CDMA.** Dans cet article on présente les résultats de la comparaison des divers algorithmes distribués de la contrôle du pouvoir, dans leur modelage dans le système MATLAB, à la base de la relation le signal-interférence, selon deux critères: selon la vitesse de la convergence et selon la possibilité du stagnation.

Siminiuc R. **Méthode immunologique (ELISA) pour la détermination quantitative de prolaminer toxiques de soriz.** Dans cet article sont décrit des caractéristiques de la méthode ELISA pour déterminer le contenu de gliadine dans le grain et aussi, les résultats de la détermination quantitative de prolamine toxiques de soriz.

Turcanu T., Lozovanu C, **ABC-costing comme un outil pour perfectionner le processus de changement technologique et de développement des entreprises IT**. Dans cet article on montre la nécessité de changement dans le domaine de technologie de l'information. Il est décrit et analyse le processus de changement technologique dans les entreprises IT, en soulignant les faiblesses et les forts de celui-ci, et les

risques et les opportunités qu'apporte le marché. Pour profiter de toutes les opportunités apporter par les changent, les entreprises doivent être très sensibles aux changements du marché, la mise en œuvre du changement doit être le plus bref, il est donc nécessaire que les coûts soit évaluer assez exactement pour fournir des informations précises pour la prise de décision, afin que l'utilisation de l'approche de l'ABC est le mieux adapté à ces fins.

Nistor D. **Création de services consultatifs en Moldavie: une étude de cas CAA / ProConsulting.** Le but de cet article est d'analyser le développement des services de conseil en management en Moldavie. Consultation du marché des services en Moldavie est sous-développé. Du marché commercial pour les services de conseil en gestion a commencé avec les services guidées de cabinets de conseil internationaux aux grandes entreprises et des engagements spécifiques pour les PME. Afin de mieux connaître les services actuels du marché du conseil en Moldavie a été effectue l'analyse de l'activité d'un cabinet de conseil, qui a débuté dans les services guidés par les projets des donateurs internationaux. Résultats de l'étude de cas permettent d'avoir des informations de base pour le développement des processus de conseil en Moldavie.

Bodean G. **La vérification des microprocesseurs par la syntaxique contrôlent génération des programmes de test.** Dans le travail on examine l'approche de la synthèse des générateurs des programmes de test (PT) contrôler stylistique et syntaxique. Est présentée la dépendance entre la longueur des programmes de test et la distribution des probabilités sur la métrique de la qualité de la vérification des projets des microprocesseurs (MP). Étaient faits les expériences déterminées, probabilistiques et contrôler de test de la vérification MP. Les résultats acquis prouvent clairement les avantages de la syntaxique approche proposée en comparaison d'autres méthodes à la génération stochastique contrôler des tests pour la vérification des microprocesseurs et les dispositifs comme "le système sur le cristal".

Cârstea C. **Le Design D'un Système Flexible Et Générique D'évaluation Pour Les Systèmes D'informatique Complexes.** Il est bien - le fait connu que le fait de prendre les décisions sans avoir la cible pour les faire le travail, est d'habitude sans effet. On peut dire le même de l'activité de planification, qui apportera des avantages moindres s'il n'est pas contrôlé et supervisé. Le contrôle est une évaluation continue des progrès faits dans la réalisation du projet, dans le rapport avec de certains critères divisés sur les niveaux de cibles. Quand nous nous occupons des projets complexes, qui impliquent une période de deux trois ans et plus de 20 personnes, flexibles et contrôlent des instruments sont nécessaires.

Pleşca A. **Aspects théoriques à propos de jonction température à semiconducteurs de pouvoir.** Dans le présent travail on a déterminé une série de relations de calcul pour la température de la jonction dans le cas des dispositifs semiconducteurs de pouvoir, ayant comme point de départ l'impédance thermique transitoire. On a calculé la différence de température entre la jonction semiconductrice et la capsule du dispositif pour un impulse de flux thermique, une variation linéaire ascendante, un impulse rectangulaire, une série d'impulses rectangulaires. On a calculé également la même différence de température pour des impulses de flux thermique triangulaire ascendants et descendants, une série d'impulses triangulaires, trapézoïdales et des fragments de sinusoïde.

Oprea D. Les modes d'économie d'énergie par la production et de la consommation d'énergie électrique. La partie importante du bilan énergétique de l'avenir pour toutes les économies nationales représente l'économie d'énergie possible. Par exemple, l'UE prévoit d'atteindre par une utilisation efficace de l'énergie baisse de la demande d'énergie de 20% jusqu'en 2020. En collaboration avec la conservation de l'énergie est de cette manière la voie à une baisse de la production de gaz à effet de serre. Les principales méthodes sont décrites dans les champs de production, le transport et la distribution, la consommation d'énergie électrique. Le document est une contribution pour la résolution de l'approvisionnement énergétique à l'avenir.

Yang B. **L'application parallèle de lancement sur le grappe d'ordinateurs**. L'utilisation des grappe d'ordinateurs est une solution idéale pour la pratique du calcul parallèle. Nous décrivons une interface web pour trois niveaux des application parallèle, nommée Visual Membrane Petri Nets, conçu pour la modélisation et la simulation des systèmes de membrane biologiques.

Ciobanu R. **Elaboration et la recherche de multiplicateur planétaire précessionnelle.** Le multiplicateur est un élément indispensable de la micro-turbine hydroélectrique et turbine éolienne a haute énergie. Il aide à augmenter la vitesse basse de rotor limitée par la vitesse petit d'écoulement de l'eau et par le diamètre de placement relatif des grandes lames qui participent à la conversion d'énergie. Résultats des recherches théorétiques du multiplicateur planétaire précessionnelle sont présentés dans le présent travail.

Moraru C. **Expropriation pour cause d'utilité publique.** Dans cette étude, l'auteur révèle le contenu de l'institution de l'expropriation pour la utilisation public, les procédures juridiques nécessaires à l'expropriation. Un des principaux objectifs a été d'analyser le degré de réglementation juridique de l'expropriation dans la littérature, de faire la différence pour la notion d'expropriation, de réquisition et de la confiscation. On été identifiés et on été considérés comme des lacunes, les confusions et les contradictions de l'institution juridique de l'expropriation pour la utilisation public. L'importance scientifique de ce travail est incontestable, comme a été dictée par la nécessité de fournir une protection juridique de ce qui est porté «à la mai»' un préjudice grave à un droit de propriété - expropriation.

РЕЗЮМЕ

Торосян Г., Гази А. **Технологическое проектирование процесса адсорбции фурфурола при обработки сточных вод.** Фурфурол широко распространенное органическое вещество. Используется также в нефтехимии в качестве растворителя нефтепродуктов, а также для их очистки. В работе предложен простой вариант обработки сточных вод, состоящий в использовании блока из двух устройств – смесителя, в котором суспензия цеолита в очищаемой воде перемешивается до достижения адсорбционного равновесия, и отстойника, в котором отработанный адсорбент отделяется от очищенной воды. Для технологического оформления процесса адсорбции фурфурола предлагается использование перекрестно-ступенчатой или противоточной схем аппаратурного оформления, что позволяет также значительно сократить расход адсорбента. Обе схемы содержат равное число основных аппаратов и, следовательно, практически идентичны по требуемым капитальным вложениям и эксплуатационным затратам, однако предпочтение, отдается противоточно - ступенчатой схеме. Данная схема и обсуждается в статье.

Иеремия М. **Реконфигурация университетской площади на основе существующего размещения национального театра**. Конструкции, входящие в состав национального театра в Бухаресте, были разработаны в период 1963-1968 гг. После землетрясения 1977 года в несущих конструкциях не произошли существенные разрушения. 17 августа 1978 в корпусе главного зала произошел пожар, после чего театр был полностью отреставрирован внутри и частично снаружи. Решено было убрать железобетонную «шляпу» и, взамен, перекрыть каркасом все старое здание, который дает ему нынешний вид. В этом духе, в результате указаний государственного руководства того времени, в 1983 году, проектный институт «Карпаты» разработал новый проект корпуса большого зала, в котором несущие конструкции были значительно изменены. Таким образом, увеличилось вместимость главного зала за счет исключения несущих криволинейных стен, были разобраны четыре из восьми железобетонных диафрагм, был выполнен новый фасад, который опасно перегружает несущие элементы автостоянки.

Профир А. **Моделирование клеточных функций используя мембранные временные трансляторы.** Предложены два формализма: временные трансляторы и временные мембранные трансляторы для моделирования молекулярных механизмов живой клетки, играющие центральную роль в получении, хранении, обработке и передаче информации.

Lupan O. **Анализ ZnO-наностержней, выращенных на *p*-Si (100) с помощью гидротермального синтеза без катализатора.** В данной работе представлена подробная процедура чистки Si, чтобы получить ZnO при низкой температуре (95-98 °C). Кроме того, представлена новая технология гидротермального синтеза массивов наностержней ZnO на подложке Si *p*-типа в 15 мин. Представленные исследования показывают что измерения микро-Raman и фотолюминесценции на ZnO наностержней обладают хорошим потенциалом для LED устройств и дальнейшего их развития. Ноностержни ZnO могут быть использованы в качестве наноматериала в световое излучение или фоторегистрации для изготовления многофункциональных наноустройств.

Бостан В. **Обоснование гидродинамического профиля лопастей ротора микрогидроцентрали.** Исследование и разработка систем для конверсии возобновляемых источников энергии (ВИЭ) как цель исследования представляет большой интерес и важность. Группой исследователей Технического Университета Молдовы была предложена новая концептуальная схема микро гидроэлектростанции с вертикальной осью ротора и индивидуализированной ориентации каждой лопасти. Настоящая работа представляет результаты численного симулирования компьютерной динами жидкостей в компьютерной программе ANSYS CFX.

Тону В., Цуляну К., Дауд В. **Исследование однородности состава топливной смеси в горелках с различными типами стабилизаторов**. Статья представляет работы моделирования топливной смеси на экспериментальном стенде для исследования устойчивого горения с различными типами стабилизаторов. Во время проведенных исследований три типа стабилизаторов были использованы, один из которых был разработан авторами. На основе обработки экспериментальных данных, было предложено два уравнения, полученные в ходе исследований. Результаты исследования представлены в виде трехмерных и круговой монограммы.

Евдокимов Р. **Сравнительный анализ распределенных алгоритмов управления мощностью в CDMA.** В данной статье приведены результаты сравнения различных распределенных алгоритмов управления мощностью, через моделирования их в среде MATLAB, на основе отношения сигнал-помеха, по двум критериям: по скорости сходимости (конвергенции) и по возможности простоя.

Siminiuc R. **Иммуноферментный метод анализа (ELISA) для количественного определения токсичных проламинов в соризе.** В данной работе описаны особенности иммуноферментного метода анализа для определения глиадина в злаках, а также результаты, полученные экспериментальным путем, количественного определения проламинов в соризе.

Цуркану Т., Лозовану К. **ABC-костинг как инструмент оптимизации процесса технологических изменений и развития ИТ-предприятий**. В статье излагается необходимость перемен в сфере информационных технологий. Описан и проанализирован процесс технологических изменений в местных ИТ-компаниях, акцентируя внимание на его слабые и сильные стороны, а также на риски и возможности, идущие от рынка. Чтобы воспользоваться всеми преимуществами рынка, фирмы должны быть очень чувствительны к изменениям рынка, а внедрение изменений в компании во времени должны быть наименее краткими, поэтому необходимо, чтобы затраты были оценены наиболее точно, так как они должны обеспечивать точной информацией для принятия решений, а использование подхода ABC лучше всего подходит для этих целей.

Нистор Д. **Формирование консалтинговых услуг в Молдове: ситуационный анализ CAA/proconsulting.** Цель статьи состоит в анализе развития консалтинговых услуг по менеджменту в Молдове. Рынок консалтинговых услуг в Молдове неразвит. Коммерческий рынок для консалтинговых услуг по менеджменту начался с услуг поддерживаемых интернациональными консалтинговыми фирмами оказываемых для больших и малых предприятий. Для того чтобы узнать лучше настоящую ситуацию на рынке консалтинговых услуг в Молдове, был сделан анализ деятельности одной консалтинговой фирмы которая начала свою деятельность под руководством интернационального донорского проекта. Результаты ситуационного анализа дают полезную информацию для последующего развития консалтингового процесса в Молдове.

Бодян Г. **проверка процессоров синтаксически-управляемой генерацией тестовых программ.** В работе рассмотрен подход к синтезу стилистически и синтаксически управляемых генераторов тестовых программ (ТП). Представлена зависимость между длиной тестовых программ и распределением вероятностей на метрике качества проверки проектов микропроцессоров (МП). Были проведены детерминированный, случайный и управляемый тестовые эксперименты верификации МП. Полученные результаты явственно доказывают преимущества предложенного синтаксического подхода по сравнению с другими методами управляемой стохастической генерации воздействий.

Кырстя К. **Проектирование гибкой системы оценки для менеджмента сложных информационных систем.** Известно, что принятие решений, не имея возможности их проверки, чаще всего бесполезно. То же самое можно сказать и о планировании деятельности сложных информационных систем, которые приносят мало пользы если не , которая принесет меньшие выгоды, если этим не будут управлять и контролируется. Контроль - непрерывная оценка успехов, делаемых в создании из проекта, в отношениях с определенными критериями, разделенными на целевых уровнях.

Плешка А. **Теоретические аспекты относительно температуры в силовых p-n переходах полупроводников.** В настоящей работе определён ряд расчётных зависимостей для p-n переходов в случае силовых полупроводниковых приборов, имея как точку отправления переходной термический импеданс. Была рассчитана разница температуры между p-n переходом и корпусом устройства для определённого теплового импульса.

Опря D. Способы для экономии энергии за счет производства и потребления электрической энергии. Важной частью будущего энергетического баланса для всех национальных экономик представляет возможную экономию энергии. Например, ЕС планирует достичь за счет эффективного использования энергии снижения спроса на энергоносители на 20% до 2020 года. В этой статье рассматриваются пути экономии энергии за счет производства, транспортировки, распределения и потребления электрической энергии. Вместе с сохранением энергии, путь к снижению производства парниковых газов. Работа является вкладом в решение проблемы энергоснабжения в будущем.

Янг Б. **Запуск параллельных приложений на кластере компьютеров.** Использование вычислительных кластеров является отличным решением для запуска параллельных программ. В данной работе описан веб-интерфейс для параллельного трех-уровнего приложения, Visual Membrane Petri Nets, предназначенного для моделирования мембранных биологических систем.

Чобану Р. **Разработка и исследование планетарного прецессионного мультипликатора**. Мультипликатор является неотъемлемой частью микро гидроэлектростанций и ветроагрегатов большой мощности. Он помогает увеличить число оборотах низкооборотного ротора, скорость которого ограничена небольшой скорости течения воды и относительного большим диаметром размещения лопастей, которые участвуют в преобразовании энергии. В настоящей работе представлены результаты теоретических исследований планетарных прецессионных мультипликаторов.

Moraru С. **Экспроприация для общественных целей**. В этом исследовании автор хотел раскрыть содержание института экспроприации в общественных, правовых процедур, необходимых для экспроприации. Одной из главных целей было анализ степени правового регулирования экспроприации в литературе, отличие понятий концепции экспроприации, реквизиции и конфискации. Были выявлены и анализированы некоторые пробелы, неясности и противоречии правового института экспроприации для общественности. Научное значение этой работы не вызывает сомнений так как это продиктовано необходимостью обеспечения юридической защиты тому кому принесен самый серьезный ущерб праву собственности - экспроприации.

TECHNOLOGICAL DESIGN OF FURFURAL ADSORPTION FROM WATER SOLUTIONS

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INTRODUCTION

It has been investigated an adsorbtive abilities of zeolites as sorbents available in Armenia and Iran, in particular mordenite, clinoptilolite, and also H-mordenite, ZSM-5 in relation to organic pollutants for the purpose of device-technological design of process of waste water treatment. Here was studied as organic pollutant furfural.

Furfural is used as a solvent in petrochemical refining to extract dienes and aromatics from other hydrocarbones.13 % of furfural is used as additional processing solvent, generally in petrol chemistry – for butadiene separation from oil cracking gases, for refining of plant oils and lubrication oils. Furfural is also an intermediate in the production of the solvents. The related compound hydroxymethylfurfural (which is derived from hexoses) has been identified in a wide variety of heat processed foods.

Furfural is an active monomer used for chemical compound synthesis. About 64% of furfural throughout production the world are used for furfuryl alcohol synthesis. Furfural, as well as its derivative furfuryl alcohol can be used either by themselves or together with others to make solid resins. 16% of furfural is directed for furan & tetrahydrofuran synthesis.

Furfural is a toxic substance – LD $_{50}$ 126mg/kg/, MPC in reservoirs - 1mg/l, in air - 0.05mg/m3. Furfural has an odor similar to almonds.

Furfural vapor is an irritant of the skin, eyes and respiratory tract. It may also cause unconsciousness. Long-term exposure to furfural may cause sensitization of the skin, loss of the sense of taste, numbness of the tongue, and breathing problems. Consequently the furfural existence in sewage and its removal is an actual problem.

Nowadays natural zeolites are focused in applications in the sector of wastewater decontamination, for instance for removal of ammonium from municipal sewage and abatement of radionuclides from effluents of nuclear power plants [1]. There are many reasons for zeolites using in mentioned fields: good selectivity for many toxic cations and harmful compounds [1], as adsorbents for organic compounds [2,3].

MATERIALS AND METHODS

Zeolites occur in nature in specific kinds of rocks. Zeolite rich rocks are widespread in Northern part of Armenia, occurring in very extended geological formations. The zeolite types are exclusively clinopilolite - in Idjevan / Northern-East of Armenia / and mordenite in Shirak / Northern-West of Armenia/. The one clinoptilolite sample used also in this study were obtained from Semnan province in Iran.

Taking advantage of their high zeolite content, high cation exchange capacity and selectivity many agricultural applications of zeolites have been proposed recently. Nowadays some of natural zeolites were characterized from the point of view of chemical composition, type of structure and chemical, thermal and radiation resistance.

Natural zeolites - mordenite and clinoptilolite were dehydrated at 400°C in vacuum (0.1 mm) for 3-4 hours. H-mordenite and ZSM-5 was prepared in our laboratory [2,3].

The removal of organic substances is carried out as follows.

The researches were spent in static conditions on a laboratory rocking chair. Sorbents brought in quantity of 1,0 ±0.01 g in water solutions, volume 100 ±0.1 ml containing furfural in quantity from the maximum solubility. Further a mix placed on a rocking chair and subjected to hashing during 6h., at temperature of 20°, then test defended within 24 h.

Furfural sorption. On 1 gr of sorbent added on 10ml solutions of furfural in water. The mix was carefully shaken up within 6 hours. The measurements of molar refraction of a solution were carried out before and after sorption. On a difference of concentration of an organic solution expected amount of adsorbed furfural.

Residual quantities of substances were defined by methods of UV-spectroscopy and HLECh (system Water 486-detector, Water 600S -

controller, Water 626-Pump, a column 250x4 mm filled microspherical silica as sorbent, speed of a stream of a mobile phase of 1 ml/mines).

On the basis of the analysis of data isotherms of adsorption which have been processed by means equations of Dubinin-Radushkevich, Langmuir, Friendlich have been constructed [4].

The elementary version of device-technological design of adsorbtive waste water purifications is use of the block from two devices – the blender in which sorbent suspension in cleared water mixes up before achievement adsorbtive balance, and sediment bowl in which fulfilled adsorbent separates from the cleared water. Calculation of such scheme, taking into account the maximum adsorption data of furfural from water environments the specified sorbents, has shown that the expense of the last is inadmissible is great (for example, in the case of furfural it will make 1,545 kg/l for H - mordenite, at initial concentration 1 g/l) [5,6]. Considerably to reduce the expense of adsorbent use of more perfect schemes of device design – crossing-step or counter-flow allows.

On the basis of the received experimental and settlement data mathematical models of the technological scheme of adsorbtive water treating from noted pollutant - furfural have been deduced.

RESULTS AND DISCUSSION

Adsorption of furfural by zeolites in isothermal conditions is preliminary studied at 20^oC (293K $)$ and relation solid phase : liquid (adsorbent : a furfural solution) = 1:100. Equilibrium concentration of fufural in a solution defined by UV - at $\lambda = 260$ $v\mu$. Results of research are resulted in table 1 where equilibrium concentration are expressed in relative units C / C_s. Here C_s – concentration of the saturated solution of furfural at 20 $^oC,$ this concentration is equal C_s =800 $mmol/l$ [1]. Adsorption isotherms in co-ordinates $a = f (C/C_s)$ are presented at the picture 1.

An interpretation of isotherms made within the limits of the theory of volume filling of a micro pore (TVFM), according to [1] applicable and

Table 1. Adsorption of furfural from a water solution on zeolites at 293 To (C_s = 800 $mmol/l$).

C / C_s	Adsorption, $a, mmol/gr_{adsorbentc}$				
	Mordenite	H-	Clinoptilolite/$_{Arm}$	Clinoptilolite/$_{Iran}$	*ZSM – 5*
0,0044	0,058	0,125	0,070	0,076	0,170
0.0088	0,087	0,205	0,120	0,135	0,250
0,0170	0,126	0,261	0,270	0,295	0,353
0,0440	0,184	0,352	0,240	0,261	0,461
0.0610	0,210	0,404	0,260	0,278	0,510
0.0880	0,220	0,430	0,320	0,342	0,540
0,1320	0,256	0,465	0,350	0,375	0,590

to adsorption of the dissolved substances. Considering, that in most cases, volumes are distributed under the normal law, isotherms of adsorption of furfural on investigated adsorbents in co-ordinates of the equation of Dubinin-Radushkevich (equation DR).

$$ln \, a = ln \, a_s – (RT / E)^2 \cdot \{ ln \, (C_s / C)\}^2, \quad (1)$$

where: C_s and C – concentration, accordingly, the saturated and equilibrium solutions; a and a_s - accordingly, equilibrium and maximum adsorptions.

The adsorption is maximum in the case of zeolite **ZSM-5** (table 1), that, apparently, it is possible to explain to that average diameter of its pore (0,75 *nanometers*) is more than Van-der-Waals diameter of a molecule of furfural (0,65 *nanometers*), from that furfural adsorption becomes possible not only on a surface of crystals of zeolite

(as in case of natural zeolites), but also by partial introduction of molecules of furfural in a mouth of pore. It should be note that clinoptilolite from Semnan more actively to its Armenian analogue.

While transfer of mordenite in the H-form, apparently, took place partial dealuminated zeolite, with destruction of a part of tetrahedrons $(Al_4O)^{-5}$ and, as consequence, expansion of some part of pore, as has led to quantity increase of sorpted furfural, in comparison with initial mordenite. Values of characteristic energy of furfural adsorption on the investigated sorbents are close between themselves4 and, with confidential probability 0,86, it is possible to accept $E = 9,5 \pm 1,2$ *Kgoule /mol..*

On superficial groups of hydro group and atoms of oxygen of H-zeolites processes of formation of chemical bonds owing to molecular

interactions with group of carboxyl in furfural proceed.

Kinetic researches of adsorption spent *in* a cylindrical reactor in diameter 72 *mm* supplied

propeller type mixer in diameter of 18 *mm*. A mixer drive – noncontrollable, **n** = 600 *mines⁻¹* (10 *sek⁻¹*).
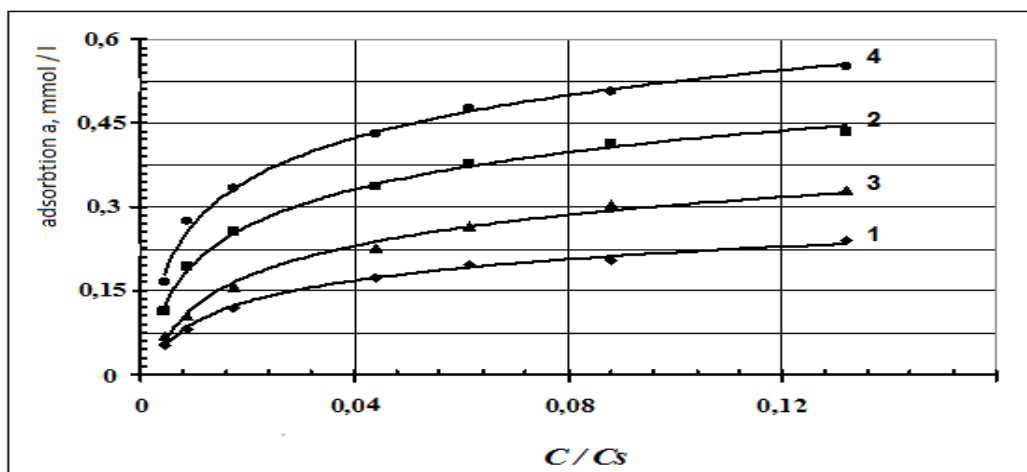

Figure 1 . The isotermes of furfural sorption from water solutions on zeolites
1- natural mordenite, 2-natural clinoptilolite/$_{Iran}$, 3. natural clinpotilolite/$_{Arm}$ 4 ZSM-5
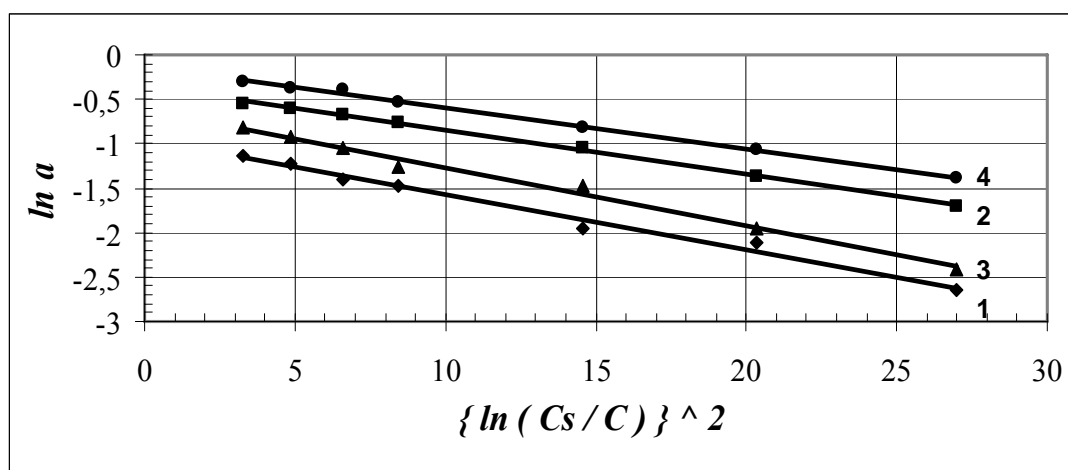

Figure 2. Isotermes of furfural adsorption on zeolites
in Dubinin-Radushkevich equation coordinates $ln \ a = f \{ ln \ (C_s \ / \ C)\}^2$

Suitability of a mixer for creation of suspension with uniform of adsorbent distribution in liquid volume was checked on condition **Re$_м$ ≥ Re$_м$***, where **Re$_м$*** - boundary value of criterion of Reynolds for a mixer, providing creation of uniform suspension, **Re$_м$** – value of the same criterion for a used mixer. Value **Re$_м$*** is equal [4]:

$$Re_м* = C \cdot Ar \cdot (d_э \ / \ d \ )^{0,5} \cdot (D/d \ )^k \qquad (2)$$

There are:

Ar = d$_э^3$ ·(ρ$_{тв}$ – ρ$_{ж}$)· ρ$_ж$ ·g / μ² – Archimed criterion for solid phase,

C и k – constant for propeller mixer,

C = 6,6 , **k** = 1 ; **d$_э$** – ecvivalent diameter of particles (**d$_э$** = 0, 375 mm),

d = 18 *мм* – mixer diameter,

D– diameter of reactor,

ρ$_{sol}$ = 2160 *кг/м³*– zeolite density,

ρ$_{liquid}$ and μ – density and viscosity of liquid phase, at 20°C,

ρ$_{liquid}$ = 997 kg/*m³*, **μ** = 0,894·10⁻³ pa·*sec*), **g** = 9.81 m/*sec²*.

In table 2 the parameters of equations DR received by processing MLS (a method of the least squares) the isotherms resulted on rice are resulted. 2. The correlation factors are calculated for received regressive equations, are rather close to unit that

testifies to applicability TVFM to adsorption process of furfural on the investigated zeolites.

Table 2. The parameters of Dubinin-Radushkevich equation during the furfural adsorption on zeolites.

№ zeolites	The equation of regression	R^2	a_s, mmol/gr	E, kjoul/mol
1	$ln\ a = -0,9242 - 0,0638\ \{ ln\ (C_s/C)\ \}^2$	0,9981	0,389	9,81
2	$ln\ a = -0,3638 - 0,0494\ \{ ln\ (C_s/C)\ \}^2$	0,9997	0,695	11,1
3	$ln\ a = -0,6031 - 0,0668\ \{ ln\ (C_s/C)\ \}^2$	0,9988	0,547	9,58
4	$ln\ a = -0,1362 - 0,0460\ \{ ln\ (C_s/C)\ \}^2$	0,9992	0,872	11,5

After substitution of numerical values, we receive $Re_м^* = 2856$. The used mixer provides value of criterion of Reynolds:

For reduction of an error of the experiment arising at sampling because of possible infringement of set relation solid :liquid and equilibrium concentration of furfural, volume of a reactionary mix, in comparison with experiments at research adsorptive balance till 500 *ml* have been increased. At such initial volume of a mix, selection 8 ÷ 10 tests at 1 *ml* practically does not affect a process course.

The kinetic curve of furfural adsorption is resulted on figure 3 at C = 20 *mmol /l* in coordinates $\gamma = f(\tau)$, there is:

γ –relative approach of adsorption to balance; $\gamma = a_\tau / a$. Here are

a_τ – current value of adsorption at the moment of time,

τ, a – an equilibrium value of furfural adsorption in solution 18 *mmol /l*.

The speed of approach to balance in the conditions of experiment, practically not depend from a kind of adsorbent; in all cases balance was reached for 180 ÷ 190 *min*. The dependence of $\gamma = f(\tau)$ It is almost linear on an extent ~ 80 % of all time of an establishment of balance (till contact120 ÷ 150 *мин*). Such behavior of process is characteristic for cases when speed of adsorption is supervised external diffusion mass transfer [5] that is possible as in case of rather fast, in comparison with external, internal mass transfer, and in case of its absence.

If for natural clinoptilolite and mordenite internal diffusion (and, hence, internal mass transfer) cannot have places because of small diameter of a time *ZSM--5*, (and, probably, some part of time *H-mordenit*) have diameter, a little больший, than Van-der-Waals diameter of a molecule of furfural (0,75 *nanometers*, at diameter of a molecule of furfural of 0,65 *nanometers*). An absence of the appreciable contribution internal

pore (up to adsorption of ~90 % from equilibrium) in kinetic of furfural adsorption in this case follows diffusion, apparently, attribute to increase *in effective* diameter of adsorbate molecule because of hydration that limits adsorption only to area a mouth of pore a time and so complicates diffusion of hydrate molecules in pore space, that the share diffusions in mass transfer becomes sighting small. Apparently, basically, for this reason adsorption of furfural also has smaller size, than the porous structure of zeolite allows. In favor of this assumption says that fact, that adsorption of furfural from tetrachloromethan (no hydrated solvent) zeolite *ZSM--5* has size 0,31 *г/г* [6], or 3.3 *mmol/g*, that almost in 4 times exceeds size of its maximum adsorption from water (a_s = 0,872 *mmol/g*).

From specific equation ($a = (C_0 - C) \cdot V / g$) follows, that the expense of adsorbent for cleared water volume (m) can be according:

$$m = (C_0 - C_к) / a_к \qquad (3)$$

Here C_0 and $C_к$ - accordingly, initial and final concentration of furfural, $a_к$ - size of adsorption, equilibrium with $C_к$. As a rule, $C_к$ has rather small size; even at use of the cleared water only in system of the closed water turn, $C_к$ usually does not exceed ~ 0,1 *mmol/l*.

If to consider, that so low concentration are answered with low sizes of equilibrium adsorption, it is easy to see, that the expense of adsorbent, at such registration of process, is inadmissible is great. From equation (3), taking into account (1), to a kind:

$$m = (C_0 - C_к) / a_к =$$
$$(C_0 - C_к) / exp \{ ln\ a_s - (RT/E)^2 \cdot [ln\ (C_s/C_к)^2]\} \qquad (4)$$

And substituting corresponding values in (4) it is received, that at decrease in concentration of furfural for the closed system of a water turn (0,1 *mmol/l*), the specific expense of a sorbent (m) will water, a step (k)where, contacting to partially
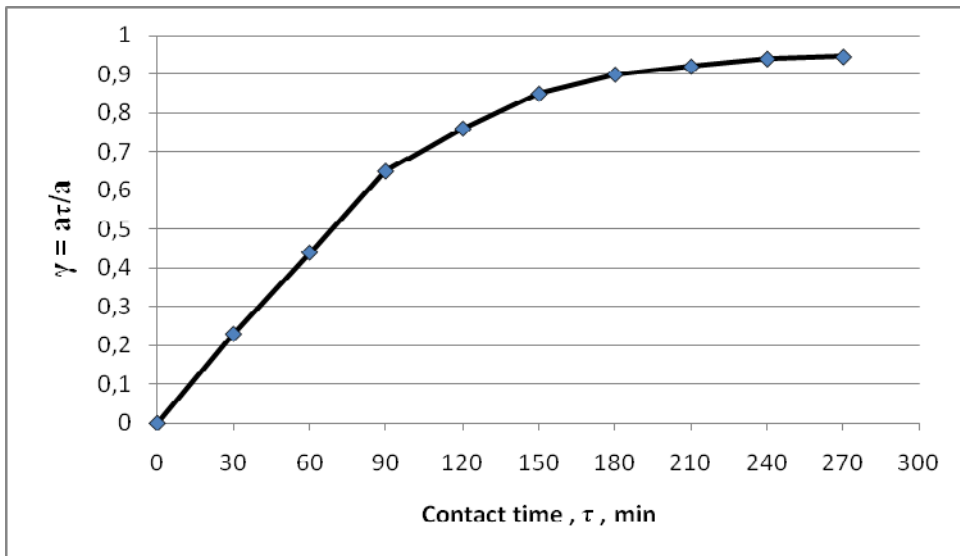
Figure 3. Kinetic curve of furfural adsorption.

make 1,745 *kg/l* for **H** - mordenite, and for zeolite **ZSM-5** – 1.04 *kg/l.*

As technological design are offered cross-step or counter-flow schemes for waste water treatment process. At equal number of the basic devices in the considered schemes preference it is given counter - step scheme. As in both considered schemes at equal number of the basic devices and, hence, identical capital investments when economic feasibility is defined by operational expenses, preference, certainly, it is necessary to give counter flow-step scheme.

It is most full used of adsorbtive capacity of sorbent at counter-flow mutual moving of adsorbent and treated water (figure 4). Here is presented the counter flow-step scheme.

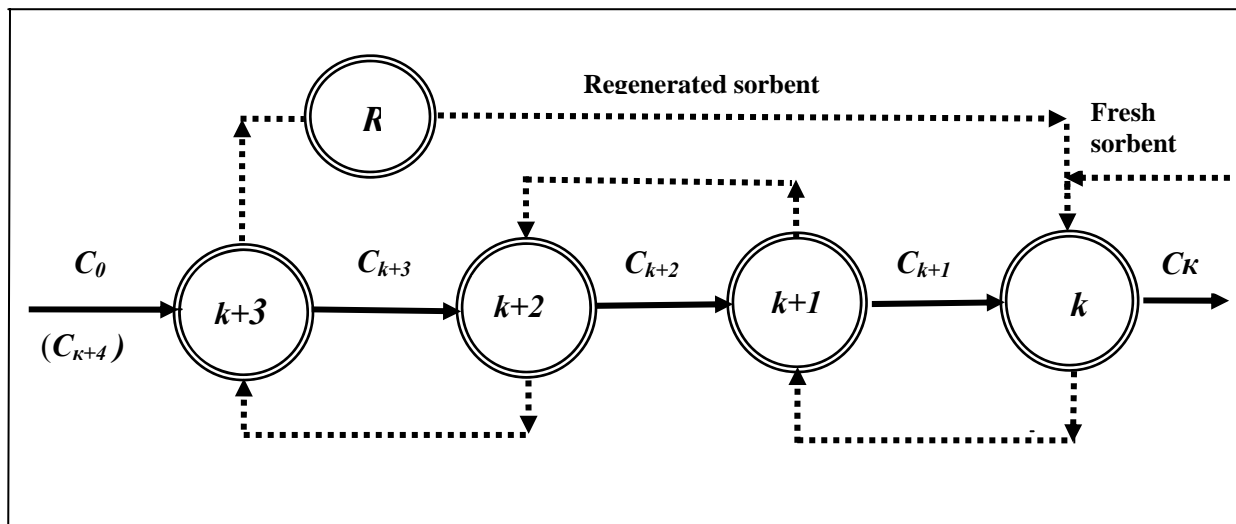An adsorbent is brought in the amalgamator-sediment bowl of last, on a course of

Figure 4. The counter-flow scheme for adsorptive water purifications *k, k+1, k+2, k+3* – units "*amalgamator-sediment bowl*"; *R*- regeneration knot of adsorbent.

cleared water (concentration of furfural C_{k+1}), absorbs furfural before achievement to specific adsorption ($a_к$), equilibrium with the set final concentration ($C_к$) it in water. After upholding, water, cleared to $C_к$, leaves installation, and adsorbent, using only small part of the adsorptive capacities, is transferred to a step *k+1* where adsorbs furfural before achievement of adsorption, equilibrium with $C_{k+1.}$

The defended water, with concentration of furfural $C_{k+1,}$ arrives on a step *k*, and adsorbent – on a step *k+2*. As a result of repetition of the described operations, adsorbent is deduced with last, on a sorbent course (and the first – on a water course), steps, having reached size of specific adsorption, a

little smaller, than equilibrium with initial concentration of furfural in water C_0. The mathematical description of process is realized by a step-by-step method.

CONCLUSION

The elementary version of device-technological design of water treatment from furfural is proposed the block from two devices – the blender in which sorbent suspension in treated water mixes up before achievement adsorptive balance, and sediment bowl in which fulfilled adsorbent separates from the cleared water. For reduce the expense of adsorbent use of more perfect schemes of device design – crossing-step or counter-flow allows.

As both considered schemes contain equal number of the basic devices and, hence, are practically identical on demanded capital investments and operational expenses, the preference have been gives to counter-flow step scheme.

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RECONFIGURATION OF THE UNIVERSITY SQUARE BASED ON AN EMBLEMATIC PLACEMENT OF THE NATIONAL THEATRE

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INTRODUCTION

The buildings that compose The National Theatre of Bucharest assembly were designed between 1963 and 1968. There weren't significant degradations of the structural elements after the 1977 earthquake. On 17.08.1978, a fire burst in the Main Hall building and after that the theatre was totally rebuilt on the outside and partially on the inside. It had to disappear the reinforced concrete "hat" and the old edifice was totally covered with a carcass, which gives its actual shape. Following the State's directions in that period, in 1983, The Institute of Design "*Carpați*" elaborated a remodelation model of the Section A building – Main Hall – which changed the stress structure of the building. In this way the Main Hall's capacity was increased, by removing 4 from the 8 curved reinforced concrete walls, and it had been created a new facade that loads in a forbidden way the structural elements of the adjacent parking lot.

1. SEISMIC SPECIFICITY OF BUCHAREST CITY: LOCATION OF THE NATIONAL THEATRE

The city of Bucharest is located in the central part of the Moesian sub-plate, in the Romanian Plain. The seismic hazard in this area is due to the Vrancea sub-crust source, with a focal point at the depth of $h = $ $= 60$–170 km, located at approximately 150 km North-East of the city.

The destructive earthquake which took place in Vrancea on March 4, 1977 ($h = 109$ km), with a magnitude of $M_{GR}=7.2$ ($M_W=7.5$) was characterized by a narrow frequency range and a fundamentally long soil vibration span ($T_C=1.1÷1.5$ s), as well as relatively small values of the PGA and EPA in the central area of the city, where the theatre stands (on an essentially clay-based soil).

2. SHORT HISTORY OF THE NATIONAL THEATRE RECONSTRUCTION

- **1836 - 1852: the beginnings**

- 1834 – The Philharmonic Society is founded, following an initiative by Ion Heliade Radulescu and Ion Campineanu;
- 1836 – The Philharmonic Society buys a piece of land called Hanul Campinencii for the purpose of building a National Theatre;
- 1840 – Ruling Prince Alexandru Ghica approves the project;
- 1845 – Viennese architect Heft's plan is chosen for this purpose; the building, in the Baroque style (fig.1), was to last until 1944 when it was blown up by Nazi bombardments.
- **1852 - 1864: The Great Theatre**
- 1852 – The Great Theatre in Bucharest is opened, its first managing director being Costache Caragiale. The auditorium, with a small number of seats, having initially been built for high class audiences, was enlarged in order to accommodate other categories of audiences as well.


Figure 1. The old National Theatre (1852 - 1944).

- 1864 – 1877 Official acknowledgement of the National Theatre
- 1864 – The Great Theatre becomes a public cultural institution when, by decree signed by the then Prime Minister Mihail Kogalniceanu "decided that the building must be managed by the state and become a national institution".

- 1875 – Alexandru Odobescu, general manager of the theatre, places the name of **National Theatre** on the front of the building.
- 1877 – following an initiative by Ion Ghica, general manager of the theatre, the Parliament promulgated the Theatres Law, inspired by the Comédie Française regulations written by Napoleon.

  During the Independence War, the theatre organized shows for the support of wounded soldiers and for hospital maintenance. During the shows, audiences were informed by the state of things on the front line.
- **In 1942** the National Theatre Museum was founded, thanks to George Franga's efforts.
- Liviu Rebreanu, general manager of the National Theatre, inaugurated the Theatre Museum on September 10, 1942.
- **August 24, 1944** – The building of the National Theatre on Victory Road (Calea Victoriei) is destroyed during the bombardment which took place towards the end of the Second World War.
- **1944 – 1948: Transition towards "a new world"**
- 1944 – 1948 – the assault of Bolshevik type Communist ideology: authors and plays serving the ideological direction of the Party are imposed. The theatre continues to present its shows in the following halls: Comedia (Majestic), Studio Hall (in Amzei Market area), festivity halls of high schools St. Sava and Matei Basarab, as well as at the Military Circle; after a while, only Comedia and Studio halls remained in its possession.
- **In 1967** - the location of the new National Theatre (Figure 2 - first illustrations), which had been chosen by the Gheorghe Gheorghiu-Dej regime in 1963, began to be cleared off.
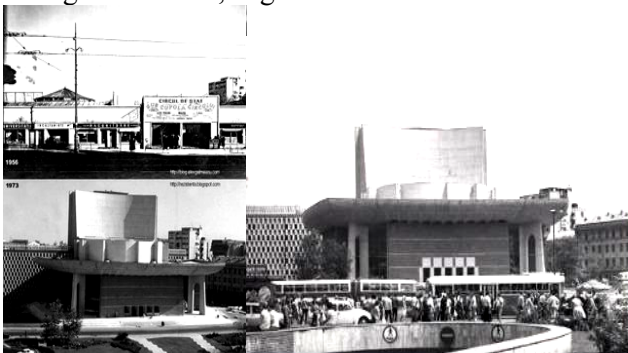
Figure 2. Old and new building of the Theatre.

- **December 20, 1973** was the inauguration date of the new building of the National Theatre (Figure 2 - second illustration), with its three

auditoriums: Main Hall, Small Hall, and Workshop Hall
- On **August 17, 1978** the Main Hall was destroyed by fire, and it was then that the idea of re-modelling the Theatre came up.

2. DESIGN, EXPERT ASSESSMENT AND REDESIGNING OF THE NATIONAL THEATRE ASSEMBLY

The assembly of buildings forming the National Theatre in Bucharest comprises four main parts/sections, as follows:
-    Section A – the Main Hall and the stage tower;
-    Section B – Annexes ;
-    Section C - Studio Hall;
-    Section D – Technical room and underground parking lot.

The technical assessment of the existing stress structure of the theatre was made by Project Building Industry Ltd., its beneficiary being the National Theatre in Bucharest, represented by its general designer S.C. PECCON INVEST Ltd., cessionary of copyright.

The buildings included in the National Theatre assembly in Bucharest were designed in 1968 by "Proiect Bucureşti" Institute, chief designers of the project being architects Horia Maicu, Romeo Belea and Nicolae Cucu; the structural design chief was Professor eng. Alexandru Cismigiu.

No significant damages of the stress structure were noticed after the earthquakes of 1977 (the strongest of them all), 1986, 1990 and following.

On August 17, 1978 the section of the Main Hall (Section A) was affected by a fire which, however, did not damage the stress structure.

Ceausescu did all his best to find pretexts for imposing his own style on the city architecture. Following the earthquake of 1977, he decided to reconstruct Bucharest in North-Korean style. He took advantage of the 1978 fire at the National Theatre and imposed his point of view. The facade of the theatre was completely changed; inside, only partial changes took place. The reinforced concrete "hat" that Ceausescu associated with the bourgeois regime had to be replaced. Also, the exterior frescoes depicting the history of the theatre were never finished. Architect Cezar Lazarescu covered the old building completely with a carcass which gives it the existing, inconspicuous shape. However, the theatre re-modelling took place at the same time

with the construction of the Civic Centre and the People's House. The urban planning of the area around Dambovita River required a relocation of the Musical Comedy Theatre (formerly bearing the name of "Queen Maria"), so it was also moved in the University Square, once the stylish building that had once hosted it (in the former Senate Square, now called United Nations Square) was demolished.

Similarly, following certain decisions of the State leaders of the time, the Design Institute "*Carpați*" elaborated, in 1983, a project for further changes of the Section A building – Main Hall – which included the following:
-   the enlargement of the hall capacity from 900 to 1,400 seats;
-   a new space layout, with two more auditoriums on the ground floor and underground floor;
-   development of exhibition spaces (5,000 m^2) by over-flooring;
-   a new, higher facade was placed over the old roof.

All these changes and restructurings led to major, as well as difficult changes in the stress structure of the building (Section A – Main Hall), as well as in the way in which gravitational loads were disposed, unacceptable from the point of view of the design requirements.

A local fire burst out in the Studio Hall (Section C) in 2005, but it probably did not significantly affect the stress structure of the building (no lab samples were taken in order to determine the rigidity and resistance of various critical elements in the area, based on statistic processing).

3. GEOTECHNICAL PROFILE OF THE SOIL AT THE NATIONAL THEATRE LOCATION

Land surveys showed the presence of a dusty clay base with limestone noodles – for the entire area – with admissible pressure levels of up to 4 *daN/cm*^{2}. The sub-soil depth was set so as to avoid reaching the groundwater point, which would have involved special water shutting-off requirements; however, the thermal unit was partially insulated due to floor lowering.

Under the foundations, the soil continued to settle under the long term action of gravity loads.

The adopted foundation systems were the classical ones, that is, including partial slab foundation, isolated foundations and continuous foundation strips.

4. COMPUTATION OF MECHANICAL STRESSES BASED ON LAB SAMPLES

The Civil Engineering Laboratory in Bucharest used the combined method of non-destructive tests on structural stress elements from the theatre (pillars and diaphragms). The resulting average resistance for the pillars was of 220.8÷251.1 *daN/cm*^{2}, corresponding to a class C12/15÷C16/20 concrete type B200÷B250. For the reinforced concrete diaphragms the resulting average resistance was of 238.0÷244.8 *daN/cm*^{2}, corresponding to a class C12/15÷C16/20 concrete of type B200÷B250. A number of manufacturing flaws were noted, referring to concrete flow breaks (pouring joints), homogeneity variations of the concrete at diaphragm level and cracks on the diaphragm width.

5. METHODS USED FOR THE TECHNICAL ASSESSMENT OF THE BUILDING STRUCTURE

According to the provisions of technical standard P100-92 paragraph 11.2.1 t
he methods used for fulfilling the technical assessment were as follows:
-   Method E-1 for qualitative in-situ assessment;
-   Method E-2 for current computation, corresponding to methods in Category A pt. 6.2 – the numerical analysis on a spatial model.

6. STRESS STRUCTURE – INITIAL AND PRESENT STATUS

In its initial form (Figure 3), from a structural point of view, the building was erected around flat or curved, high capacity structural walls, strong cells, highly ductile beams and resistant slabs which transmitted the inertial forces towards all structural elements. Damages following the 1977 earthquake were practically non-existent, thereby confirming the fact that the structure was appropriate and highly resistant. The initial project was mainly focused on preserving the elasticity of the entire system under stress from the earthquake-driven forces. Unfortunately, the massive fire of August 17, 1978 destroyed most non-structural elements, but the stress structure remained intact.

Figure 3. Initial form of the National Theatre.

Figure 4. Structure of Section A
Main Hall, following the changes made in 1983.

The theatre then duly required repairs and new finishing touches, and the respective works also involved dismantling some of its critical elements, resulting in second degree support, in a pillar-beam type. These changes were made at the expense of the seismic performance of the structure and, at the time, were received with protests and counterarguments based on existing seismic standards, still valid today under the Seismic Standard no. P100-2006.

The technical assessment identifies two major problems in the case of this construction: the slow concrete flow was accelerated by the fire; and the building capacity of taking up the earthquake-driven loads diminished, since one of its walls was torn down. Phase DE of the project, now under way, takes into account the conclusions of the technical assessment and the initial designers' recommendations, with the purpose of ensuring at least the stress level and stability of the building prior to 1978.

In Section A – Main Hall – the overhead floor is made of beams supported by a frame girder at one end, the other end being supported by a reinforced concrete cross-beam, as well as by structural walls which are empty inside.

Sections B and C show high levels of torsion, due to the lack of symmetry of their structural elements; pillars are in a critical position during the seismic energy dissipation mechanism.

Following the changes made in 1983, the stress structure of Section A – Main Hall – was fundamentally changed (Figure 4), fully ignoring the technical legislation in force at the time, and with even less concern for the present day requirements of designing codes.

As such, the Main Hall was extended by removing the curved fan-shaped structural walls (four of the eight reinforced concrete diaphragms being removed), various areas were torn down or reshaped locally, in order to make way for the official box lobby (in an atypical position, by

special request from the state leaders of the time); exhibition spaces were created, using the terrace over-flooring method (at levels 4 and 5); a new facade was built, in the shape of a high portico, in front of the original roofing, and this facade added a significant, inadequate load on level 2 of the nearby parking lot, and so on.

That is why it is paramount to revert to the initial parameters of the stress structure, conforming to in force technical standards (but also to the standards which were valid at the time of the 1982 elaboration of the project that aimed at extending the theatre capacity).

The technical assessment made in December 2006 analyzed the effects of the earthquake on the stress structure of the National Theatre assembly, by comparing standards (seismic design codes) elaborated in 1963, 1992 and 2006 respectively, and reaching the conclusion that consolidation works should mainly concentrate on the elements of Section B (the Annexes) – Figure 5. The frame type structure, which does not comply with para-seismic requirements, in the absence of continuous flooring at each level, as well as the initial design, which did not take into account the specificity of conventional seismic forces from the Vrancea area – all these were as many major arguments in favour of the decision to consolidate this building section with the help of a flexible structure with a high vibration range. There are no seismic protection expansion joints between the buildings, the existing one being just a dilatation joint. That is why the building of Section B had to be stiffened in the end areas (corner areas), in the vicinity of the other sections.
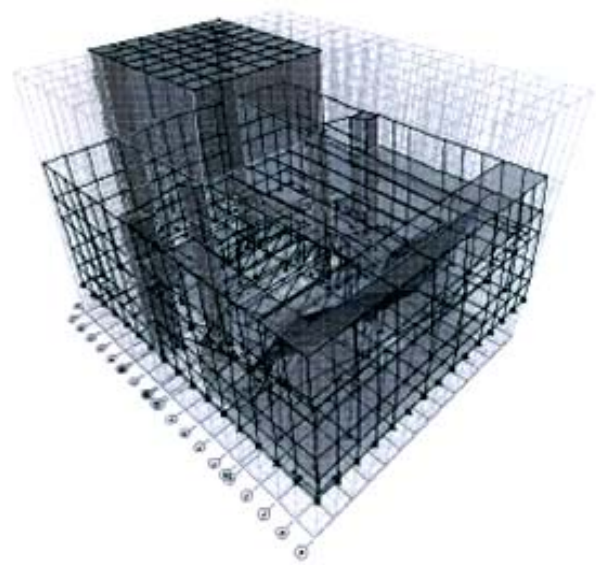
Section C – Studio building (Figure 6) – largely lacks seismic protection, especially in its cross section.

Also, the specific vibration of this unconsolidated building determines extremely dangerous assembly torsion combined with translation movements on both directions, thus
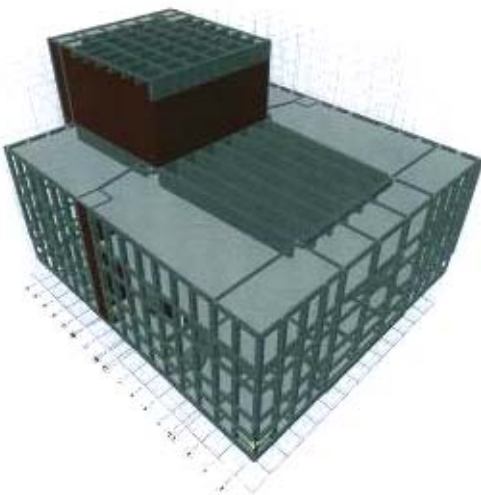
proving its unreliability in the case of seismic action (Figures 7, 8, 9). The building structure must undergo consolidation at stress structure and rigidity level.
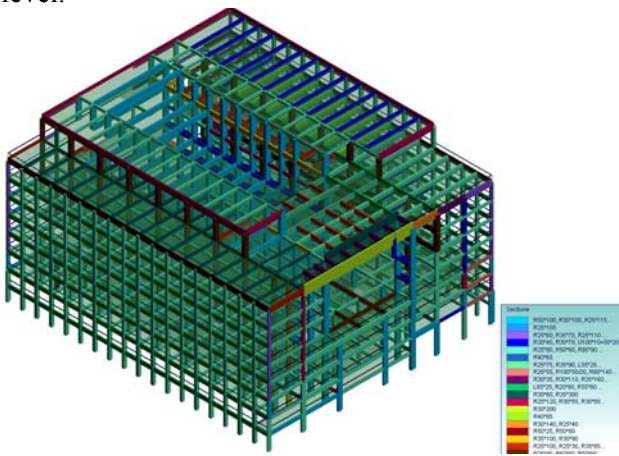
Figure 5. Structural model of Section B The Annexes

Figure 6. Structural model of Section C Studio Building.

Figure 7. Mode of vibration no 1.

Figure 8. Mode of vibration no.2.

Figure 9. Mode of vibration no.3.

Taking into account all of the above, the consolidation works of sections B and C must be made during the same stage (simultaneously), and the site premises must be organized accordingly - Figure 10.

In what sections A and D (Main Hall and underground parking lot) are concerned, these must be re-modelled according to the original solutions, to comply with the existing technical standards, including the requirements of the Code for Seismic Design.

To this end, it is critical to take into account the structural redundancy. If this requirement is complied with, in the event of elements becoming plasticized or breaking up locally, the lateral seismic force would be distributed to other elements
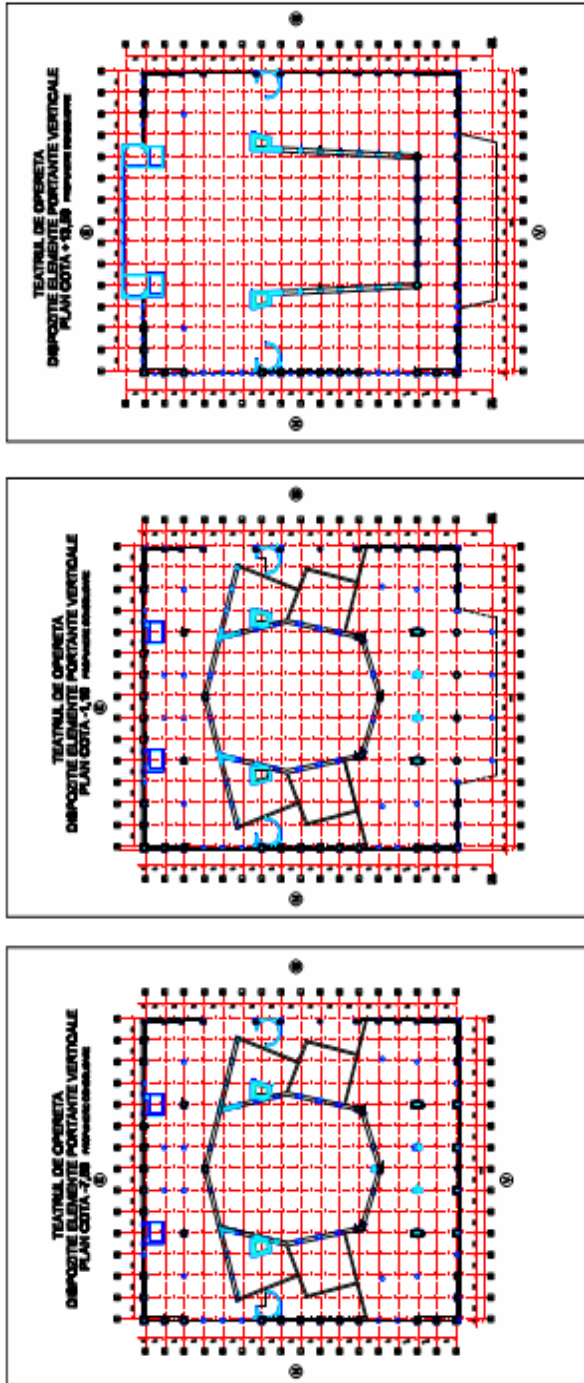
Figure 10. Musical Comedy Theatre. Location of vertical supporting elements.

in the system, in order to prevent progressive breaking. The designer must "ensure that the breaking up of a single element or of a single structural joint does not endanger the entire structure due to a loss of stability."

An unfortunate example is given by the existing support system for the over-floored terrace pillars, using statically determined beams in the cantilever. Also, vertical breaks (pillars on beams, beams on beams) determine a deflection of loads, but also certain sudden changes of the rigidity and

lateral stress at certain levels; these result in special vibration characteristics (especially at the level of the vertical seismic component) and load peaks due to the indirect load transfer. Referring to it, the existing seismic code requires "…*a direct, short length transmission of the inertia forces specific for the masses distributed throughout the building*".

The requirement for avoiding indirect support resulting in significantly increased loads, both vertically and horizontally, in the case of earthquakes, is emphasized: "***as a rule, supporting pillars on beams should be avoided***".

Therefore, the portico pillars are placing a significant pressure on the flooring over the underground parking lot (Figures11,12,13), and this area, in which the load is transferred from one building to another, is a danger zone from the point of view of the required security level, against permanent static gravity action, as well as against lateral and vertical dynamic, random actions.

Figure 11. Portico pillars in the parking lot.

Figure 12. Portico pillar in the parking lot.

It should be mentioned that during the works aimed at changing the Main Hall to its initial form and foyers a thorough analysis will be directed towards improving audiences' movement around.

Figure 13. Detail for Portico pillar in the parking.

Note: The technical assessment justly assumes that the original stress structure of the Main Hall of the theatre shows "a practically unlimited general stability in time for all certain or probable actions. Ensuring optimal building behaviour for such stresses was necessary in order to maintain it as long as possible within elasticity limits in the case of high intensity earthquakes". The seismic analysis made for this structure made of reinforced concrete diaphragms and frames resulted in a period of oscillation of T=0.53 s in the fundamental vibration mode, and **a super-unitary degree of resistance** to seismic action in the stress elements tested.

The following table shows the value of the global seismic coefficient - c_s – calculated for the theatre hall structure, according to various technical standards in force at various stages.

It can be noted that this technical seismic coefficient, which amplifies the structure mass and produces the equivalent lateral conventional calculus force, increases by 39% if the pseudo-static analysis is made in conformity with the new seismic design code (2006) as compared to the analysis according to the previous seismic standard (1992). If we were to make a comparison with the seismic standard in force at the time when the theatre structure was designed (1963) we could note an important increment (by 62%) of the global seismic coefficient value, calculated according to standard P100-92, still valid today with reference to the consolidation of existing buildings. The 1963 standard did not start from a correct assessment of the Vrancea type seismic actions, being based on

the Californian spectrum adopted for Romania, largely useless for large classed of semi-rigid structures (example: Main Hall section and Studio Hall section), and especially flexible ones (example: Annexes section, with a fundamental vibration period T_1=1.58 s).

The consolidation of fractured elements (beams, walls, masonry) is also targeted by means of crack injection with epoxy resins, or with the help of guided walls (approx. 6 cm thick) plated with ductile fastening iron nets.

The inserted ceiling placed at the +13.00 m quota will be consolidated and stiffened in order to be turned into non-partitioned offices that would change its present use as storage room.

Section D – Technical room and parking lot

The dismantling of the existing facade, made in 1983, will reduce the extra load exerted on the parking ceiling by the theatre facade and the subsequent over-flooring, while the roof from the main entrance will be displayed in its original form of 1968.

In order to increase the existing capacity of the parking lot and to redistribute loads across its stress structure, supplementary beams made of reinforced concrete will be mounted, observing the existing height limits.

Further on, the pillars supporting the parking lot will be coated – on their entire surface – in order to work jointly with the newly created cross beams.

7. PROPOSED STAGES; PROBLEMS THAT NEED TO BE SOLVED

- Consolidation of the stress structure (facade structure, main hall structure), stage tower and parking lot structure;
- Reshaping of the National Theatre building – section A, inspired from the London National Theatre – Barbican Hall building, as well as from theatres in Los Angeles and Copenhagen;
- Consolidation of section B (including offices, green rooms, gyms, smaller auditoriums), which suffered the most significant damages from earthquakes;
- Consolidation of section C – at present hosting the Musical Comedy Theatre (in the future it will host the Studio Hall of the National Theatre), which will be reshaped according to an Elizabethan-type variable geometry;
- Three more auditoriums will be set up ;

Tabel 1. Values for coefficient - c_s

Norm	$\alpha\ (\gamma_1)$	k_s	β	$\varepsilon(\lambda^*)$	φ	$\alpha_{11}/\ \alpha_1$	$\Psi(1/q)$	c_s
P13.63	-	0.05	1.698	0.85	1	-	1.2÷1.0	0.079
P13.70	-	0.05	1.509	0.85	1	-	1	0.064
P100.78	-	0.2	2	0.85	-	-	0.25	0.085
P100.81	-	0.2	2	0.85	-	-	0.25	0.085
P100.91	1.2	0.2	2.5	0.85	-	-	0.25	0.128
P100.92	1.2	0.2	2.5	0.85	-	-	0.25	0.128
P100.1/ /2004	1.2	0.24	2.75	0.85	-	1.35	0.264	0.178
P100.1/ /2006	1.2	0.24	2.75	0.85	-	1.35	0.264	0.178

- The University Square will be reconfigured and several representative monuments will be added. Here are some examples:
  - "*The Clowns' Cart*" – a monumental sculpture displaying the main characters described by author Ion Luca Caragiale;
  - "*The Crystal Monument*", accompanied by an eternal flame, dedicated to the memory of 1989 heroes;
  - "*Caragiale's Hat*", meant to emphasize the National Theatre image according to the model used before 1983.
- The erection of a National Dance Centre (now operating inside the National Theatre building);
- Most building services from the National Theatre will be renewed; examples: the air conditioning system, the fire prevention system;
- The number of seats in the auditoriums will be almost double, from 1720 at present to over 3100.

8. FINANCIAL RESOURCES USED FOR THE NATIONAL THEATRE RECONSTRUCTION

The financial agreement for the National Theatre of Bucharest works is worth 51 Mil. € +VAT (of which 28 Mil. € are granted by the European Bank for Reconstruction and Development) and covers a time span of 28 months.

MODELLING OF CELLULAR FUNCTIONS BY MEANS OF TIMED MEMBRANE TRANSDUCERS

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INTRODUCTION

In theoretical computer science, automata theory is the study of abstract 'mathematical' machines or systems and the computational problems that can be solved using these machines (called automata). A finite state transducer (FST) is a finite state machine with two tapes: an input tape and an output tape [1]. This contrasts with an ordinary finite state automaton (or finite state acceptor), which has a single tape. On this view, a transducer is said to transduce (i.e., translate) the contents of its input tape to its output tape, by accepting a string on its input tape and generating another string on its output tape. It may do so nondeterministically and it may produce more than one output for each input string. A transducer may also produce no output for a given input string, in which case it is said to reject the input [2]. The concept of membrane transducers is an extension of concept of P transducers [3-5] - inspired by the structure and the functioning of the living cell. The concept of P transducers is the most powerful framework for unifying main aspects of biological systems at the main hierarchical levels: DNA level; cellular level; cell interaction with the environment [4].

In this paper we propose two new formalisms, named *deterministic finite timed transducer* and *timed membrane transducer.* In the framework of our approach the DNA (in genes) and ARN sequences were mapped by means of systems of 1D membranes. This approach allows to capture gene structure and all relevant functional aspects of time behavior of transcriptional and translational gene regulation. All rates (and characteristic constants) of protein interaction processes with DNA (inclusively, the rate of RNA polymerase moving along genes) are taken into account.

The aim of this paper is to model, using the concept of timed membrane transducers, the molecular machinery responsible for the main cellular functions (transcription and translation processes). Our model describes the functional organization of genes as well as how environmental factors act on them.

1. DETERMINISTIC FINITE TIMED TRANSDUCERS

Our aim is to model the input/output information processing by timed (one-dimensional) membrane transducers (TMT) to understand the functioning of the living cell in terms of genetic information processing. Cellular active elements, the proteins, such as regulatory enzymes, transcription factors, RNA polymerases, ribosomes, etc. are modeled using the concept of the finite timed membrane transducers. The structure-functional organization of single-stranded DNA (in a gene), and RNA segments (copies of genes) are viewed as one-dimensional (1D) membranes. The relevant features of 1D membrane structure are reflected by regulatory elements (specific nucleotide sequences) considered as input "signals" translated by TMTs into output signals.

On the other hand, a living cell reacts to external factors considered as input signals and in our TMT model it is taken into account the influence of environmental circumstances on the rates of regulatory enzymatic reactions.

A transducer is an abstract device that translates an input string $x = x_1 x_2 \ldots x_k$, consisting of the elements of the input symbol alphabet, into another output string $y = y_1 y_2 \ldots y_r$. consisting of the elements of the output symbol alphabet. We consider deterministic finite transducers [9]. The *deterministic finite transducer* is a structure:

$$DFT = (Q, \Sigma, \Gamma, \delta, q_0, F),$$

that consists of: $Q = \{q_0, q_1, \ldots, q_n\}$ − set of states; $\Sigma = \{a_1, a_2, \ldots, a_k\}$ − input symbol alphabet; $\Gamma = \{b_1, b_2, \ldots, b_s\}$ − output symbol alphabet; δ: $Q \times (\Sigma \cup \{\varepsilon\}) \times (\Gamma \cup \{\eta\}) \to Q \times (\Gamma \cup \{\eta\})$ − transition function determining the behavior of the device; ε, η − empty elements; $q_0 \in Q$ − initial state; F − set of final states, $F \subseteq Q$. $\Sigma^* = \Sigma \cup \{\varepsilon\}$, $\Gamma^* = \Gamma \cup \{\eta\}$.

The record $\delta(q_i, a_i, b_k) = (q_k, b_k)$ means that the *DFT,* being into the state $q_i \in Q$, *reads $a_i \in \Sigma^*$ from the input tape,* passes into the state $q_k \in Q$, and writes

$b_k \in \Gamma^*$ into *the output tape* (for shortly, the notation $\delta(q_i, a_i) = (q_k, b_k)$ is used). The initial configuration is (q_0, x, η), where $q_0 \in Q$, $x \in \Sigma^*$. (q_i, x', y') is an intermediate configuration of *DFT* where $q_i \in Q$, $x' \in \Sigma^*$, $y' \in \Gamma^*$. The final configuration is (q_f, ε, y), where $q_f \in F$, $y \in \Gamma^*$. For $\forall q_k \in Q$ and $\forall x = a_1 a_2 .... a_n$, $a_i \in \Sigma^*$, the following relation holds:
$\delta(q_i, a_1 a_2 ... a_n) = \delta(\delta(...\delta(\delta(q_i, a_1), a_{2i}), a_3)...) a_n)$. The obtained result is $y = b_1, b_2, ..., b_s \in \Gamma^*$. Thus, *DFT* translates an input string $x \in \Sigma^*$ if and only if there is a *some* path $(q_0; a_1 a_2 ... a_n, \eta) \vdash (q_1; a_1 a_2 ... a_{n-1}, b_1) \vdash ... \vdash (q_i; a_i a_{i+1} ... a_i, b_1 b_2 ... b_{i-i...} b_{n-1}) \vdash (q_f; \varepsilon, b_1 b_2 ... b_n)$ from the initial start state $q_0 \in Q$ (through $q_1, ..., q_i \in Q$ – intermediate states) to the final state $q_f \in F$ such that input x is translated into the output $y \in \Gamma^*$. To examine the translation of the input signals into output signals we extend *DTF* notion using the temporal characteristics. In biological processes $F = \varnothing$ because the functional mechanisms of proteins, described below, are cyclic.

We introduce a notion of *delay time*, denoted by τ_m, i.e., the time between the instant $t_i \in R_+$ in which the transducer is into a state $q_i \in Q$ $(i = 0, ..., n)$, reading the input signal $a_i \in \Sigma^*$ and the instant t_{i+1}, in which the transducer passes into the state $q_k \in Q$ $(k = 0, ..., n)$ and produces the output signal $b \in \Gamma^*$ in correspondence to the determined transition function δ. $\tau_m = t_{i+1} - t_i$. $T = \{\tau_m\} \subseteq R_+$.

The deterministic finite timed transducer can be defined in the following way:
DEFINITION 1. The *deterministic finite timed transducer* is a construct:

$$TT = (Q, \Sigma, \Gamma, \delta, q_0, T),$$

where $Q, \Sigma, \Gamma, \varepsilon, \eta, q_0, T$ are similar to those elements mentioned above;
δ: $Q \times (\Sigma \cup \{\varepsilon\}) \times (\Gamma \cup \{\eta\}) \times T \rightarrow Q \times (\Gamma \cup \{\eta\})$ is a transition function that maps state-symbol-symbol-delay_time to the state–symbol . The record $\delta(q_i, a_i, b_k, \tau_m) = (q_k, b_k)$, (or $\delta(q_i, a_i, \tau_m) = (q_k, b_k)$) means that the *TT*, being into the state $q_i \in Q$ reads $a_i \in \Sigma^*$, passes into the state $q_k \in Q$ and writes $b_k \in \Gamma^*$.
In the next section we show how can be described by means TT the input/output signal processing by a cellular biosensor [4].

2. CELLULAR BIOSENSOR AS A TIMED TRANSDUCER

The input/output signal processing by a cellular biosensor can de described by a timed transducer:

$$TT_c = (Q^C, \Sigma^C, \Gamma^C, \delta^C, T^C, q_0^C),$$

where:
$Q^C = \{q_0^C, q_1^C\}$ is the finite set of states: q_0^C represents the "healthy" state of the cell; q_1^C – "*illness*" bacteria state of cell; $\Sigma^C = \{0,1\}$ – the finite input vocabulary; $\Gamma^C = \{G\}$ – the finite output vocabulary: G represents the fluorescent proteins;
δ^C: $Q^C H(\Sigma^C \chi \{\varepsilon\}) H(\Gamma^C \chi \{\eta\}) H T^C \rightarrow Q^C H(\Gamma^C \chi \{\eta\})$ – the transition function of TT_C:

$$\delta^C(q_0^C, 0, \tau_0^C) = (q_0^C, \eta),$$
$$\delta^C(q_0^C, 1, \tau_1^C) = (q_1^C, G),$$
$$\delta^C(q_1^C, 1, \tau_2^C) = (q_1^C, G),$$
$$\delta^C(q_1^C, 0, \tau_3^C) = (q_0^C, \eta);$$

$T^C = \{\tau_0^C, \tau_1^C, \tau_2^C, \tau_3^C\}$ is the set of delay times, where:
τ_0^C indicates the penetration time of cellular cytoplasm by environmental factors; τ_1^C – action time of endogenous factors on cytoplasm components; τ_2^C – biosynthesis time of G fluorescent proteins; τ_3^C – cytoplasm escape time of G fluorescent proteins; q_0^C – the initial state of TT_c;
$\{0,1\}$ input symbols describe the absence and presence of environmental mutagen factors, respectively; $\{\eta, G\}$ output symbols describe the absence and presence of green fluorescent proteins;
Fig. 1 illustrates the functional mechanism of regulatory enzyme modeling by TT_c

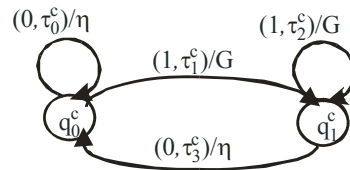**Figure 1.** Input/output signal processing by the cellular biosensor modeled by TT_c.

3. TIMED MEMBRANE TRANSDUCERS

Now we define a *deterministic finite timed transducer with localization*, called *timed membrane transducer*.
DEFINITION 2. The deterministic finite timed transducer with localization, named *timed membrane transducer*, is a construct:

$$TMT = (Q, \Sigma, \Gamma, \delta, q_0, T, L),$$

where: Q, Σ, Γ, ε, η, q_0, T are similar to those components mentioned in Definition 1;

δ: $Q \times (\Sigma \cup \{\varepsilon\}) \times (\Gamma \cup \{\eta\}) \times T \times L \to Q \times (\Gamma \cup \{\eta\}) \times L$ is a transition function that maps state-symbol-symbol-delay_time–localization to the states–symbol – localization.

The record $\delta(q_i,\ a_i,\ b_k,\ \tau_m\ l_j\ ) = (q_k,\ b_k,\ l_k)$, (or $\delta(q_i,\ a_i, \tau_m\ l_j\ ) = (q_k,\ b_k,\ l_k)$) means that the *TMT* being into the state $q_i \in Q$ reads $a_i,\ \in \Sigma^*$ being located in the region delimited by the l_k membrane (l_j – membrane label) or being located on the l_j membrane. So, l_j represents the location of TMT, $l_j \in L$. After that *TMT* passes into the state $q_k \in Q$ and writes $b_k \in \Gamma^*$, changing its localization: $l_k \in L$. $L \subseteq I_+$

Forwards, the functional mechanisms of the proteins, such as transcription factors, RNA polymerases, ribosomes, regulatory enzymes, etc. are modeled using the concept of *TMT*.

4. GENE TRANSCRIPTION MODELLING BY TIMED MEMBRANE TRANSDUCERS

Transcription is the mechanism by which a template strand of DNA is utilized by specific RNA polymerases to generate RNA copies of the gene [8]. All RNA polymerases are dependent upon a DNA template strand in order to synthesize *m*RNAs (copies of genes). The resultant RNA is, therefore, complimentary to the template strand of the DNA duplex and identical to the non-template strand. The non-template strand is called the coding strand because its' sequences are identical to those of the *mRNA*. However, in RNA, *U* is substituted for *T*.

In this section the functional mechanism of the RNA polymerases are modeled using the concept of deterministic finite timed transducers with localization (TMT). In living cells, the ability to express biologically active proteins comes under regulation at several points: the structure of DNA sequences can affect the ability of transcriptional regulatory proteins (termed transcription factors) and RNA polymerases to find access to genes and to activate transcription from them. Transcriptional initiation is the most important stage for control of gene expression. RNA synthesis requires accurate and efficient initiation, elongation proceeds in the 5' → 3' direction (i.e. the polymerase moves along the template strand of DNA in the 3' → 5' direction), and RNA synthesis requires distinct and accurate termination. Proteins (for instance, RNA polymerases) only recognize "signals" that physically (conformational) complement their surface features. A promoter region contains important sequences that are required for RNA polymerase to bind. Promoter sequences promote the ability of RNA polymerases to recognize the nucleotide at which initiation begins.

Transcription proceeds in an ordered process. RNA polymerase (in the prokaryotic cell) is composed of 5 distinct polypeptide chains. Association of several of these generates the RNA polymerase holoenzyme. The holoenzyme (Core + σ) has a much higher affinity for promoter sequences. Thus σ-subunit confers sequence specificity onto the Core enzyme and ensures that transcription only starts from promoter sequences. When the RNA chain is about 10 nucleotides long, σ-subunit dissociates, leaving Core. The loss of σ-subunit allows Core to leave (unbind) the promoter and bind DNA less specifically. Now Core can elongate RNA processively (utilizing its affinity for nonspecific DNA).

The RNA polymerase is directed to the start point of the gene, the sigma factor is released and the RNA polymerase carries out the process of transcription. Similarly, there are other base sequences at the end of a gene, denoted as stop signals {TAA,TAG,TGA}. The START and STOP signals are recognized by RNA polymerases. We consider that gene coding regions comprises for prokaryotic genes – polycistrons, for eukaryotic genes – interrupted amino acid coding sequences, i.e., sequence of exons and introns. Following termination the Core polymerase dissociates from the DNA template strand. The Core and σ subunit can then reassociate forming the holoenzyme again ready to initiate another round of transcription (cyclic process).

Let us describe the functional mechanism of RNA polymerase by means the timed membrane transducer TMT_1:

$$TMT_1 = (Q^1,\ \Sigma^1,\ \Gamma^1,\ \delta^1,\ q_0^1,\ T^1,\ L^1),$$

where $Q^1 = \{q_0^1, q_1^1, q_2^1, q_3^1, q_4^1\}$ is the finite set of RNA polymerase states, which indicate: q_0^1 – free RNA polymerase (holoenzyme (Core + σ)), the initial state of TMT_1, q_1^1 – RNA polymerase recognizes the *promoter signal* and binds to the DNA (RNA Polymerase-Promoter Complex); q_2^1 – RNA polymerase recognizes the *start signal* and begins to move along DNA template strand (releasing the σ factor), transcribing the gene; q_3^1 – RNA polymerase, reading the *stop signal*, ends the gene transcription process and releases the DNA; $\Sigma^1 = \{\gamma,\ \sigma,\ s,\ \alpha,\ t\}$ is the finite vocabulary of the input signals recognized by RNA polymerase: γ –

promoter signal; σ – sigma factor; *s* – start point of the gene; α – nucleotides, α ∈ {*A, T , C, G*); *t* – stop signal, i.e., transcriptional termination site of the gene; $\Gamma^1 = \{s', \theta, t'\}$ the finite vocabulary of the output signals: *s'* – start point of RNA copy of gene, t'– stop point of RNA copy of gene, θ – nucleotides, θ ∈ {*U, A, G, C*); $\delta^l: Q^l H(\Sigma^l \chi \{\varepsilon\}) H(\Gamma^l \chi \{\eta\}) H T^l H L^l \rightarrow Q^l H(\Gamma^l \chi \{\eta\} H L^l)$ – transition function of TMT_l that determines the order of events in transcription:

$$\delta^1(q_0^1, \varepsilon, \tau_0^1, l_0) = (q_0^1, \eta, l_0),$$

$$\delta^1(q_0^1, \gamma, \tau_1^1, l_0) = (q_1^1, \eta, l_1),$$

$$\delta^1(q_1^1, s, \tau_2^1, l_1) = (q_2^1, s', l_1),$$

$$\delta^1(q_2^1, \alpha, \tau_3^1, l_1) = (q_2^1, \theta, l_1),$$

$$\delta^1(q_2^1, t, \tau_4^1, l_1) = (q_3^1, t', l_1),$$

$$\delta^1(q_3^1, \sigma, \tau_5^1, l_1) = (q_0^1, \eta, l_0);$$

$T^1 = \{\tau_0^1, \tau_1^1, \tau_2^1, \tau_3^1, \tau_4^1, \tau_5^1\}$ is the set of delay times, where: τ_0^1 – time-interval when the holoenzyme is localized in the cytoplasm; τ_1^1 – concentration of DNA breaks that correlates with the transcription initiation probability; τ_2^1 – promoter escape time; τ_3^1 – time of nucleotide synthesizing; τ_4^1 – DNA escape time; τ_5^1 – σ factor reassociation time. $L^1 = \{l_0, l_1\}$ – locations for RNA polymerase: l_0 – map the cell cytoplasm; the 1D membrane l_1 maps the gene with its regulatory region. The functional mechanism of the RNA polymerase modeling by TMT1 is pictured in Fig. 2.
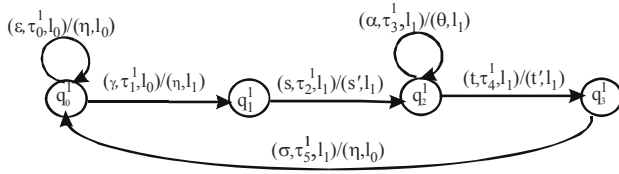
Figure 2. The functional mechanism of RNA polymerase modeling by TMT_l.

5. TRANSLATION PROCESS MODELLING BY TIMED MEMBRANE TRANSDUCERS

The translation process is the RNA directed synthesis of polypeptides (proteins). The processes leading to the ability to form a peptide bond are very complex. The template for correct addition of individual amino acids is the *mRNA*, yet both *tRNAs* and *rRNAs* are involved in the process. The *tRNAs* carry activated amino acids into the ribosome which is composed of *rRNA* and ribosomal proteins. The ribosome is associated with the *mRNA* gene copies ensuring correct access of activated *tRNAs* and containing the necessary enzymatic activities to catalyze peptide bond formation [7].

The ability to identify the roles of the various ribosomal proteins in the processes of ribosome assembly and translation was aided by the discovery that the ribosomal subunits will self assemble *in vitro* from their constituent parts.

Following assembly of both the small and large subunits onto the *mRNA*, and given the presence of charged *tRNAs*, protein synthesis can take place. To reiterate the process of protein synthesis: synthesis proceeds from the *N*-terminus to the *C*-terminus of the protein; the ribosomes "read" the *mRNA* in the 5' to 3' direction; active translation occurs on polyribosomes (also termed polysomes). This means that more than one ribosome can be bound to and translate a given *mRNA* at any one time. The chain elongation occurs by sequential addition of amino acids to the *C*-terminal end of the ribosome bound polypeptide. Translation proceeds in an ordered process. First accurate and efficient initiation occurs, then chain elongation and finally accurate and efficient termination must occur. All three of these processes require specific proteins, some of which are ribosome associated and some of which are separate from the ribosome, but may be temporarily associated with it. RNA polymerase produces a transcription unit that extends from the promoter to the termination sequences. The gene is defined in reference to the start site – those sequences before the start site are called the upstream sequences, those after the start site are called downstream sequences. The immediate product is the primary transcript. Transcriptional unit comprises: start codon {*AUG*} → Met (not fMet), interrupted amino acid coding sequences, stop codons.

The initiation of translation requires the (*AUG*) recognition by ribosomes. The ribosomes are known to scan *mRNA* from left to right (5' to 3') and to initiate translation usually at the first-encountered *AUG* triplet (*start signal*). The ribosome binds directly to the Shine-Dalgarno sequence, and translation is initiated at an *AUG* triplet located several bases downstream of the sequence. The code is composed of a triplet of nucleotides. That all 64 possible combinations of

the 3 nucleotides code for amino acids, i.e. the code is degenerate since there are only 20 amino acids. Elongation of polypeptides occurs in a cyclic manner. Like initiation and elongation, translational termination requires specific protein factors identified as releasing factors. The signals for termination are the same in both prokaryotes and eukaryotes. These *signals* are termination codons present in the *mRNA*. There are 3 termination codons: *UAG*, *UAA* and *UGA*. The inactive ribosome then releases its *mRNA* and the 80S complex dissociates into the 40S and 60S subunits ready for another round of translation. The cycle can now begin again.

The *TMT₂* describes the functional mechanism of ribosomes:

$$TMT_2 = (Q^2, \Sigma^2, \Gamma^2, \delta^2, q_0^2, T^2, L^2),$$

where: $Q^2 = \{q_0^2, q_1^2, q_2^2\}$ is the finite set of the ribosomes states, which indicate: q_0^2 – diassociated ribosome (with ribosome recycling factor); translation is initiated at an *AUG* triplet (denoted by *s'*) and binds directly to the *mRNA* gene copy; the initial state of *TMT₂*, q_1^2 – ribosome scans *mRNA* gene copy, translating triplets of the *mRNA* gene copy into amino acids (synthesized polypeptidic chain); q_2^2 – ribosome ending the translation of *mRNA* gene copy and releasing the *mRNA* (the newly-synthesized polypeptide is released from the ribosome)*;* $\Sigma^2 = \{\omega, s', b, t', \rho\}$ – the finite input vocabulary (signals recognized by ribosomes): ω – Shine-Dalgarno sequence; *s'* – start signal (*AUG*) of translation; *b* – triplet of the *mRNA* chain; *t'* – stop signal of translation; ρ – ribosome recycling factor; $\Gamma^2 = \{\pi, \mu\}$ – finite output vocabulary: π – amino acid *Met*; μ – one of 20 types of amino acides; δ^2*:* $Q^2 H (\Sigma^2 \chi \{\varepsilon\}) H (\Gamma^2 \chi \{\eta\}) H T^2 H L^2 \rightarrow Q^2 H (\Gamma^2 \chi \{\eta\} H L^2)$ – the transition function of TMT₂ that describes the order in translation:

$$\delta^2 (q_0^2, \omega, \tau_0^2, l_0) = (q_0^2, \eta, l_2),$$
$$\delta^2 (q_0^2, s', \tau_1^2, l_2) = (q_1^2, \mu, l_2),$$
$$\delta^2 (q_1^2, b, \tau_2^2, l_2) = (q_1^2, \pi, l_2),$$
$$\delta^2 (q_1^2, t', \tau_3^2, l_2) = (q_2^2, \eta, l_2),$$
$$\delta^2 (q_2^2, \rho, \tau_4^2, l_2) = (q_0^2, \eta, l_0);$$

$T^2 = \{\tau_0^2, \tau_1^2, \tau_2^2, \tau_3^2, \tau_4^2\}$ is the set of delay times, where: τ_0^2 indicates the ribosome assembling time; τ_1^2 – synthesizing time of amino acid of *Met*; τ_2^2 –synthesizing time of amino acid of

polypeptidic chain; τ_3^2 – RNA escape time; τ_4^2 – recycling factor association time with ribosome; $L^2 = \{l_0, l_2\}$ are locations of the ribosomes: l_0 and l_2 mapping the cell cytoplasm and the RNA strand, respectively. In Fig. 3 it is represented the functional mechanism of ribosomes by *TMT₂*.
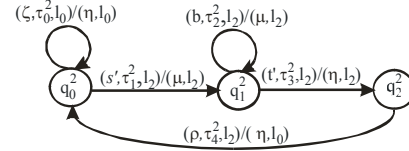
Figure 3. The functional mechanism of ribosomes modeling by *TMT₂*.

6. FUNCTIONAL MECHANISM OF THE REGULATORY ENZYME

It is known that a living cell reacts to internal and external factors, considered as input signals. They are denoted by $x, x \in \{0,1\}$. The low and high concentrations (intensities) of the input signals are denoted by 0 and 1, respectively. As a result of input signals action on regulatory enzymes two states of enzymatic activities can be obtained: E^+ (activated state) and E^- (inactivated state), respectively. E^+ enzyme molecules destroy repressor molecules R and E^- can not destroy repressor molecules [5].

The functional mechanism of regulatory enzyme which react with the endogenous factors is described by *TMT₃* :

$$TMT_3 = (Q^3, \Sigma^3, \Gamma^3, \delta^3, q_0^3, T^3, L^3),$$

where $Q^3 = \{q_0^3, q_1^3\}$ is the finite set of state: q_0^3 and q_1^3 indicate that the regulatory enzyme is in inactive (E^-) and active (E^+) state, respectively, $q_0^3 \in Q^3$ – initial state of *TMT₃*; $\Sigma^3 = \{0,1\}$ – the finite input vocabulary; $\Gamma^3 = \{\nu\}$ – the finite output vocabulary: ν represents the low concentration of repressor molecule; δ^3: $Q^3 H (\Sigma^3 \chi \{\varepsilon\}) H (\Gamma^3 \chi \{\eta\}) H T^3 H L^3 \rightarrow Q^3 H (\Gamma^3 \chi \{\eta\} H L^3)$ – the transition function of *TMT₃* :

$$\delta^3 (q_0^3, 0, \tau_0^3, l_0) = (q_0^3, \eta, l_0),$$
$$\delta^3 (q_0^3, 1, \tau_1^3, l_0) = (q_1^3, \eta, l_3),$$
$$\delta^3 (q_1^3, 1, \tau_2^3, l_3) = (q_1^3, \eta, l_3),$$
$$\delta^3 (q_1^3, 0, \tau_3^3, l_3) = (q_0^3, \nu, l_0);$$

$T^3 = \{\tau_0^3, \tau_1^3, \tau_2^3, \tau_3^3\}$ is the set of delay times, where: τ_0^3 indicates the allocation time of the

regulatory enzyme (*RecA*) in cytoplasm, τ_1^3 – interaction time of the regulatory enzyme and DNA breaks, τ_2^3 – repairing time of DNA break and the destroying a repressor molecule *R*, τ_3^3 – DNA escape time; $L^3 = \{l_0, l_3\}$ are locations of the regulatory enzymes: l_0 and l_3 mapping the cell cytoplasm and the DNA break, respectively.

Fig. 4 illustrates the functional mechanism of regulatory enzyme modeling by TMT$_3$
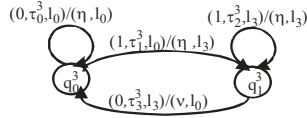
Figure 4. The functional mechanism of regulatiry enzyme modeling by *TMT₃*.

7. FUNCTIONAL MECHANISM OF REPRESSOR MOLECULES

The functional mechanism of repressor molecule can be described by TMT$_4$ (Fig. 5):

$$TMT_4 = (Q^4, \Sigma^4, \Gamma^4, \delta^4, q_0^4, T^4, L^4),$$

where: $Q^4 = \{q_0^4, q_1^4\}$ is the finite set of state: q_0^4 – repressor is free, q_1^4 – repressor is binding to the operator; $\Sigma^4 = \{\varphi\}$ – finite input vocabulary, $\Gamma^4 = \{\beta, \beta'\}$: β – operator is repressed by repressor molecule; β' – operator is free; $\delta^4: Q^4 H (\Sigma^4 \chi \{\varepsilon\}) H (\Gamma^4 \chi \{\eta\}) H T^4 H L^4 \rightarrow Q^4 H (\Gamma^4 \chi \{\eta\} H L^4)$ – the transition function:
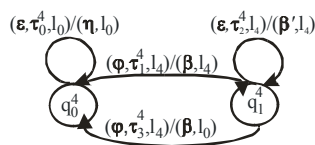
$$\delta^4 (q_0^4, \varepsilon, \tau_0^4, l_0) = (q_0^4, \eta, l_0),$$
$$\delta^4 (q_0^4, \varphi, \tau_1^4, l_4) = (q_1^4, \beta, l_4),$$
$$\delta^4 (q_1^4, \varepsilon, \tau_2^4, l_4) = (q_1^4, \beta', l_4),$$
$$\delta^4 (q_1^4, \varphi, \tau_3^4, l_4) = (q_0^4, \beta', l_4);$$

$T^4 = \{\tau_0^4, \tau_1^4, \tau_2^4, \tau_3^4\}$ is the set of delay times, where: τ_0^4 indicates the allocation time of repressor molecule in cytoplasm, τ_1^4 – binding time of repressor molecule to operator site, τ_2^4 – repression time of operator site, τ_3^4 – operator escape time;

Figure 5. The functional mechanism of the repressor molecules by *TMT₄*.

$L^4 = \{l_0, l_4\}$ - locations for repressor molecules: l_0 and l_4 mapping the cytoplasm and the operator site, respectively; $q_0^4 \in Q^4$ – initial state of *TMT₄*..

8. CONCLUSION

The cell structure is determined by membrane structures. The main cellular functions connected to the genetic information processing such as the regulation of gene expression, protein biosynthesis, etc. are determined by the proteins present that perform different cellular tasks. In this paper we introduced two formalisms: *deterministic finite timed transducer* and *timed membrane transducer.* It is shown that the functional mechanism of proteins can be modeled by timed membrane transducers (with localization), and the action of environmental factors on cellular biosensors can be described by deterministic finite timed transducer.

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ANALYSIS OF ZnO-NANORODS GROWN ON *p*-Si (100) VIA CATALYST-FREE HYDROTHERMAL DEPOSITION

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INTRODUCTION

The *n*-ZnO nanorod arrays/*p*-Si heterojunction for photo-detector structures was fabricated by a rapid hydrothermal deposition without employing a catalyst or seed layer. X-ray diffraction spectra showed that ZnO nanorod arrays were grown with *c*-axis relationship to the *p*-Si substrate. The photodetection mechanism for the *n*-ZnO/*p*-Si heterostructure is discussed.

1. ZnO-NANOROD - BASED OPTOELECTRONIC DEVICES

Zinc oxide (ZnO) is an attractive material since it has both a direct band gap (of ~3.4 eV) and a very large free exciton binding energy (of ~60 meV) [1]. Zinc oxide nanorods (ZnO NRs) are most promising one-dimensional nanostructures which present enormous interest for low-dimensional light emitters or photodetectors in various nanophotonics systems [2]. It is due to their unique physical and chemical properties, which should favor light emission at room temperature [3]. At the same time, small-diameter ZnO nanowires are expected to lower the lasing threshold because quantum effects result in enhancement of density of states near the band edges and radiative recombination due to carrier confinement [4]. Since the reported room-temperature lasing actions of ZnO nanorod arrays [5], a diversity of scientific research was undertaken reported on zinc oxide for use in short-wavelength optoelectronic devices ensuring efficient utilization in applications [6-8].

In this context multiple device structures, such as heterojunction [9], homojunction [10], or metal-insulator-semiconductor structure [11], have been explored to generate the UV and visible electro-luminescence from zinc oxide. Liu *et al*. [12] investigated the effects of post-annealing on the electrical properties of *n*-ZnO/*p*-Si heterojunction obtained by hydrothermal technique by using a ZnO seed layer deposited by ion beam sputtering technique. The large difference in the thermal expansion coefficients of the two materials [13] and the high reactivity of Si is problematic for producing ZnO/Si heterojunctions by conventional thermal processing. According to Kayes *et al*. [14] it has been demonstrated theoretically and experimentally that nanorod semiconductor arrays arranged perpendicular to the substrate enhance the overall efficiency. The ZnO/Si system is interesting due to the fundamental information it may provide about synthesis and heteroepitaxy in large mismatch systems (>40%), which could be useful for producing efficient devices. To overcome such problems different techniques for surface pre-treatment have been reported, like deposition of ZnS [15], GaN [16], nitridation of the Si surface [17], CaF$_2$ [18]. The introduction of the insulating layer (e.g. SiN or CaF$_2$), will affect the electrical properties of ZnO/Si junction [19-20]. Few studies concerning the growth of catalyst-free ZnO thin films on Si substrates by different techniques have been performed, due to inherent problems encountered in the growth process [19]. Aqueous solution synthesis is known to be a simple, low temperature, and large-area deposition technique for group II-VI semiconductors such as ZnO. Despite reported achievements, data are not good enough to be implemented in on ZnO/Si due to their low efficiency, which still makes this field of great research interest to develop a process for growing ZnO nanorods directly on *n*- and *p*-Si substrates. Also, it is to be taken into account that at this stage, the aqueous chemical synthesis of ZnO nanorods on *n*- and *p*-Si is not extensively studied yet. From another side, silicon substrates come in our research focus, because Si is not only of interest to integration of optoelectronic devices, but also the cheapest wafer materials with a cubic structure [21]. Also, Si is easier to cleave in comparison with other substrates (i.e. GaAs). Considering *n*- and *p*-type Si as the substrate for the fabrication *n*-ZnO/*p*-Si or *n*-ZnO/*n*-Si hetero-junctions by the chemical technique looks more promising for nano-LEDs arrays and photodiodes. To overcome the limited availability of documentation on growth of ZnO nanorods on Si and implement their properties it is necessarily to find optimum regimes for growing nanorods on Si.

Here, we present a detailed cleaning procedure for Si to get deposited ZnO at low temperature (95-98°C). Also, it is reported on hydrothermal technique used to synthesize ZnO nanorod arrays on *p*-Si in 15 min. Their characteristics have been studied and a high quality material was identified by micro-Raman and photoluminescence measurements. Also, the fabricated heterostructures by this method show feasibility as a new optoelectronic device structure.

2. EXPERIMENT DETAILS

The ZnO nanorod arrays were grown on the *p*-type Si (100) substrates with an electrical resistivity 0.05 Ω·cm. We used these substrates because, the crystal orientation of the majority of wafers used today is (100) [22]. Silicon samples are commonly platelets cleaved from a Si wafer and has been sequentially cleaned by using solvent clean step, RCA-1 clean and HF dip as reported before [23]. The most common cleaning procedure for silicon wafers in electronic device manufacturing is the deionized (DI) water rinse. Cleaning processes for silicon surface are performed in water-based solutions, with the exception of solvent (acetone or isopropylalcohol) cleaning step, which are used to remove organic contaminants. Solvent clean step consists in placing Si wafers in the warm acetone bath (50-53°C) for 10 min, and then followed by ultrasonically cleaning in DI for 2-3 min. As acetone leaves its own residues, Si wafers were placed in methanol for 4-5 min under ultrasonical cleaning. After this step the substrates were rinsed abundantly with deionized water (optional), and then blow dry with a flux of air. RCA clean was used to remove organic residues from Si wafers. At this stage silicon is oxidized, in order to leave a thin SiO$_2$ on the surface of the substrate. The recipe used for RCA-1 [23] cleanser consists of 50 ml DI water, 10 ml of ammonium hydroxide (27%) mixed and heated at 70-75°C on hot plate, then 10 ml of hydrogen peroxide (30% H$_2$O$_2$) was added. After 2 minutes of vigorously bubbling of RCA-1 solution, Si wafers was soak in it for 15-20 min. After this step Si wafers were transferred to a beaker with overflowing DI water to rinse and remove the remained solution. Afterwards a hydrophilic surface condition was observed which is related to the presence of a high density of silanol groups (Si–OH) or to a thin interfacial oxide film [21-23]. Afterwards, the oxidized substrates were dipped for 3 min in hydrofluoric acid (2% HF made from 240 ml DI water and 10 ml HF of 49%) in a polypropylene beaker to remove silicon dioxide

from the Si surfaces and thoroughly rinsed in running deionized (DI) water (18.2 MΩ·cm) flow. Si wafers showed hydrophobicity observed by realizing wetting test (a little DI water drop on the surface beads up and rolls off – not shown).

Next, samples were dipped in an aqueous solution prepared by using 0.1-0.5 M of zinc sulfate (99.5%) with an ammonia solution of 29.4% (Fisher Scientific). The vessels is placed on a preheated oven for 15 min at 95 °C and then allowed to cool down naturally to room temperature [24]. After the ZnO arrays on the Si were rinsed in DI for 5 min and then the samples were dried in air at 200 °C for 5 min. It is of importance to find an optimum deposition regime for an optimum ZnO/*p*-Si interface formation where a very thin SiO$_2$ layer is formed after deposition.

The synthesized products were characterized by XRD (Rigaku 'DB/MAX' powder diffractometer) and a scanning electron microscope (SEM). The composition of ZnO nanorods was carried out using the Energy dispersive X-ray spectroscopy (EDX). The room temperature Raman scattering was investigated with a Confocal Laser Raman System in the backscattering geometry under the excitation by a 532 nm laser. Current-voltage (*I-V*) characteristics were measured using a semiconductor parameter analyzer with input impedance of 2.00×10^8 Ω [25]. ZnO/*p*-Si structure was exposed to UV-Vis light in order to investigate spectral response measured with the aid a Xe arc lamp dispersed by a monochromator. The light was modulated with a mechanical chopper.

3. RESULTS AND DISCUSSIONS

The XRD spectrum shown in Figure 1 agreed with the standard card of ZnO with hexagonal structure (JCPDS 036-1451) and no diffraction peaks from of other impurities were detected. The strong intensity and narrow XRD peaks of ZnO are indicative of the good crystallinity of material. The (002) peak at 34.42° was dominant and shows that ZnO nanorods are quasi-oriented and the growth direction was along (001). Presence of other peaks (100), (101), (102), (110), (103) and (112) demonstrate that nonepitaxial growth has performed in our procedure. The lattice constants *a* and *c* of wurtzite structure ZnO were calculated, according to Bragg's law:

$$n\lambda = 2d \sin \theta \qquad (1)$$

where *n* is the order of diffraction (usually *n* =1), λ is the X-ray wavelength and *d* is the spacing between planes of given Miller indices *h*, *k* and *l*.

The lattice constants a and c were determined as $a = 0.3250$ nm, $c = 0.5210$ nm for pure ZnO.
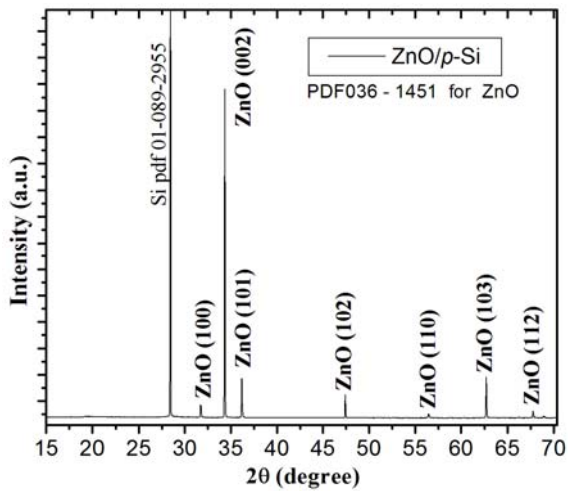
Figure 1. The X-ray diffraction pattern of the ZnO nanorods grown on *p*-Si (100) substrate.

The SEM observations of our samples (Figure 2) were in agreement with XRD data analysis (Figure 1).

Figure 2 shows a typical morphology of the ZnO nanorods deposited on *p*-Si(100) substrate. The ZnO nanorods showed grass-like morphology and the angle between nanorods and substrate plane was about 50-75°. Radius of the ZnO nanorods varied in the range 50-175 nm. The aspect ratio was estimated larger than 10.

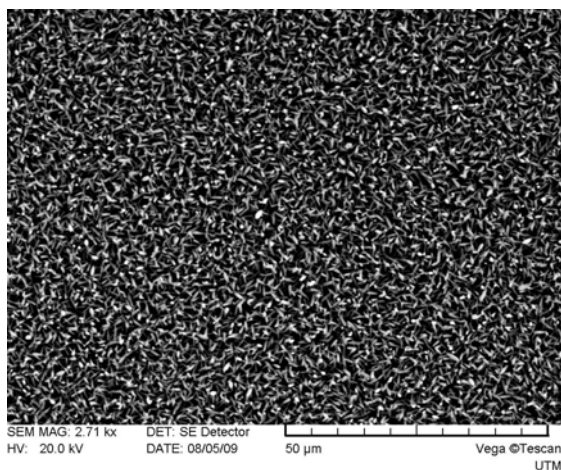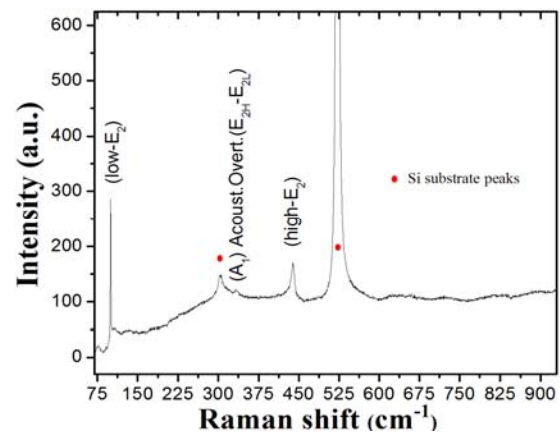**Figure 2.** SEM image of ZnO nanorods hydrothermally grown on *p*-Si substrate.

Using energy dispersion X-ray spectroscopy, we found that the Zn:O ratios in our structures to be 1:1 atomic ratio in all samples.

The vibrational properties of ZnO material are important in order to understand transport properties and phonon interaction with the free carriers. Wurtzite zinc oxide belongs to $C_{6v}^4 (P6_3 mc)$ space group, such symmetry is one of the simplest uniaxial crystals. According to theoretical group analysis it has eight optical modes that exists at the Γ point of the Brillouin zone,

$$\Gamma_{opt} = A_1(TO, LO) + 2B_1 + E_1(TO, LO) + 2E_2$$

The two B_1 modes are silent and A_1, E_1, E_2 modes are Raman active and polar. Due to the fact that ZnO is polar along the c axis of its hexagonal unit cell, which is made by alternating Zn^{2+} and O^{2-} ions layers, the A_1 and E_1 modes split into TO-transverse optical and LO-longitudinal optical components. This is for four of six active modes. The remaining Raman modes are from low and high frequency submodes of E_2 which are noted as E_2(low) and E_2(high), respectively. Figure 3 shows Raman spectrum of ZnO nanorods deposited on Si(100) substrate. In the Raman spectrum can be observed distinct peaks at 99.98, 303.8, 333.4, 439.2 and 521.1 cm^{-1} in the low wave-number region. The Raman spectrum was indexed with Si and ZnO emission modes. Peaks at 303.8 and 521.1 cm^{-1} come from Si substrate (Figure 3). It can be seen a weak shoulder located at the low energy side of 439.2 cm^{-1} peak, which corresponds to E_1(TO) at 410.2 cm^{-1}. The zinc oxide peaks located at 99.98 cm^{-1} and 439.2 cm^{-1} and are attributed to the low- and high-E_2 mode respectively of non-polar optical phonons.

Figure 3. Room-temperature Raman spectra of ZnO nanorods hydrothermally grown on *p*-Si substrate and thermally annealed at 400 °C.

The E_2(high) is clearly visible at 439.2 cm^{-1} with a FWHM of 6 cm^{-1}, while the line-width of the peak corresponding to E_2(low) mode is about 4cm^{-1}, which is comparable to values reported for ZnO in the literature [25,28]. E_2(high) peak is associated with high sample crystallinity. In our studies, the

absence of other phonon modes indicates that all nanorods are perpendicularly quasi-oriented to the substrate surface. It can be observed that ZnO nanorods are *c*-axis oriented, which is in accordance with the SEM results presented above and XRD measurements.

Room-temperature Raman spectra of nanorods hydrothermally grown on Si substrate demonstrate the high quality of the wurtzite crystal structure of our ZnO nanomaterial.

Figure 4 shows photoluminescence (PL) spectra of the ZnO/*p*-Si structure at room-temperature. The PL spectra of the as-grown sample (Fig. 4) consist of a broad and intensive near bandgap band with the maximum at 3.26 eV at room temperature. No visible emission is observed in the sample (at least at the level three orders of magnitude less that the intensity of the near bandgap luminescence). One visible PL band at 2.38 eV can be observed in spectra, which is associated with deep levels defects in ZnO [26,28].
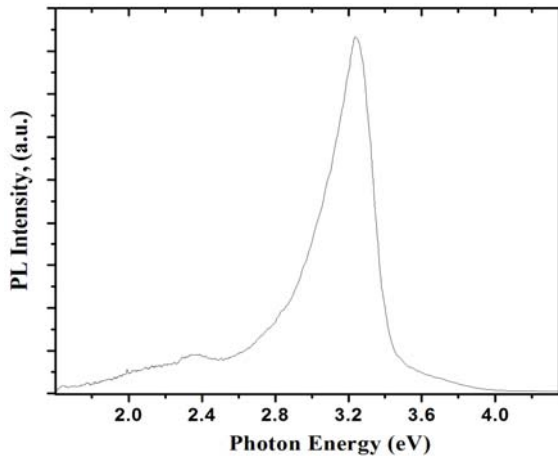

Figure 4. Photoluminescence of the *n*-ZnO-nanorods/*p*-Si structure measured at 300 K.

Figure 5 shows a typical current-to-voltage characteristic (*I-V*) curve measured in dark from as-grown ZnO/*p*-Si structure.

The *I-V* curves show rectifying properties with a turn-on voltage of ~1.2 V for forward bias and a reverse bias breakdown voltage of -3 V.

Insert in Figure 5 shows *I-V* curves (in the dark measured at 300 K) of the nano-ZnO/*p*-Si junction after annealing at 400 °C for 1 h in air.

Spectral responsivity of the ZnO nanorods/*p*-Si structure (Figure 6) and the energy band-gap model (Figure 7) were used to explain the junction formed between *n*-ZnO nanorod and *p*-Si substrate.
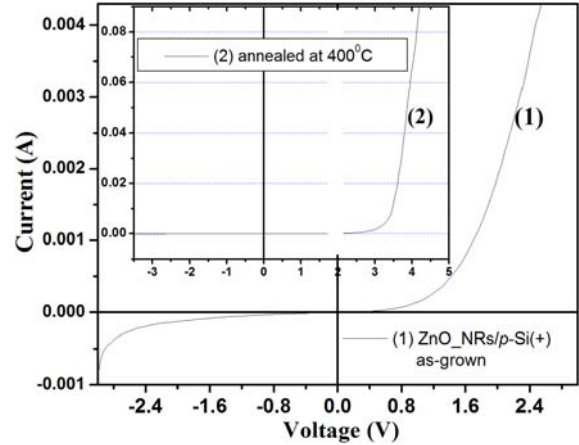
Figure 5. Typical *I-V* curve of the nano-ZnO/*p*-Si junction in the dark measured at 300 K.

Visible light photons excite charge carriers in the depletion region of the ZnO nanorods/*p*-Si junction. These excess carriers are quickly swept out to external electrodes due to the built-in electric field. Based on energy band-gap model, the depletion widths for ZnO and *p*-Si can be expressed as [27]:

$$W_{ZnO} = \left[\frac{2\varepsilon_1\varepsilon_2 N_{Si}}{qN_{ZnO}(\varepsilon_1 N_{Si} + \varepsilon_2 N_{ZnO})} V_{bi} \right]^{1/2} \quad (3)$$

$$W_{Si} = \left[\frac{2\varepsilon_1\varepsilon_2 N_{ZnO}}{qN_{Si}(\varepsilon_1 N_{Si} + \varepsilon_2 N_{ZnO})} V_{bi} \right]^{1/2} \quad (4)$$

The relative voltage supported in each semiconductor is

$$\frac{W_{ZnO}}{W_{Si}} = \frac{N_{Si}}{N_{ZnO}} \quad (5)$$

V_{bi} - the total built-in potential barrier between ZnO and *p*-Si, ε_1, ε_2 are the dielectric constants of *p*-Si and ZnO, respectively. N_{Si} is the acceptor concentration of *p*-Si (~10^{18} cm^{-3}), N_{ZnO} is the donor concentration in ZnO (about $5 \cdot 10^{15}$ cm^{-3}[28]). Thus, the ratio of depletion widths in ZnO to *p*-Si is ~200:1. In this way can be explained the detection of UV light and elimination of visible light responsivity generated in the depleted *p*-Si substrate.

The photodetection mechanism can be described by considering the optical characteristics of ZnO NRs. The energy band gap of ZnO is larger that the energy of visible photons and therefore the compound is transparent to the visible light. Thus, the visible light can pass through ZnO NRs and is absorbed by the underlying *p*-Si substrate. This

leads to generation of electron-hole ($e^- - h^+$) pairs which favor the photocurrent under reverse bias regime due to drift to ZnO region. But, the penetration depth of the light in *p*-Si is limited and leads to saturation of photocurrent. However, the UV photons are absorbed in ZnO NRs (see Figure 6) and photogenerated electrons drift to substrate electrode through the depletion region of ZnO. In this way current increases linearly with increasing the reverse voltage value (not shown).
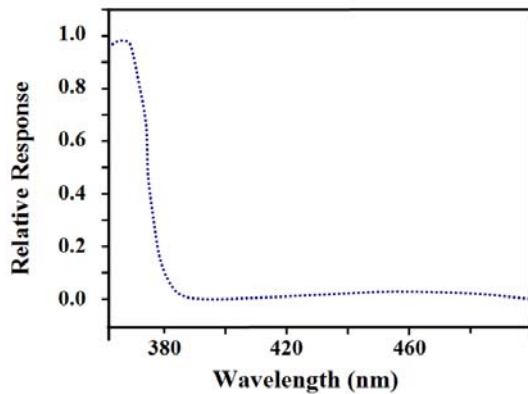
Figure 6. Spectral responsivity curve of ZnO nanorods/*p*-Si heterojunction.

To support discussions about spectral responsivity from *n*-ZnO nanorods and *p*-Si energy band diagrams were drawn. Here the effect of the interfacial state is neglected. Considering silicon dioxide layer between ZnO and *p*-Si very thin, one can neglect its effect on the energy band diagram of *n*-ZnO-nanorods/*p*-Si (Figure 7).

Figure 7. The schematic energy band diagram of the *n*-ZnO-nanorods/*p*-Si heterojunction structure under the equilibrium state.

Conduction band offset ΔE_C is $\sim 0.30\,eV$ and the valence band offset are:

$$\Delta E_V = E_g(ZnO) + \Delta Ec - E_g(Si) = 2.55\,eV$$

In such way one can conclude that the energy barriers for holes are different than the energy barrier for electrons in ZnO/*p*-Si structures.
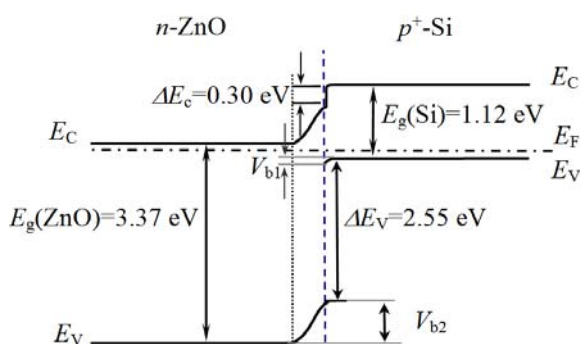
Electroluminescence has been observed from *n*-ZnO nanorods/*p*-Si structure at room temperature (not shown) when a positive voltage is applied to the *p*-Si/In-Ga substrate accordingly to a similar schematic representation like in Ref [7]. In our experiments no emission was observed under reverse bias of *p-n* heterojunction. Under forward bias of the structure white emission prove to dominate the electro-luminescence spectra.

4. CONCLUSION

In summary, ZnO nanorod arrays on *p*-type Si heterostructures were synthesized via catalyst-free hydrothermal route without template. The heterostructures consist of high-quality ZnO nanorods confirmed by SEM, XRD, Raman and photoluminescence studies. These characterizations demonstrate that the ZnO material is composed from one-dimensional nanorods with good crystal quality and *c*-axis quasi-oriented to *p*-type Si substrate. The results are consistent with the nanocrystalline nature of the zinc oxide material as observed in SEM, XRD and Raman data. It is discussed the spectral responsivity from *n*-ZnO nanorods and *p*-Si based on energy band diagrams and explain main points of the photodetection mechanism in such heterostructures.

Presented data substantially contribute to overcome some obstacles in uses of nanorods/nanowires for further development of the device structures. Also have been satisfied the features of the nanowire synthesis method desired for industry such as low-cost materials and processing, control of process parameters, environment friendly reagents, etc.

Further work: Our further research efforts are directed towards finding an optimum deposition regime for an optimum ZnO/*p*-Si interface where a very thin SiO$_2$ layer is formed after deposition. Also, efforts are directed towards synthesizing oriented one – dimensional nanorods, which will facilitate construction of semiconductor nanodevices with well-ordered alignment, expected to be extremely important for scientific, technological and industrial applications. Development of single doped ZnO nanorod/*p*-Si LED was addressed as well.

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ARGUMENTATION OF THE HYDRODYNAMIC PROFILE OF THE MICRO-HYDRO POWERSTATION ROTOR'S BLADES

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1. INTRODUCTION

The inevitable increase of global energy consumption and the risk of a major environmental impact and climate change as a result of burning fossil fuels opens wide prospects for the exploitation of renewable energies. Hydropower, as a renewable energy source, will have an important role in the future. International research confirms that the emission of greenhouse gases is substantially lower in the case of hydropower compared to that generated by burning fossil fuels. From the economical point of view, the utilisation of half of the feasible potential can reduce the emission of greenhouse gases by about 13%; also it can substantially reduce emissions of sulphur dioxide (main cause of acid rains) and nitrogen oxides.

Hydraulic energy is the oldest form of renewable energy used by man and has become one of the most currently used renewable energy sources, being also one of the best, cheap and clean energy sources. Hydraulic energy as a renewable energy source can be captured in two extra power forms:

– potential energy (of the natural water fall);

– kinetic energy (of the water stream running).

Both extra power forms can be captured at different dimensional scales.

Among clean and non-pollutant energy sources, kinetic energy of the flowing rivers is of great importance due to the enormous energy potential. This assertion stands for the vast majority of rivers with large and medium size discharge. Strong public opposition to large scale hydro-electrical power plants caused by large environmental and social costs (from damming of rivers and flooding of large tracts of fertile land to the displacement of people from the affected areas and disrupted fish migration) is making the small scale hydro-electric power plants more appealing, especially for the potential consumers in remote rural areas. Micro-hydro-electric power plants are used on a large scale as decentralized energy sources. Renewed interest for such stations started worldwide in recent decade. Decentralized systems for conversion of the kinetic energy of the free water flow into electric or mechanical energy are using turbines in the absence of dams. The kinetic energy of free water flow is a recommended energy source, available 24 hours per day and it can be efficiently harnessed by micro-hydro power stations.

Systems for conversion of river kinetic energy elaborated by the research team from the Technical University of Moldova (coordinator - Prof. acad. Ion Bostan) have no counterparts among classical systems utilized at international scale. The proposed innovations resulted from a complex theoretical and experimental research in the context of which the rotor's geometrical, functional and constructive parameters have been determined and in a specialized laboratory with modern equipment the blade's fabrication technology using composite materials have been validated [1-5].

The micro hydropower plant is a complex technical system that includes constructive components with distinct functions: rotor-turbine that draws off a part of the water kinetic energy at its interaction with the water flow; mechanical transmissions for the transformation of the converted energy; pumps and generators for useful power generation, etc. The conversion efficiency of the micro hydroelectric power plant depends on the performances of each component.

The functional and constructive parameters of the hydrodynamic rotor adopted within the carried out research separately on each working element demand experimental research of their functioning as an integral system in real conditions. The experimental research on the units of the micro hydroelectric power plant as an integral system aims at the increase of the conversion efficiency of the water flow kinetic energy into useful energy by introducing the relevant constructive modifications in the project documentation of the final industrial product.

Two micro-hydro-power stations prototypes with three and five hydrodynamic blades have been elaborated, designed, tested and manufactured specifically for conversion of the river's kinetic energy into useful energy (electrical or mechanical). The main working parts have non-standard

parameters: generators with permanent magnets, low revolution hydraulic and centrifugal pumps, multiplier systems based on planetary transmissions. One of the manufactured prototypes of the micro-hydro power stations with three hydrodynamic blades is shown in figure 1.

Figure 1. Micro-hydro power station with 3 hydrodynamic blades.

2. NUMERICAL SIMULATION OF THE FLOW-BLADE INTERACTION OF THE MICRO-HYDRO POWER STATION

The conversion efficiency of the proposed micro-hydro power stations depends strongly on the selection of the optimal hydrodynamic shape of the blades and hydrofoil positioning, i.e. at each angular position hydrofoil should have an attack angle that will maximize the tangential component of the hydrodynamic force and hence, the resulting torque. Various constructive diagrams can be considered in order to maximize the resulting torque. In the following one blade positioning configuration will be discussed.

In this configuration, the blade in zone I, fig.2, has a constant attack angle of 18° with respect to the water stream velocity vector, in zone II the blade changes the attack angle from 18° to -18°, in zone III the blade has a constant attack angle value of -18°, in the fourth zone IV the blade changes the attack angle up to 90°, keeping this value constant in zone V, and finally the blade changes its attack angle back to 18° in zone VI, thus completing a full revolution.

The computer simulations of the flow-blade interaction of the micro-hydro power station with five hydrofoils have been performed in the academic version of the commercial CFD packages ICEM CFD and ANSYS CFX. The computational

domain is a two-dimensional cutting plane orthogonal to the rotor axis and consists of three sub-domains: a
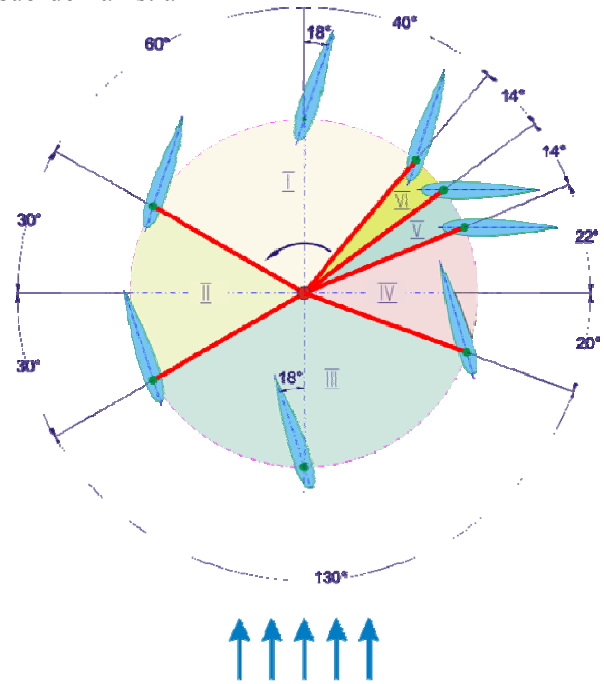
Figure 2.

far-field sub-domain, a rotor sub-domain (a circle of radius 3m with centre at rotor axis) and 5 near-blade sub-domains (circles around each blade), see fig. 3. The rotor itself has a radius of 2m, each blade is a hydrofoil with NACA 0016 profile with chord length 1.3m.

The domain extends 10m upstream and 20m downstream of the rotor axis, while laterally it extends 4m to each side. Since the computations are two-dimensional, the hydrofoils are considered infinitely long and therefore the effects due to the endplates of the hydrofoils are not taken into account.
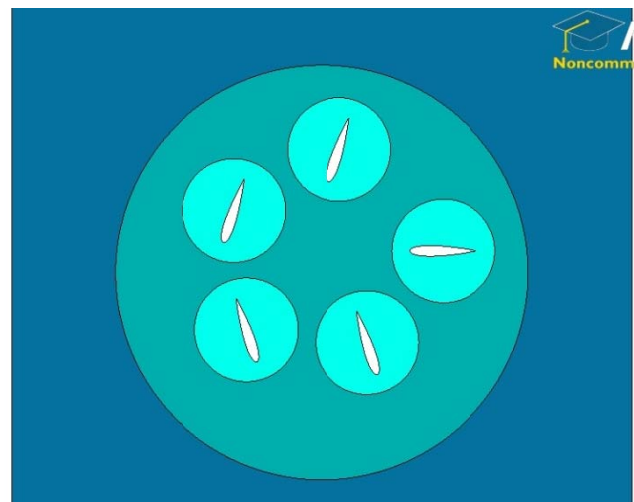
Figure 3.

The no-slip boundary condition is imposed on the surface of each hydrofoil, the streamwise flow boundary conditions with initial velocity of 1m/s and medium turbulence intensity (5%) are imposed on the upstream boundary (inlet), the free-slip boundary conditions are imposed on the lateral sides, while on the downstream boundary (outlet) a constant zero averaged pressure condition is enforced.

The geometry and mesh discretisation of the domains have been conducted in ICEM CFD. The mesh is a hybrid mesh containing tetrahedrons and very fine prism elements for modelling the boundary layer near blade walls as presented in fig. 4 and 5. The blade surface was discretised using a total of 1520 nodes. A
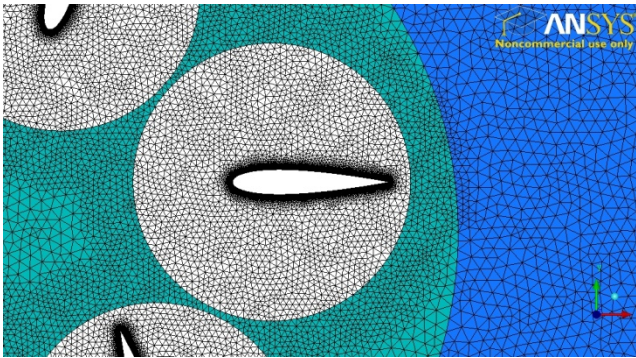
Figure 4. The mesh of the near-blade sub-domain.
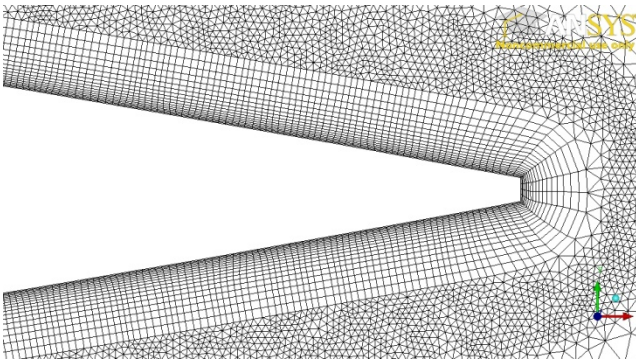
Figure 5. Mesh in vicinity of the trailing edge.

total number of 16 prism element layers have been used for modelling the boundary layer. The first boundary layer has a height of 0.00018m. The corresponding y^+ is bounded $2 \le y^+ \le 8$, where

$$y^+ = \frac{\sqrt{\dfrac{\tau_w}{\rho}}\, y}{\nu}, \qquad (1)$$

with τ_w being the wall shear stress, ρ the fluid density, y the wall normal distance and ν the fluid viscosity. A sufficient boundary layer resolution should satisfy the condition $y^+ = O(1)$ in order to describe correctly the boundary layer behaviour. For each circular near-blade sub-domains 100,150 elements have been used, which resulted in 780,245 elements for the rotor sub-domain and a total of approx 1,000,000 elements for the entire computational domain. Spatial convergence tests identified this discretisation as sufficient for convergence and optimal for computational costs. The steady CFD simulations have been performed in CFX. The fluid was chosen as water at 25°. For the turbulence model the SST $k-\omega$ model was chosen. This model was chosen since SST $k-\omega$ simulates quite well separation of boundary layers, a phenomena happening at high angles of attack, angles characteristic to the discussed setting.

3. NUMERICAL RESULTS

In figure 6 the flow velocity distribution and the turbulence kinetic energy distribution in the rotor configuration are presented. It can be noticed that due to the blades located in the upstream direction with respect to rotor axis, the velocity distribution for the blades located downstream significantly differs even if both upstream and downstream pairs of blades are making the same angle of attack of 18°. This is due to the fact that the turbulence intensity increases in the downstream of the first pair of blades, which in turn affects the blades located further downstream. Also, it can be observed that the high turbulence areas provoked by the blades located upstream extends up to the blades located further downstream.

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Figure 6. Flow velocity distribution and the turbulence kinetic energy distribution.

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RESEARCH OF HOMOGENEITY OF FUEL MIXTURE IN BURNERS WITH DIFFERENT TYPES OF STABILIZERS

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INTRODUCTION

Combustion is based on two main processes:

- physical process, within which the direct contact between fuel and oxidant takes place, which essentially determines the homogeneity of mixture subjected to combustion;

- chemical process that determines the speed of development of oxidation reactions of fuel elements from mixture subjected to combustions.

Since the temperature in the locations of combustion exceeds 900°C, the chemical process is performed very rapidly and qualitatively, and in such circumstances the combustion processes obviously remain to be determined by the way of development of physical process, over which the field specialists focus more their attention.

Despite of performances achieved at organizing the physical process by swirling flows, many effects still remain unused, both in terms of mechanism of turbulent interactions, and in terms of concept of performance of devices for organizing these turbulences.

Broad knowledge of turbulent structure of currents and concentration field of natural fuel gases will allow highlighting the possibility of intensifying the combustion process and rational construction of burners and focal points. The homogeneity of mixture is influenced by more factors: degree of turbulence, speed of mixture, and distance from mouth of burner and radius from flame axis. Another important aspect is the influence of type of stabilizer upon the homogeneity of mixture.

There is a need to study the influence of parameters mentioned in different constructions of burners and the relations between the speed w_{min} – minimum power and speed w_{max} – maximum power stabilizer of type A, Fig. 2.
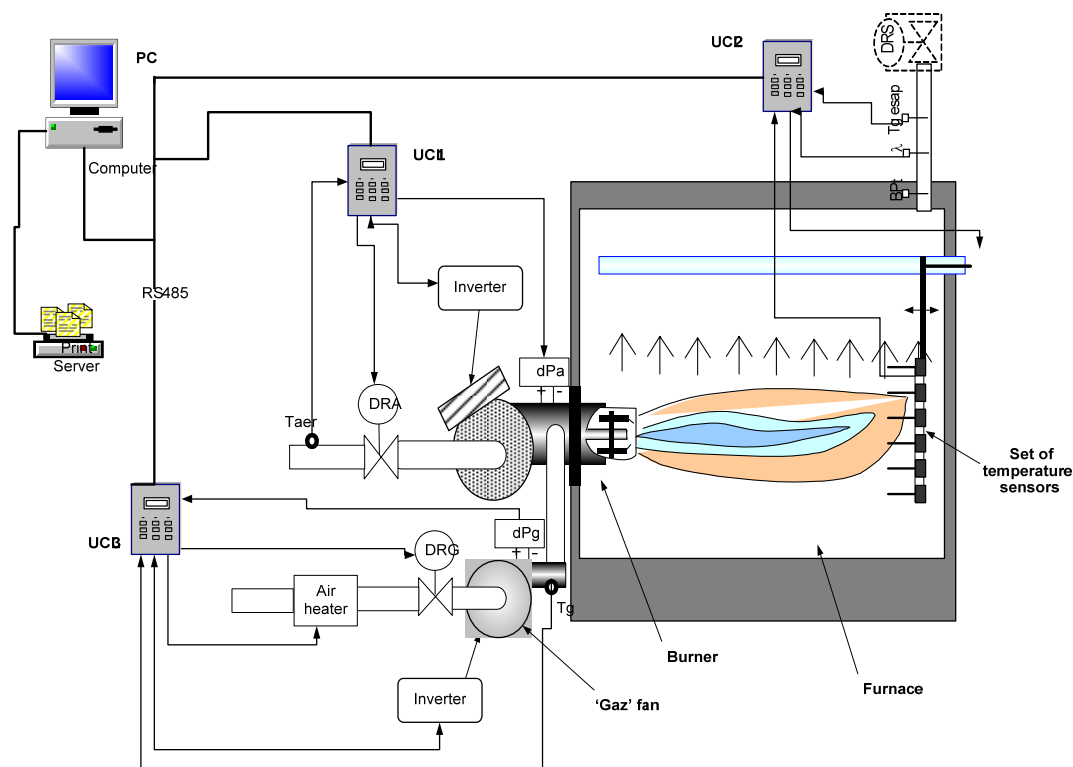
Figure 1. General structure of research installation of processes without gases combustion.
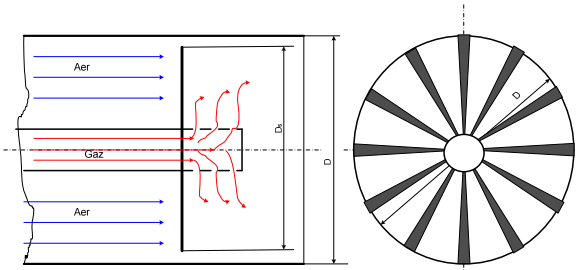
Figure 2. Combustion head with type A stabilizer.

1. PILOT PLANT

The study of field of concentration of natural gases participating in the process of combustion, formed by using different types of stabilizers, designed on different principles, was conducted on an experimental stand by improvisation of combustion processes of gases that simulate the combustion process through introducing two currents of warm air and cold air, strictly volume controlled in relation $Ca:C_g = 9,52:1$ by help of shutters of DRA, DRG types and frequency convertors, because the performance of such experiments during combustion process by using natural gases is practically impossible. The frequency convertors control the fan speed of both currents. The cold-air flow represents the oxidant at temperature $T_a= 10\div25ºC$, and heated air flow – the "gas" at temperature $T_g=60$-:-$120ºC$. Therefore, the experiments have been performed at automatic stand, shown in picture 1, replacing the gas with another product – heated air [4, 5]. The stand includes the automatization of performance of experiments in order to enable to multiply the necessary conditions and to observe the effects as significant as possible [3].

The proposed stand includes the following main parts:
-    a heating boiler of typical design, equipped with a set of sensors for measuring the temperature of gases, concentration of flue gases, temperature and pressure of coolant;
-    a gas burner with independent control mechanisms of gas (heated air) and air flow;
-    a set of microcontrollers for controlling and monitoring the experiments

As object of experimentation there were used one piece burners of "DAVA-250" type [2] with three types of stabilizers, hereinafter referred to as A, B, and C [1]:

a. Stabilizer constituted of a disk with sector blades, twisted under an angle *a* towards the air flow and with axial distribution of gas, called.

b. Stabilizer constituted of a number of blades in "V" shape with axial distribution of gas, called stabilizer of type B, Fig. 3;
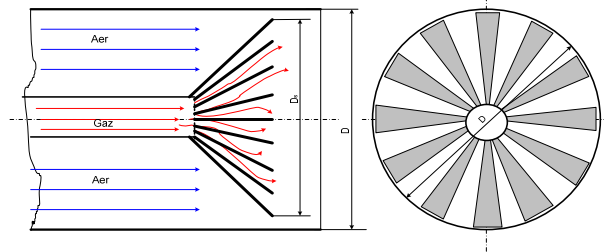
Figure 3. Combustion head with type B stabilizer.

c. conical stabilizer with the gas distribution on the peripheral part of cone, called stabilizer of type C, pic.4.
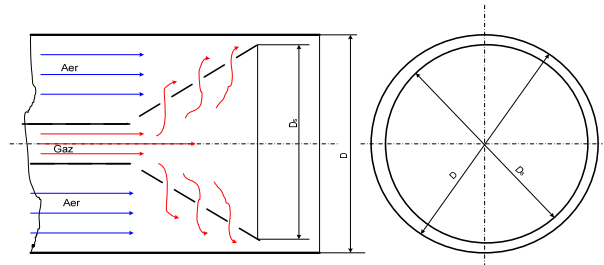
Figure 4. Combustion head with type C stabilizer.

2. RESEARCH OF FUEL MIXTURE HOMOGENEITY

Based on the analogy between the mass transfer processes and heat, the concentration of gas in mixture air-gas may be determined by changing the temperature of air-gas mixture at various points of the "flame" at the mouth of burner (Fig. 5).

The concentration of "gas" is calculated by formula:

$$C_g^{\ m} = \sum_{j=1}^{n}\left(\sum_{i=1}^{k} C_g^{\ i} \Big/ k \right)/ n, \qquad (1)$$

where: C_g^i - gas concentration in point *"i"*;

n - number of points;

k - number of repetition of measuring at each point.

The temperature of mixture in focal point has been measured throughout the volume of "flame" on rings with different radii from the burner axis, in four sections of location of sensors and at different distances from burner mouth.

It is determined in all points of a section of "flame" and, respectively, in all its sections. By using the obtained values the field of concentration shall be created on the space of concentration:
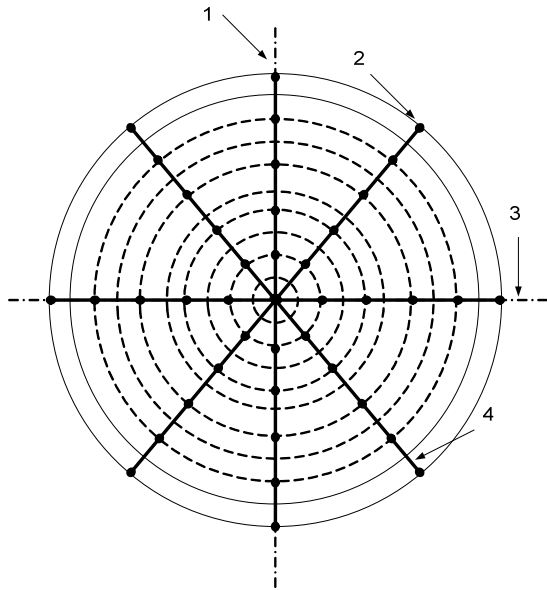
Figure 5. Schema of location of temperature sensors for determining the field of gas concentration.

flame. It is to be mentioned that in event the gas concentration reached the lower limit of 10%, it is shall be considered that the mixture is completely formed, otherwise – the mixture is under formation condition. The field of gas concentration has been investigated within the jets obtained by using these three types of stabilizers of different equal dimensions (diameter D_s, care forms equal surfaces of obstructing of stabilizers).

Another important factor influencing the field of gas concentration is the velocity of mixture, which correlates with the current power of burner. For this reason three levels of power for experimentation have been established: P_{min}, P_{med} and P_{max}. It is noted that the volume ratio of cold air and heated air ("gas") was maintained at entrance in burner, corresponding to the quality of mixture $a = 1,0$.

For each point of experimental plan a cycle of operations was performed by data collection for each section perpendicular on flame axis by step $\Delta(x/D) = 0,5$. By statistic processing of collected data, then calculating the gas concentration in all points, the field of gas concentration shall be obtained throughout the space of "flame".

Based on the obtained results there have been designed two types of diagrams of the field of gas tridimensional and circular, that allow to observe the dynamics of formation of mixture on the space of "flame" and to make a comparative analysis, to interpret them for each type of stabilizer. The obtained results shall be presented as diagrams in figures 6-:-11.
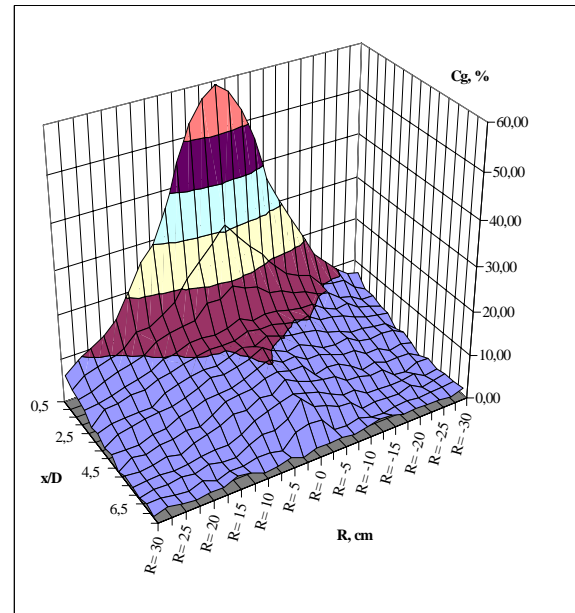
Figure 6. Tridimensional diagram of field of gas concentration for burner with a stabilizer of type A at P_{min}, D_s=124mm.

The diagrams from pictures 6 and 7 reflect that the maximum concentration of gas is directly situated at the exit from burner.
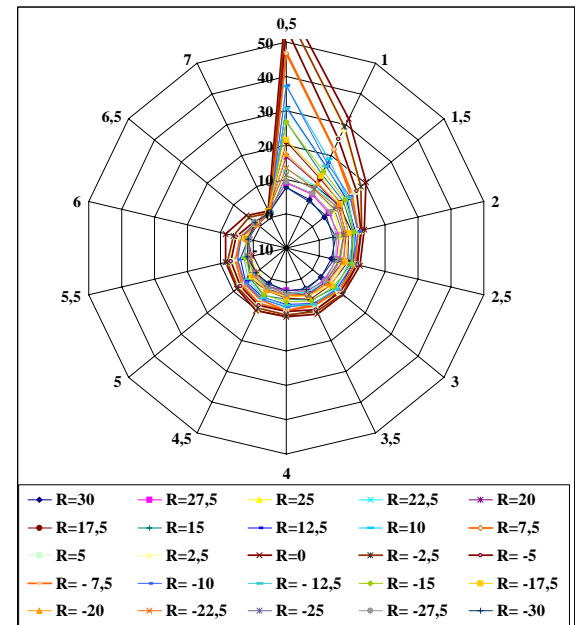
Figure 7. Circular diagram of field of gas concentration for burner with stabilizer of type A at P_{min}, D_s=124

Mixing with air, the concentration of gases suddenly drops down, the mixture becomes homogeneous and stoichiometric on all radial sections of the flame, starting with distance of x/D = 2 -:-2,5, and as consequence the length of flame is extended.
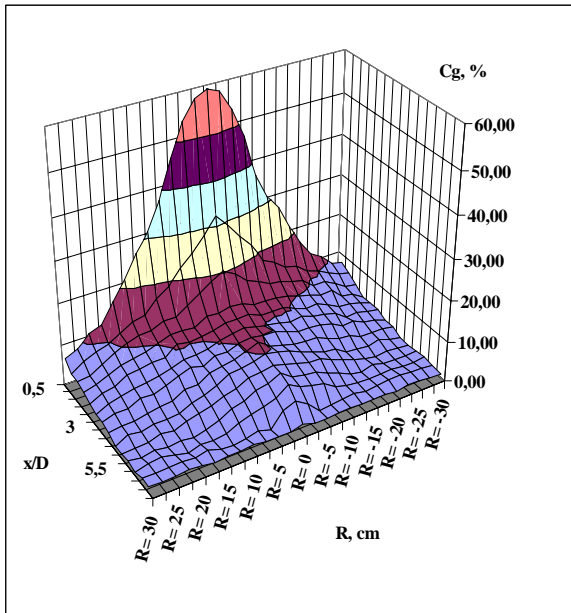
Figure 8. Tridimensional diagram of field of gas concentration for burner with stabilizer of type B at P_{min}, D_s=124mm.
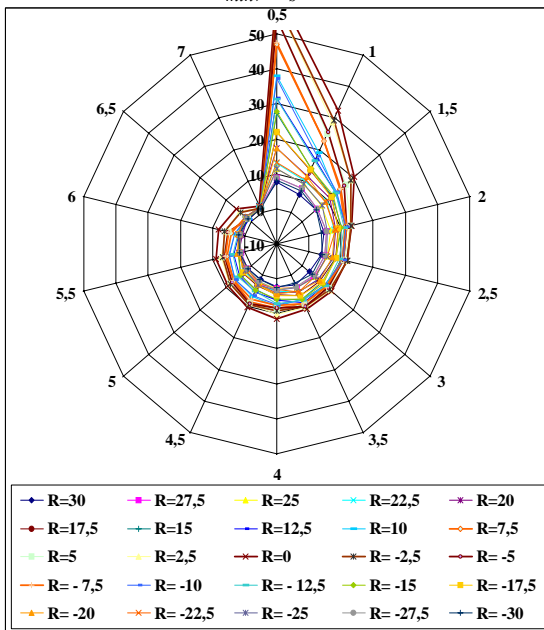
Figure 9. Circular diagram of field of gas concentration for burner with stabilizer of type B at P_{min}, D_s=124mm.

Figure 10. Tridimensional diagram of field of gas concentration for burner with stabilizer of type C at P_{max}, D_s=124mm.
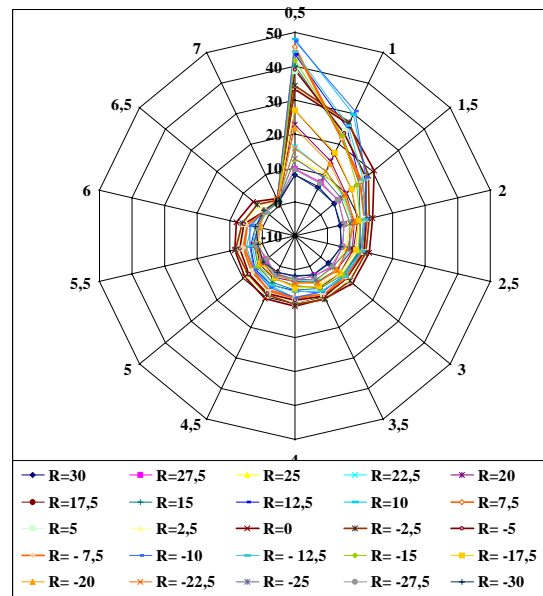
Figure 11. Circular diagram of field of gas concentration for burner with stabilizer of type C at P_{max}, D_s=124mm.

The diagrams from pictures 8 and 9 prove that the maximum concentration of gas is directly situated at exit from burner, that suddenly and continuously drops down, the mixture becomes homogeneous and stoichiometric on all radial sections of flame, starting with the distance x/D = 2 -:- 2,5.

Diagrams from pictures 10 and 11 show that the maximum concentration of gases is found around the diameter of burner exit, that

suddenly drops down, the mixture rapidly becomes homogeneous and stoichiometric on all radial sections of flame, starting with distance x/D = 1,5 -:- 2,0.

A generalized characteristic of combustion is represented by equation of distribution of gas concentration depending on the distance from the mouth of burner for each section to the distance *h*

from the flame axis. This equation shall be empirically obtained and has the following common form for all types of stabilizers:

$$C_g = k_1 \cdot (x/D)^3 + k_2 \cdot (x/D)^2 + k_3 \cdot (x/D) + C, \quad (2)$$

where: k_1, k_2, k_3 – are proportionality coefficients;

x/D – distance from mouth of burner, expressed in proportion to the burner diameter;

C – constant.

We present in tabular form the parameters of equation (2) for a set of sections and all types of stabilizers.

Table 1. Parameters of distribution equation of gas concentration.

Type of stabilizer	Diameter, D_s, mm	Power developed	Section radius, cm	Parameters			
				k_1	k_2	k_3	C
A	124	*Pmin*	0/2,5	-0,116	3,028	-25,078	73,93
		Pmed	0/2,5	-0,0864	2,2934	-19,977	66,873
		Pmax	0/2,5	-0,077	2,09	-19,042	70,94
B	124	*Pmin*	0/2,5	-0,1217	3,153	-25,815	75,027
		Pmed	0/2,5	-0,085	2,289	-20,18	67,673
		Pmax	0/2,5	-0,0814	2,17	-19,47	70,97
C	124	*Pmin*	0/2,5	-0,0511	1,49	-12,098	44,605
		Pmed	0/2,5	-0,0557	1,4466	-12,119	45,33
		Pmax	0/2,5	-0,0546	1,395	-11,52	44,83

3. CONCLUSIONS

The comparative analysis of experimental results processed by means of formula (1) shows that the field of gas concentration is approximately the similar for all types of stabilizers, with some exceptions near the mouth of exit mouth of burner. Such exception is explained not so much by the dependence of stabilizer's shape, as by the gas inlet mode: axial or peripheral.

The other areas of field of gas concentration are quite similar and are based on two factors: the degree of turbulence and velocity of air-gas mixture.

When using the stabilizer of type C it may be noticed that the mixture becomes homogeneous more rapidly and, therefore, the combustion will occur in a flame of a length shorter in relation to the cases of using the stabilizers of type A and B.

The distribution of gas concentration depending on the distance from the exit mouth of burner, calculated by formula (2) for each section at the distance h from the flame axis shows that the factors that significantly influence the homogeneity of mixture quality are the degree of turbulence of mixture and its velocity. The reduction speed of field of gas concentration characterizes the quality of mixture formation and, consequently, determines the outlet angle and flame length. The quality of homogeneity of mixture significantly depends on dimensions of stabilizers that contribute to formation of turbulence.

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THE COMPARATIVE ANALYSIS OF DISTRIBUTED POWER CONTROL ALGORITHMS IN CDMA

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INTRODUCTION

In this work are presented results of comparison of various distributed power control (DPC) algorithms. The control of transmit power has been recognized as an essential requirement in the design of cellular code-division multiple-access (CDMA) systems. Indeed, power control allows for mobile users to share radio resources equitably and efficiently in a multicell environment. For this purpose they were modelled in the simulation environment MATLAB, basing on the CIR (Carrier to Interference Ratio) by the following two criteria: speed of convergence and system's outage performances. For modeling a cellular system model of 19 co-channel cells, which are spaced with a reuse distance, has been considered on the assumption that each cell is a hexagon.

1. DPC ALGORITHMS

Unlike Centralized Power Control (CPC) algorithm which uses the global information to update the powers and balancing the CIRs Distributed Power Control (DPC) algorithms use the local information for the power updating and CIR balancing. There are different types of DPC algorithms suited for fulfilling different QoS requirements.

These algorithms are iterative and generally each algorithm converges to the desired value after certain number of iterations. The iterations taken to converge to the desired value depends on the responsiveness of the algorithm.

Some of the DPC algorithms considered are given below.

1. Distributed Power Control (DPC);
2. Fully Distributed Power Control (FDPC);
3. Improved Fully Distributed Power Control (Improved FDPC);
4. Balanced Distributed Power Control (BDPC);
5. Fixed Step Distributed Power Control (FSDPC);
6. Augmented Constant Improvement Power Control (ACIPC).

2. SPEED OF CONVERGENCE

As the radio channel is highly stochastic, the channel characteristics vary very quickly. So, the power update by any power control algorithm should be fast enough to converge and stabilize the system quickly. So, the speed of convergence is an important performance comparison parameter that gives the responsiveness of the power control algorithm.
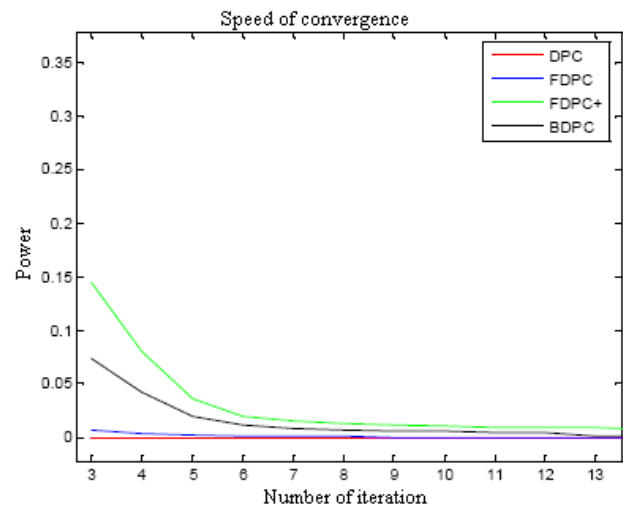
Figure 1. Comparison of speed of convergence of various power control algorithms:
DPC – Distributed Power Control algorithm
FDPC – Fully Distributed Power Control algorithm
FDPC+ – Improved Fully Distributed Power Control algorithm
BDPC – Balanced Distributed Power Control algorithm.

The figure 1 represents a dispersion of power levels in all consecutive iterations for the four algorithms. From the diagram it is clear that DPC algorithm converges faster than FDPC algorithm, BDPC algorithm and Improved FDPC+ algorithm. DPC algorithm almost converges instantly, but the deficiency of fully distributed quality makes it impractical for implementation.

Though the convergence of FDPC algorithm is more slowly than the DPC algorithm, its property

of the full distribution makes it more effective than DPC algorithm. BDPC algorithm converges slowly, but it has good power balancing property. The powers are balanced unlike FDPC algorithm and Improved FDPC algorithm which makes it more effective for practical implementation. Improved FDPC algorithm has the worst parameters, both in convergence, and in balancing of power that makes it improper for practical implementation.

3. ALGORITHM′S OUTAGE

Viability of system also is important parameter of work which shows system effectiveness. DFSPC – Distributed Fixed Step Power Control algorithm and ACIPC – Augmented Constant Improvement Power Control algorithm are compared on their outage performance since they can be implemented for satisfying different QoS (Quality of Service) requirements.

Fixed Step algorithm supports a communication quality depending on target CIR (Carrier to Interference Ratio), and ACIPC algorithm involves in cell removal if target CIR is not attained. Outage performance for these two algorithms in every iteration is shown on fig. 2.
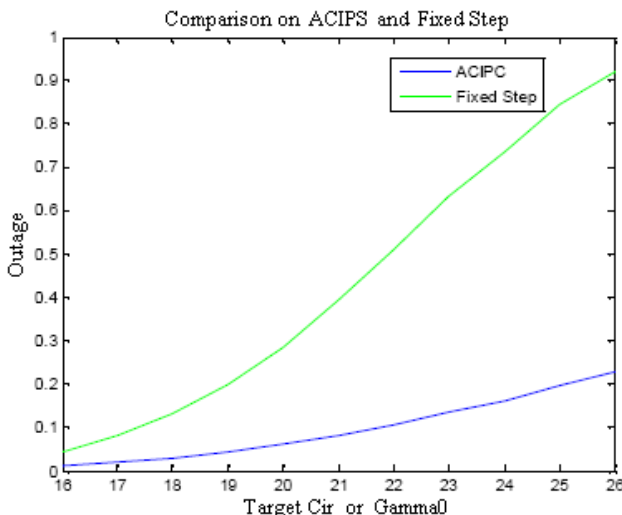
Figure 2. Comparing on outage performance of ACIPC algorithm and DFSPC algorithm.

From figure 2, it is clearly that Fixed Step algorithm has got worse outage performance in comparison with ACIPC algorithm. Fixed Step algorithm's protection property of a communication quality makes it more attractive to practical implementation and for satisfaction of QoS requirements that raises system capacity. ACIPC algorithm has very good outage performance in comparison with Fixed Step algorithm. Its

disadvantage consists in that it launches procedure of removal of cell. So, ACIPC algorithm can be the considerable option for achievement of the best QoS requirements and enhanced features of system.

CONCLUSIONS

The presented results of modeling show that each algorithm possesses different speeds of convergence and outage performance. From these results it is possible to conclude that speed of convergence only partially sizes up efficiency of algorithm. Other factors like tremendous increase or decrease in the transmitting powers, call dropping probability and maintaining required QoS all the time, also need to be considered here.

Thus, it is possible to conclude that each of the observed algorithms is good or bad depending on certain conditions. In convergence DPC algorithm has the best parameters among the remaining studied algorithms. BDPC algorithm is the best in power equalization whereas ACIPC algorithm exceeds other algorithms under QoS requirements. Thus, each algorithm has own advantages and lacks.

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ENZYME   LINKED IMMUNO SORBENT ASSAY FOR THE QUANTITATIVE ANALYSIS OF PROLAMINS OF SORYZ (ELISA)

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INTRODUCTION

The detection of the content of prolamins plays an important role to enable the selection of food for patients who suffer from any form of gluten intolerance, especially for celiac and allergic individuals. Prolamins are protein fraction of wheat, rye, barley, and other cereals, that are not soluble in 0.15 M NaCl solution, but soluble in 40-70% ethanol. All the wheat prolamins (gliadins), rye prolamins (secalins), and barley prolamins (hordeins) are toxic for celiac patients. There is no agreement concerning toxicity of oat prolamins (avenins), while rice prolamins (oryzins) and corn prolamins (zeins) are not toxic at all. The percentage of prolamins in gluten is approximately 50 % for wheat. According to Codex alimentarius, "gluten free" foods are those containing less than 10 mg of gliadins (prolamins) in 100 g of dry substance (20 mg of gluten per 100 g of dry substance) [1].

1.   GENERAL

Gluten is the characteristic term for the protein mixture of glutelins and prolamines (gliadins) found in cereals. The proportion of glutelin to gliadin in the protein mixture is approximately the same. One exception are starches: Their prolamine /gluten proportion is depending on the washing degree of the starches (factor between 1.6 and 2.6). There exist various groups of gliadins. Their contents vary from cereal to cereal. Gluten is found in many cereal products, however, due to its inherent physicochemical properties as binding and extending agent it is commonly used as an additive in foods.

Detection of gluten plays a role in the quality control and selection of foods for individuals with gluten intolerance. In cases of gluten intolerance enteropathy, celiac disease, sprue and related allergic reactions, a diet free from gluten contained in wheat, rye, barley and in some cases oat would be necessary.

In the Codex Standard for gluten free foods the term „gluten free" is defined as follows: „In accordance with this standard "gluten free" means, that the total amount of the used gluten of wheat, rye, barley and oat in the products or those crossed species in food or ingredients is not more than 200 ppm (mg/kg) on the dry substance basis". A limit of Gluten to 20 ppm is in discussion.

Prolamines are those gluten fractions, which can be extracted with ethanol (40 - 70 %). The prolamine content of gluten generally is 50 %. Therefore, the limit for prolamines is 100 ppm (mg/kg) corresponding to an approx. gluten content of 0.02 %.

The common detection of gluten is based on microscopic, electrophoretic and chromatographic methods. These methods seldom yield acceptable quantitative results, particularly in the case of processed and cooked foods. In addition, these methods are time consuming and require expensive laboratory equipment. In accordance with the "Codex Standard for gluten free foods" (temporary draft) the gluten detection in foods and ingredients has to be based on an immunological method and the detection limit should be at least 10 ppm in products based on dry substance. With the RIDASCREEN®FAST Gliadin test it is possible to detect gluten from wheat, rye and barley quantitatively with a detection limit of 10 ppm. It works in raw as well as in processed foods [2, 4].

2.   TEST PRINCIPLE

The basis of the test is the antigen-antibody reaction. The wells of the microtiter strips are coated with specific antibodies to gliadins. By adding the standard or sample solution to the wells, present gliadin will bind to the specific capture antibodies. The result is an antibody-antigen-complex. Sample components not bound by the antibodies are then removed in a washing step. The bound gliadin is detected by an antibody conjugated to peroxidase (enzyme conjugate). Any unbound enzyme conjugate is then removed in a washing step. Enzyme substrate (urea peroxide) and

chromogen (tetramethylbenzidine) are added to the wells and incubated. Bound enzyme conjugate converts the colorless chromogen into a blue product. The addition of the stop reagent leads to a color change from blue to yellow. The measurement is made photometrically at 450 nm [2, 4].

3. MATERIALE ȘI METODE

As materials for making experiments were used native grains of soriz "Alimentar 1";

Method for determining is Enzyme Linked Immunoassay R5 Mendez (ELISA) :the official method proposed by the Codex Alimentarius;

Measurements were made this year in Laboratory of Applied Research and Analysis "R&C Lab" S.r.l., (Uni En Iso 9001:2000), Vicenza, Italy.

4. RESULTS

The results are read off the calibration curve which can be used only to determine the gliadin concentration in samples assayed at the same time as the calibrators.

The mean values of the absorbance values obtained for the standards are entered in a system of coordinates on semi logarithmic graph paper against the gliadin concentration in µg/kg (ppb). The gliadin concentration corresponding to the absorbance of each sample can be read from the calibration curve

The results show that the soriz grains (Sorghum oryzoidum) the concentration of toxic prolamine is undetectable, or null, which includes soriz in the category of recommended cereals for celiac alimentation.

CONCLUSION

According to the results we can conclude that the soriz is a gluten-free cereal that can be recommended with certain for people with gluten intolerance or sensitivity. This allows the expansion of local gluten-free cereals for human food, increasing food security.

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ABC – COSTING AS A TOOL TO EFFICIENT THE PROCESS OF TECHNOLOGICAL CHANGES AND DEVELOPMENT OF IT-ENTERPRISES

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1 THEORETICAL FRAMEWORK FOR CHANGE AND CHANGE MANAGEMENT

Charles Darwin shows that do not survive the most beautiful, smartest or the strongest, the future are of those who best adapt to change. Change is, in the opinion of McCalman and Paton, "a continuous process of confrontation, identification, evaluation and action" Kurt Lewin considers change as a dynamic equilibrium of forces pushing to change on the one hand, and on the other hand, forces resistance to change.

Equilibrium of change forces after Lewin K.:

Pressures for change	Resistance to change
▪ technological Change	▪ obsolete Mentalities
▪ knowledge explosion	▪ mental block
▪ product obsolescence	▪ lack of interest
▪ Improving working conditions	▪ fear of new
	▪ fear of failure
	▪ low degree of professionalism
	▪ changing the force structure work

There are two categories of factors that influence change within the organization:

▪ External factors that can not be controlled by managers. (new products introduced by competitors, the amplification, advertising new products, price reductions in various categories, improving product or services offered to customers, change technologies supposing computer and industrial robots using, enabling rapid resolution of complex problems of production and management, contributing to reduce costs and improve quality, reflected positively in financial terms, the influence of specific external factors: international organizations, as the World Bank, International Monetary Fund and the European Union).

▪ Internal factors acting through changes in the organization. There are decision-making processes, communication, interpersonal relationships, leadership, management style etc.

The usual change management is defined as structured approach to shifting/transitioning individuals, teams, and organizations from a current state to a desired future state. It is an organizational process aimed at empowering employees to accept and embrace changes in their current business environment.

Looking through different sources we consider that there are three basic definitions of change management.

The first and most evident definition is that the term refers to the task of managing change. Managing change is itself a term that has at least two aspects. The first relates to making changes in a planned, managed and systematically way. This is the purpose - to implement more effectively new methods and systems in an ongoing organization. The changes which will be managing go in here and are controlled by the organization. However, these changes could come from outside. The second dimension of change management refers to managing changes, resulting from activities such as legislation, social and political upheavals, actions by competitors, changing economic currents and so forth. There are changes witch the organization carries little or no control. The first and second dimensions are usually characterized as being pro-active and reactive.

Change Management can also be seen as an area of professional practice and this is the basis for *the second definition* of the term. Independent consultants can act as agents of change in order to help their customers to manage facing change, or to help them to take a proactive approach to change management by taking on the task of inevitable changes. In almost all cases, the process is treated taking into consideration the characteristics of the situation. The consultants undertake the process of change management by working with managers and users who know the specifics.

A third definition of change management is based on matter of subject. It consists mainly of models, methods and techniques, tools, skills and other forms of knowledge involved in change management practice.

There are a lot of benefits of change management, as following:

▪ risk reduction and quality service improvement;

▪ improve communication. A better communication between users and organization will lad to a better understanding of individual needs and priorities, highlighting that business units don't act isolatable;

▪ contribute to simplify and to support the information and operation flux. The process of change process will help the organization to rationalize information flux, to maximize software utilization in order to reduce inutile rapports and to raise productivity;

▪ made analysis can help to reduce product /service costs. This can help enterprises to grow up and to concentrate to revenues and profits. The analysis include product cost analysis, service cost analysis which can be useful for decision making.

In conclusion, we can mention that the process of change management is a difficult one because it implies a great modification in the company activities, but the benefits are considerable for company evolution.

The purpose of Technology Change Management is to identify new technologies (i.e., tools, methods, and processes) and track them into the organization in an orderly manner.

Technology Change Management involves identifying, selecting, and evaluating new technologies, and incorporating effective technologies into the organization. The objective is to improve software quality, increase productivity, and decrease the cycle time for product development.

2   THE FIELD OF IT OF REPUBLIC OF MOLDOVA

In accordance with the OECD definition, 2007, the information technology is a part of Information Technology and Communication Sector, as also electronic communications (EC), the production of ITC equipment and commercialization of ITC equipment.

The imperfection of national statistical systems doesn't allow following up the evolution of quantitative indicators. Estimation made by regulatory organs show that in 2008, the turnover of the IT industry was estimated at 184.7 million lei. Thus, during 2006-2008, the turnover of IT industry has grown 2.8 times. During the period 2003-2008, the export volume of software products has increased 10 times, from 1.2 million up to 26.3

million U.S. dollars. This increase is a result of incipient public policies aimed at supporting the development of the ICT sector. According to ANRCETI (National Agency for Regulation in Electronic Communication and Informational Technology) in 2009 the agency give 36 license for service providing in the field of elaboration, maintaining and implementation of software, equipment an informatics systems, and 35 licenses for service providing in the field of designing, elaboration, implementation of automatic informational systems and resources with state impact (data base creation and using and services of information delivering) and services of their functioning insure.

On other hand, the expenses for IT in 2008 was about 833 million lei, showing an increase of 228 million compared to 2006. The structure of IT spending show the growth of advanced software purchases (23% of total spending); it has increased 2,5 times compared to 2006. The growth is due to the raise of licentiate software using. Last survey of Business Software Alliance (BSA) on pirate PC-software show that the share of illegal used software decreased from 96% in 2006 to 90% in 2008, and was about 40 millions dollars SUA. The illegal use of software limits the industry development and reduces considerably the IT market.

It is important to mention that IT expenses per capita are only 20 dollars, compared to the average of 725 dollars per capita in the UE.

In conclusion, we can mention that the IT sector is a relatively young sector for the republic, it is developing dynamically, but its potential is used insufficiently. The requirements of UE to respect copyright in order to use licentiate software, the estimation made by regulatory organs and the experience of foreign developed country show that the sector of IT has a great potential, which can be capitalized also by using properly technological changes management.

3   ABC-SYSTEM AS A TOOL FOR TO EFFICIENT THE PROCESS OF TECHNOLOGICAL CHANGES AND DEVELOPMENT OF IT-ENTERPRISES

As we mentioned in the theoretical framework change management can refer to managing changes made in ongoing companies, by introducing different tools and instruments, as to assure the implementing of change in other organization, as consultancy. At the moment, the IT

companies should take into consideration that if they want to be competitive on the market they should be very receptive to market change in order to use it in their activity in one hand and in other hand to be able to provide changes in partner companies. The technology used by IT-companies are success factor for their market position, but often the cost of the implementation and ulterior transfer to final products are non-defined. The specific of IT companies consist in the difficulty to estimate the direct and the indirect cost of elaborated software, due to the running in the same time of some projects. Other observation is that local IT companies are not only elaborating software program, they offer and other services as maintaining, implementation, functioning insure. IT companies don't have a cost system to calculate the product cost. Almost IT-companies have an accounting who is registering all costs made by the enterprise, so we can conclude that the cost system is the only evidence function. In this condition IT-companies doesn't know the real costs of their products.

As we mention the tendency is to increase the export of software products, which suppose that their product should be competitive on foreign market. To be competitive on the market means to be the best by assuring finest rapport cost-quality. In this order of ideas the cost of product/service became one of important variable in the client decision making process.

So, in order to improve cost calculation of final products, of maintaining, implementation, functioning insure service and to capitalize the tendencies of growing export it is necessary to improve cost systems of IT-companies. Modern cost system should offer relevant information for decision making, but in the same time it should register all process cost, so we can speak about integrated systems. Integrated cost system is an integrated cost management and financial reporting which allow getting all the needed information for cost decision in correspondence with the overall objectives of the company. One of the instruments of integrated system is the ABC (Activity Based Costing). Activity based costing is based on the following ideas. Firstly, designing, producing and distributing products and services requires many activities to be performed. Performing these activities requires resources to be purchased and used. Purchasing and using resources causes costs to be incurred. Restated in reverse order, the ABC logic is that resources generate costs, activities consume resources and products consume activities. Thus, a company's activities are identified, then

costs are traced to these activities (or activity cost pools) based on the resources that they require. Then, costs are assigned, or traced from each of these activity cost pools to the company's products (or services) in proportion to the demands that each product (or service) places on each activity. In ABC, a measure of the relevant activity volume is used to trace each type of costs, rather than exclusively using measurements (or allocation bases) related to the volume of the products or services produced. Using this logic, ABC tends to solve the problems created by traditional cost (figure 1)
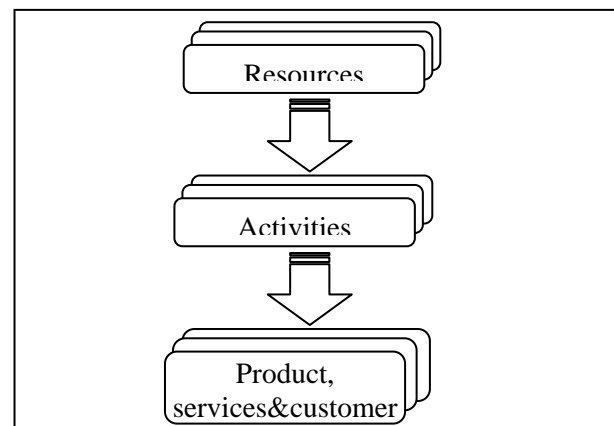
Figure 1. Cost assessment based on ABC-logic.

ABC systems was designed by Cooper and Kaplan, in the 1988 in a series of articles, they conceptualized the ideas of ABC for manufacturing companies which were confronting with the enlargement of production line, raising of indirect costs, wrong decision due to incomplete information for process making. For the begging, as Cockins mention, it was used as a superior product and service costing technique. Also he said that ABC removed the grotesquely distorting effect of broad-brushed overhead allocators, like labor hours or sales dollars. It replaced cost allocations with substantially more realistic cost assignments and consequently much greater accuracy. In the 1990s, managers discovered that the same data they generated to recompute their ABC product or service costs could also be used to gain better insights and manage their product design and process design costs. It could also be used for performance measurements that align with business processes.

In 1998 Cooper and Kaplan argued in a series of articles that service companies are the ideal candidates for ABC. Their justification was that most of costs in service organization are indirect, fact confirmed and by our IT company experience. Service organization must also supply most of their

resources in advance. Until recently many service organizations were either government owned monopolies or operated in a highly regulated, protected and non-competitive environment. These organizations were not subject to any great pressures to improve profitability by identifying and eliminating non-profit making activities. Cost increases could also be absorbed by increasing the prices of services to customers. Little attention was therefore given to developing cost systems that accurately measured the costs and profitability of individual services. But situation change, and the crisis of last years imposes the company to pay more attention to their product, to reconsider their financial statement in order to maintain desired profitability.

ABC systems rely on a greater number of cost centers and second stage cause-and-effect cost drivers. ABC systems provide more meaningful decision making information because they recognize that many of the so-called fixed overhead costs vary in proportion to changes other than production volume. By identifying the cost drivers that cause costs to change and assigning costs to products on the basis of cost driver usage, costs can be more accurately traced to products. This cause-and-effect relationship provides a superior way of determining the relevant costs.

An ABC system involves the following four stages:

1. identify the major activities which take place in an organization;

2. create a cost centre/cost pool for each major activity;

3. determine the cost driver for each major activity;

4. trace the cost of activities to products according to a product's demand (using cost drivers as a measure of demand) for activities.

In the following will try to explain in a basis of simple process the application of ABC-system.

Key problem: The client of company X wants to improve existent software, which was early developed by company X, in a period of 6 months. He wants that improvement to be done by the same team, in order to reduce errors. The team is already involved in other different projects; but the company doesn't want to lose its client. In this case it is important to evaluate how much will cost this project, and will it be profitable for the company if our client offers 30 000 valor units.

The manager decided to take into consideration the client offer, and create a work team (table 1).

Table 1. Project Team.

The function	Persons	Monthly Salary, v.u.	Cost/hour, v.u.
Team leader	1	700	4,3
Developer	3	500	3,12
Designer	1	500	3,12
Tester	1	450	2,8

In the team 2 persons will work only on this project, and others will be implied partial at project: one of them will be working for 6 moths by 4 hours per day, one of them will be only implied for 2 months (figure 2).
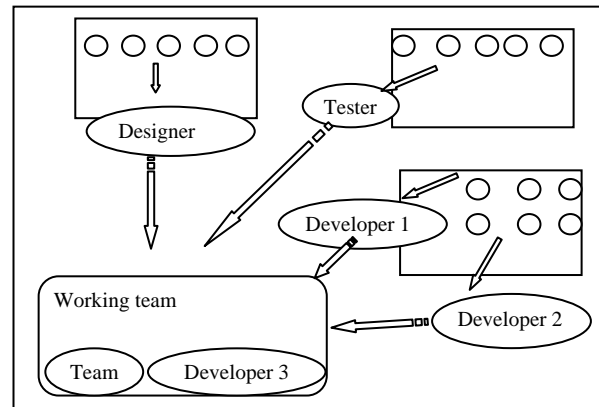
Figure 2. Working team

We have determined main activities in the process of soft were improving: project management, design, soft elaboration, testing. As cost driver was taken the indicator of man-hours needed for each activity. After resources evaluation, the costs were assigned. (Table 2)

Table 2. Costs of used equipment.

Equipment		Quantity	Price/unit, u.v.	Total price, u.v.	Depreciation (20% per year) annual	Depreciation (20% per year) per hour
PC	Dev 1	4	600	2400	480	0,23 (0,06)
	Dev 2					
	Dev 3					
	Tester					
Notebook	Team Leader	2	750	1500	300	0,15 (0,075)
	Designer					

Chairs	6	110	660	132	0,07 (0,0117)
Tables	6	150	900	180	0,09 (0,015)

Activity	Depreciation per hour, u.v.
Project management	0,1
Designing	0,1
Programming	0,087
Testing	0,087

Administrative expenses were evaluated taking into consideration that in the company work 80 persons on a estimated period of 6 months. (Table 3)

Table 3. Administrative expenses.

Administrative expenses	UM	Monthly quantity	6 months consume	Unit price (u.v)	Total (u.v)	Expences /men* hour (u.v)
Electric Energy	kW	5266,6	31600	0,1	3160	0,04
Thermo energy	-	-	-	-	4670	0,056
Rent	m²	500	3000	15	45000	0,56
Security	month	1	6	500	3000	0.037
Clean services	month	1	6	250	1500	0.018
Internet	month	1	6	200	1200	0.014
Water	m²	21	126	0,5	63	0.0008
Total, men* hour	**0.7258 u.v**					

Overall expenses was evaluated and there are presented in table 4.

As we can see the revenue of the company from this activity will be 30000-17080,2=12919,8 (u.v). Using ABC we distribute indirect costs on the basis of man-hours as cost-driver.

4.   CONCLUSIONS

Actually, to change mean to be the promoter of innovation and to gain benefits from it. The innovation supposes to make supplement costs, and we need a proper system to allow costs to final products. The used system at the moment doesn't allow to evaluate and to transfer correctly the costs.

We've argued that the ABC- system offered all needed instruments to calculate properly the costs of products and services.

Table 4. Overall expenses by activity.

Activity	Men* hour	Direct cost		Indirect costs (depreciation)	Administrative expenses	Total
		salary	foods			
Project management	992	4265	620	99,2	720	5704,2
Designing	320	998	200	32	232.3	1462,3
Programming	1763	5500	1102	153,4	1280	8035,4
Testing	444	1243	277,5	35,5	322.3	1878,3
Total	**17080,2**					

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CREATING CONSULTING SERVICES IN MOLDOVA: CASE STUDY CAA/PROCONSULTING

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INTRODUCTION

Business environment is in permanent changes that influence enterprises to catch every opportunity in order to be competitive on the market. Very often enterprises don't have enough knowledge and experience to use those opportunities. In this case the consulting companies can help them to get more information and abilities to become more active in organizing their business, managing changes of business processes. Professionals appreciate a lot programs that develop multilateral managerial skills, as capacities to analyze commercial situation, financial figures, abilities to organize teamwork and effective communication, decision making skills and solution providing in a wide range of managerial activities corresponding to the company needs and constantly changing business environment.

But the consultancy services in Moldova also are still under developed. Until now it has been dominated by 3rd party (donor) financed projects aimed at economic development and social development. The commercial market for management consulting services is starting up slowly with services rendered by (international) consulting firms to the largest 150 companies in the country and small engagements to small and medium sized companies in relation with different problems such as elaboration of the business plan to obtain credit, how to set up a cost or financial management, how to manage marketing activities. To support our opinion that the implementation of changes in the companies will facilitate development of the consulting market we used study case approach. In order to argue our judgments we took the experience of a consulting company that started its activity under the donor projects.

CCA/Proconsulting has been quite successful in the past 7 years. Now the company is at the threshold of a new development phase and should prepare itself to participate in the anticipated changes in the need for professional services in the coming years both in donor financed projects and in commercial engagements for the private enterprises.

The Managing Director is seeking advice how to anticipate the growth demand in the market for professional services and in particular he needs changes in the company strategy, the development of a commercial strategy and the translation of these new directions into internal organizational consequences such as requirements for streamlining the consulting process, the internal organizational structure and the staffing of key positions.

Before being able to make conclusions on how the business environment influenced the entrepreneurial behavior and adequately the consulting services, we had to become familiar with the ins and outs of the company and how the organization is operating in the market. Therefore a business review, including the analysis of the situation has been carried out. During the assessment we spent time in getting acquainted with the company's activities, results and achievements to date, met with all the people in the organization.

We also tried to get more familiar with the market for management consulting in Moldova by studying the available market information and data on the various competitors and met with representatives of various organizations active in professional services, business development and trade relations in Moldova. Thereafter we have worked with the Managing Directors and key people to discuss on how they see the changes in the strategy, business development, marketing and promotion and the internal organization of the consulting process and, in general, in the life of the consulting companies.

1. MARKET DEVELOPMENT AND MARKET POSITION

Moldavian consulting market still is in an early stage of development. Most consulting related services will for some time be dominated by donor financed projects. Areas of major interest are training on management, marketing, financial management, organizational development. Changes

in country and regional business environment and legislation, preparation for the implementation of the Free Trade Agreement with EU will drive the future needs for professional consulting services, in the beginning mostly provided by foreign international consulting firms in combination with local consulting partners.

Later on the process will be continued with local consulting companies that have gained experience in cooperating with foreign international firms. These local companies have gained experience by working together with international firms and have created a quality profile, which is essential in developing credibility with local industrial and non-industrial companies to become an important services provider.

Amongst around 150 consulting firms and NGO's are providing consulting related services in Moldova. Out of these 150 companies/firms around 15 are comparable with the type of portfolio the CCA/Proconsulting company has. Apart from four or five companies (Business Consulting Institute, Business Intelligent Services, Acsa, Agro Info) most of them are smaller, have a shorter track record and not such developed reputation. Big four audit international firms (Price Waterhouse Coopers, KPMG, Deloitte and Touche and Ernst and Young) are all bigger than the Moldovan consulting firms, but they, at the moment do any consulting work. This will rapidly change.

CCA/Proconsulting has a sound track record, a very good reputation with their beneficiaries, donors, banks and parties familiar with the company, particularly in rural development and agriculture, but also in implementing big development projects.

That reputation to a large extend is limited to the company's capabilities in facilitating obtaining loans and credits via the development of business plans and taking care of the related formalities in finalizing such procedures. It is clear now that this small portfolio basis will no longer provide for any guarantee for continuity for the company and thus a further analysis has to be made what kind of services, close to the firm's key competences can create better prospects for the future.

2. HUMAN RESOURCES

The status of HRM in the company is typical for a still relatively young owner managed business in a developing environment. Thus not much structure, little formalized systems and

structures, no job descriptions, no structural performance evaluation etc. and implementation of good ideas failing because of daily pressure of the business. Apart from one situation 2 years ago the labor force has been rather stable. Population currently consists of young (un-experienced) bright individuals who are eager to learn, but need guidance and direction. Staff positions in Finance, IT and Office management are well filled and the organization receives above average support.

The company is very weak in business development, marketing and sales and currently totally depends on the efforts made by the Managing Director. Not without success so far, but the environment is changing and this requires a quite different approach.

Training is envisaged by everyone, but is hardly ever taking place. As is the case with personal goal setting and defining objectives for people that go beyond their immediate tasks, which would direct them towards a contribution to the development of the organization as a whole. In the absence of any regular evaluation of the professionals' contribution by the Managing Director this is not felt to be a problem by the consultants, but it is for the Managing Director who would like to see the consultants to take much more responsibility and initiative.

Short communication lines are in place but the exchange of job related information is limited. Company wide information is seldom provided. Remuneration and motivational systems are considered to be very important to get and keep people involved and let them work hard and disciplined. However compensation systems are connected to individual output targets in projects and not to contribution of development of the company.

The terms of employment, particularly the variable part of compensation of an individual is therefore project related, which creates difficulties when the project is ended and no money is available to continue "motivational" payment.

3. ORGANIZATION AND CULTURE

The organization is formally split in two legal entities, but informally operates as one entity. And with reason as there has been quite some synergy to date. The organization structure is flat with ambitious young professionals and limited career opportunities. The familiar hierarchical distance between individuals in an organization formerly run in a communistic country (risk

avoidance, lack of initiative, lack of speaking up and taking risks) is still there, even within this young and ambitious group of people. The sense of being part of a (business) community is not very well developed, because the Managing Director as the leader in the organization has not consciously taken any actions to change the culture. Consequently people feel more committed to the work/project than to the company. Loyalty to the company and/or the shareholders is almost nonexistent.

4. OPERATIONS

Engagement and project management is rather individually determined. Basic registration and administration rules are in place and followed. Financial control of engagements with head of departments and regular reporting to top management is executed properly. Quality control exists but is not formalized in rules and procedures. Working paper files, client files and beneficiary files exist but are individual and not formalized in standard working paper files and in line with professional requirements. Engagement management is at the level one could expect from an organization in this stage of development. Moving on to the next stage requires upgrading of internal procedures, quality control and making processes transferable to newcomers.

Available office space does not allow for any further growth. Current use is already beyond maximum limits (need is there for meeting room, extra workplaces, interview rooms and training facilities).

5. FINANCIAL MANAGEMENT

Financial management is the responsibility of the Managing Director who is aware of all relevant details and is on the ball, concerning all financial matters. Appropriate automated accounting systems are in place. Reporting is up to date and on time. The systems seem adequate to cope with the different requirements for NGO projects and commercial business. Lucrative and creative solutions have been found and implemented to cope with legislative issues. In general the financial control over the company is rather sophisticated, considering the stage of the company's development and the local comparisons that can be made with similar organizations.

SWOT Analysis

Strengths:
- on top level sound network with influential people with donors, banks, government;
- good reputation, fine track record in deliverance of big projects;
- known for Financial Management expertise;
- developed internal organization, language skills.
- finances available for investments.

Weaknesses:
- on average limited experienced professionals in a narrow field of expertise;
- lack of business development marketing skills;
- limited sales capacity in specialized field (rural area, credit.);
- lack of setting priorities and direction and rigid follow up of execution (getting results).

Opportunities:
- emerging consulting market;
- large companies first;
- growing funds from EU, EBRD, bi-lateral for Institution Development, Management Training, and foreign investment projects;
- emerging consulting market with medium sized companies, particularly for practical Finance related services (accounting and bookkeeping);
- growing market for recruitment and selection (HRM) services;
- subcontracting and cooperation agreements with international consulting firms (language and culture).

Threats:
- inability of potential clients to pay for services;
- lack of interest with foreign companies to invest in Moldova;
- inability to acquire top level professionals with adequate commercial attitude and skills;
- failure in bringing workforce up to speed; knowledge, attitude, commercial and business orientation.

CONCLUSIONS AND RECOMMENDATIONS

The company has done surprisingly well taking into account the difficult business and legislative environment under which the organization had to be build up from scratch. With a good feeling for entrepreneurship the shareholders have in a balanced manner taken initiatives that have lead to a financially healthy organization that now will have to develop and invest in order to

participate in the gradually growing market of diversified consulting services.

Major fields of concern are the following:
- lack of clear direction (strategy, portfolio);
- business development capacity and capabilities;
- organizational development and culture;
- staffing key positions;
- office space/accommodation.

During the work we come up with a new and rather ambitious vision&mission for the company that has been basis for further developed recommendations: *Through our solutions we add value to our clients' businesses and help them grow their business and market share.*

In ten years the company tends be the a leading consulting firm in Moldova offering a wide range of specialized services, some of them organized in separate business units, some of them in separate legal entities. Services and related solutions will be rendered to small (start-ups), medium sized and large companies.

The company sized, about 100 professionals, will be active on the not for profit and the commercial market. Not for profit will be covered by a small, but highly qualified and commercially successful NGO that will operate as the foremost fundraiser and project management entity in the Moldavian market for 3rd party financed projects. The commercial market will nationally and internationally be covered by a highly skilled consulting firm with a balanced workforce of young, older and seasoned professionals with an outstanding reputation in the market place. The consulting firm will operate as subcontractor for the NGO, but will also acquire (commercial, private and public) consulting projects independently, and might also operate under the flag of other NGO's and will solely provide services to organizations and companies and not to individuals.

Key to the success of the combined firms are and have been commitment to deliver top quality service, a proactive development and business attitude, an innovative climate and culture where people are challenged to continuously seek for new and surprising solutions for our clients' problems and develop themselves, a strong commercial business orientation and above all the attitude to enter into a true partnership with all our clients, small, medium sized and big.

A new organizational structure was proposed, which has lead to numerous recommendations in the field of Human Resources Management, Organization and Culture, and the change management aspects relating to the implementation of a new organization, with new activities, carried out in a different manner and requiring a complete different attitude from all people involved. Also it was proposed that CCA and Proconsulting legally should be separated but operationally closely together to maintain synergy.

The given conclusions resulted in the following portfolio recommendations:

CCA's (Business Advisory Center NGO) services portfolio concentrates on:
- Business Development in: Tourism, Agriculture/Trade, Public administration;
- Career Management e.g. in: Career Counseling, Training, Professional orientation;
- Tourism and Infrastructure.

Proconsulting will focus on the development and sale of professional services in the following domains:
- Investment Consulting, incl.: Business planning, Market research, Legal and Tax ,Partner Search, Credit/Loan brokerage;
- Financial Management, incl.: Financial analyses/Financial Planning, Cost reduction programs, ABC, Budgeting systems, Accounting and bookkeeping;
- Information Technology, incl.: Software development for financial analyses and planning, Standard packaged software sales;
- Human Resources Management in the longer term incl.: Recruitment and Selection, Search, Change Management, Reorganization and restructuring;
- Management Training in-company and open market: Management skills, financial management;

Based on the outcome of the assessment a business development plan has been recommended for the most urgent development areas, including necessary promotional actions, responsible jobholders and an indication of the required time input per identified action.

Larger and more diversified company now needs further formalization of functions and responsibilities in job descriptions and in compensation schemes and structure. Function structure: Junior Consultant; Consultant, Manager; Director, Partner.

Goals and objectives of senior professionals should partially be related to the contribution of the jobholder to the organization and should promote cooperation within the organization between units. Compensation should be linked to final results of the company and the contribution the own unit is making tot that result. Compensation is build up from fixed basis salary, yearend bonuses and profit sharing.

Internal communication should be intensified (Flash news via the network, monthly company meetings, internal training courses, possibility to have lunch together, etc.)

Individual training plans should be developed and implemented. Individual goal setting, performance evaluation, coaching and counseling must be started up, two formal performance evaluation meetings per year, one with supervisor and one coaching/counseling session with Managing Director, well-structured and administered. Remuneration system has to be altered. The individual contribution should have a more direct relationship with a contribution to the development of the total company. Not only quantitative targets but also qualitative.

HRM is line management responsibility, final responsibility lies` with managing director, possibly supported operationally by staff member. New way of goal setting and performance evaluation and counseling and compensation structure will be nothing less than a culture shock. Senior Management has to manage this revolution in change of attitude. Further growth of workforce in line with development of the changes in business, particularly in Accounting services, Investment Consulting and Financial Management. Establishment of business links with consulting firms in the west is crucial for the company's future.

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MICROPROCESSOR VERIFICATION BY SYNTACTICALLY-CONTROLLED GENERATION OF THE TEST PROGRAMS

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INTRODUCTION

Random (stochastic) test generation is an actual up-to-date direction and efficient technique for simulation-based verification of large complex hardware (digital) designs such as microprocessors [1,…, 9]. From one hand, there exist sophisticated verification tools for generation, including controlled, random tests, which are used for functional verification of processors [10, 11, 12]. From the other hand, it is proposed to add specific language constructs to HDL to keep the randomization features [13, 14].

An important issue is the evaluation of the effectiveness of random test verification methods. A variety of coverage metrics have been proposed: the branch coverage and path coverage [15, 16] models used in software testing [17], finite state machine based metrics [18,…, 21], an observability metric [22, 23], and design-specific metrics such as architectural events [1, 24].

The predecessors paid more attention to development of the tools that help the user to control the process of test programs (TP) generation. Till now the generalized model of estimation of the test programs quality is not yet developed. Our objective is to make an advance in developing the estimation of quality and the controlled synthesis of the test program generator (TPG).

In this paper it is proposed the approach, called *syntactic* (keeping tradition in [25]), where the structure of stochastic grammar defines the controlled languages constructs for weighted random test generation. The structure of grammar is "restored" from the microprocessor (MP) specification just from the instructions set specification and the interface protocol description.

Here it is used the existing HDL languages (namely VHDL) features for implementation of the proposed methodology. In the next section of the paper the mathematical model for quality evaluation of the controlled random test generation is proposed. Then, in section 2, briefly is presented the unit under verification, and in sections 3, 4, and 5 is presented the methodology of synthesis of the (stochastic) grammar generator for simulation-based

verification of a simple microprocessor. In Section 6 the results of microprocessor test benches simulation are presented and analyzed. The paper ends with some concluding remarks and ideas about future development of controlled random testing for verification.

1. THE LENGTH OF RANDOM TEST VERIFICATION

To compute the test length we take into account the tools (simulation coverage Report) of evaluation of the simulation coverage measure in a widely used CAD-system such as Quartus II from Altera. This "estimation" is based on computation of percentage of exercise (flip-flopping) of the design's nodes, more exactly, is checked as the ratio of output ports actually toggling between 1 and 0 during simulation, compared to the total number of output ports presented in the netlist.

Let us p_e is the probability of exercising of node e on feeding of a test pattern to inputs of unit under verification (UUV). So, the probability $P_e(l)$ of exercising of node e on feeding l test pattern is equal to

$$P_e(l) = 1 - (1 - p_e)^l, \qquad (1)$$

where $e \in E$, E is the netlist of design.

For the small values of p_e results the inequality:

$$1 - (1 - p_e)^l \geq 1 - \exp(-l \cdot p_e) \qquad (2)$$

Accepting λ as the level of confidence (vs risc) of the random test verification of length l, i.e. $P_e(l) = \lambda$, from (1) and (2) is follows:

$$l \leq \frac{1}{p_e} \ln \frac{1}{1 - \lambda} . \qquad (3)$$

For computation l the level of confidence λ and the probability p_e must be known before. For example, if the values of λ are equal to 0.632; 0.865; 0,95; 0,982 etc., then values of random test length are: $l = 1/p_e$; $2/p_e$; $3/p_e$; $4/p_e$ etc.

It is easy to prove that the formula (3) is valid also if the path coverage metric is used. The value (3) is an apriori estimation of the verification test

length *l* and is well correlated with experimental data presented in referenced bibliography.

Thus, we obtain a theoretical model of estimation random test verification quality. But, any theoretical model must be approved practically. In the further sections of the paper we develop the syntactic model of random generator for microprocessor verification. Some verification experiments will be performed and the resulted test length will be compared with expected one.

2. BRIEF PRESENTATION OF UNIT UNDER VERIFICATION

The considered unit under verification is a 4-bit microprocessor slice AM2901. Its full VHDL description is available from [26]. Figure 1 depicts the AM2901 microprocessor as a gray-box. Slice-MP contains the following functional units: two-address RAM array RAM_Regs, the one-word shift register Q_Reg, the source operand multiplexer Src_op, the arithmetic logic unit ALU that performs three arithmetic operations and five logic functions of two 4-bit operands, the output multiplexer Out_Mux. The **a** and **b** 4-bit addresses are used to address the RAM_Regs 16-word register file, where size of the word is equal 4 bit.

Signal **d** is a direct input to the **r** source operand multiplexer. Signal **q** represents the contents of Q_Reg and feeds the **s** to source operand multiplexer. The ALU has carry-in c_{in}, carry-out c_{out} and other additional signals.

The function of MP-slice is defined by a 9-bit microinstruction *i*. Three bits *i*[2:0] define the source operands, *i*[5:3] – ALU function, and *i*[8:6] – ALU destination.

Thus, the stimuli are the signals and instructions with predefined structure (syntax). This
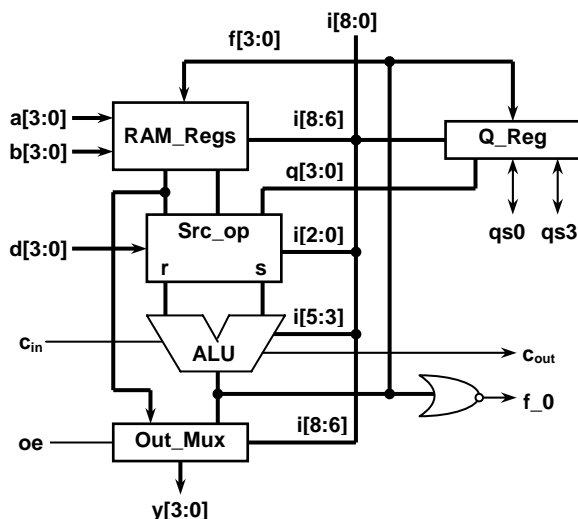
Figure 1. AM2901 block diagram.

property is common for all microprocessors. So, further analysis can be extended to general case.

3. PROPOSED TECHNIQUE

In the study case there is no limitations on the syntax of generated test sequences. But the instructions must be arranged under a certain rule. The objective of test generation process is the synthesis of test (micro)programs with a specific syntax. From this point of view some instructions load the data in the memory's elements, others - process or/and unload the data from them.

Thus, the rule of composition of the test program structure can be formulated by the next paradigm:

> "*data load → inherently data process → unload (and analysis) of results*".   (4)

The rule (4) expresses the semantic aspect of the objective of random test programs generation. In the other words, rule (4) reflects the stochastic generation process of test programs with data dependency and can be accepted as a link between functional (behavioral) model of the MP [31] and rules of construction of TPG, proposed in [29].

More sophisticated type of dependences can be introduced: *primary*, *data*, *instructional*, and *functional*. Primary (structural) dependence defines the syntax of instructions. Data dependence appears when is needed to set up the transition of data between the instructions. There are 3 types of data dependences: read after write, write after read, and write after write. Data dependence frequently occurs in pipeline design. Instructional dependence defines the link between MP specific instructions, e.g. push-pop, loop-exit, call-return, etc. Functional (behavioral) dependence is established by an experienced designer on basis of his knowledge of behavior of the design entities (modules).

To provide the condition (4) let us represent the component parts of instruction, i.e. ALU functions and operands, by a graphical images (pictograms). The pictogram of component consists of terminal and internal nodes that represent the elements of memory (registers) and ALU functions (symbol ∗). There are 8 ALU source+function pictograms: s0..s7, and 8 destination pictograms: d0..d7 (see Tables 6-1, 6-2 and 6-3 in [26]). The arcs mean transition of data. The zigzag-arc means selection of the RAM word.

The pictograms are connected ("glued") by suitable terminal nodes (like in puzzle-game). The gluing of pictograms is performed in the following way: source with destination creates an instruction

structure (word in the sentence), and resulted structure is connected with another instruction
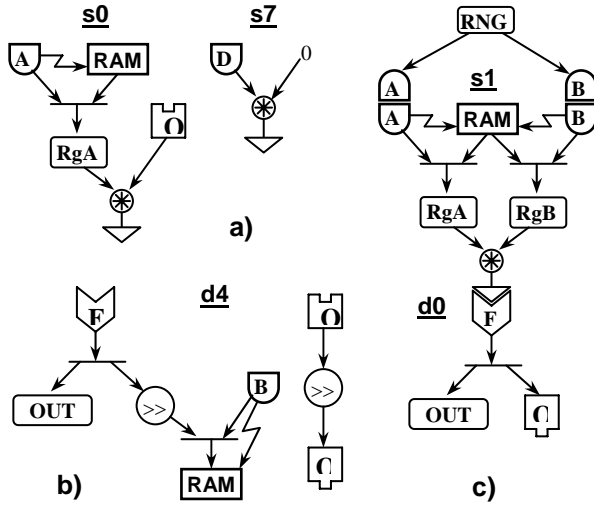
Figure 2. Pictograms of AM2901 μ-instructions: (a) source operand and ALU function, (b) ALU destination, and (c) example of "gluing" pictogram.

structure, thus "building" a sentence, i.e. test program. This process can be executed recursively. All connections are performed according rule (4). Some typical pictograms and a fragment of glued pictogram are shown in figure 2. The node RNG in figure 2, c) means a random number generator.

Introduced pictograms can be used prototype for wizard tools of automation of synthesis of the test program stochastic generator. This illustrative representation of the structure (syntax) of generated sequences is an intermediary step for jump to formal synthesis of generation grammar of the random test programs.

4. SYNTHESIS OF THE TEST PROGRAM GENERATOR

The technique of synthesis of the syntax test generator, inclusively generation of random test cases, is well known for compiler testing [27,28]. The test cases generator is controlled by programming language syntactic diagram (SD). And the SD is needed for a MP to generate the syntactic correct test programs. But the MP specification doesn't have such SD. Many efforts must be made to construct (synthesis) a syntactically (and, may be, semantically) correct model of the random TPG [29]. But in our study case the MP is a simple one. Accepting the rule (4) and assuming the degree=2 for data dependence it was synthesized the random syntactic tree, shown in figure 3.

In the figure 3 callout !(..) mean equiprobable generation of item and the non marked fan-out branches have uniform probabilities.

A stochastic grammar can be associated with this tree. A grammar is defined by a 4-tuple $G=(V_N, V_T, R, S)$ where V_N and V_T are nonempty sets of terminal and nonterminal symbols, respectively. The symbol S, $S \in V_N$ is called the starting symbol and $V=. V_N \cup V_T$ is the vocabulary of G. The finite nonempty set R of $(V^* V_N V^*) \times V^*$ is called production rules. In a stochastic grammar G_s with each production $\alpha_i \rightarrow \beta_{ij}$ is associated a probability p_{ij}, where α and β are strings of symbols over the vocabulary, $0 < p_{ij} \le 1$, $1 \le i \le k$, $1 \le j \le m_i$, $\sum_{j=1}^{m_i} p_{ij} = 1$.

For the study case we have the next stochastic grammar G_{St}:

$$V_N = \{S, A, B, C, D, E, F, H, Z\}$$
$$V_T = \{s0,\ldots,s7, d0,\ldots,d7, 0,\ldots,7\}$$
$$S = S$$
$$R = \{ S \xrightarrow{p_{SA}} d3'0's7, \; S \xrightarrow{p_{SB}} BOC,$$
$$B \xrightarrow{1/7} s0, \; B \xrightarrow{1/7} s1, \ldots, B \xrightarrow{1/7} s6,$$
$$O \xrightarrow{1/8} '0', \; O \xrightarrow{1/8} '1', \ldots, O \xrightarrow{1/8} '7',$$
$$C \xrightarrow{p_{CD}} d0DC, \; C \xrightarrow{p_{CF}} FB, \; C \xrightarrow{p_{CH}} HS,$$
$$C \xrightarrow{p_{CZ}} d1S, \; D \xrightarrow{1/2} s2OC, \; D \xrightarrow{1/2} s6OC,$$
$$F \xrightarrow{1/4} d2, \; F \xrightarrow{1/4} d3, \; F \xrightarrow{1/4} d5,$$
$$F \xrightarrow{1/4} d7, \; H \xrightarrow{1/2} d4, \; H \xrightarrow{1/2} d6 \}. \; (4)$$

The synthesis of TPG is reduced to definition of generator grammar production rules. The syntax of grammar (structure of TPG) can be synthesized (builded), for example, by the top-down recursive
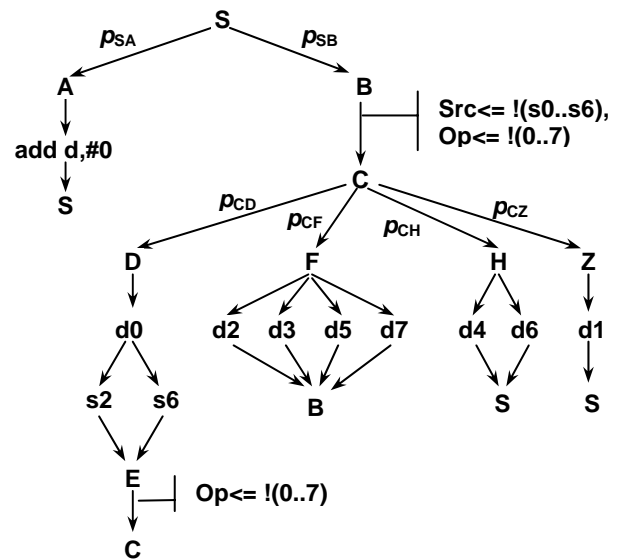
Figure 3. Probabilistic syntactic tree for generator of AM2901.

descent parsing method, analyzed in [29]. The syntax of grammar should guarantee that the derived TP would always be valid.

The repartition of probabilities $P(R)$ on rules of set R is called syntactic style [30]. In accordance with Chomsky classification the grammar G_{St} is of type 2, i.e. is noncontextual (context-free). The grammar G_{St} defines the structure of the random (weighted) test program generator for verification of the AM2901 slice-MP. In the HDL language, in particular VHDL, is needed to have the corresponding mechanism to produce a sentence in grammar G_{St}. Also note that some transition probabilities have the predefined values and another probabilities, such as $p_{S(\bullet)}$ and $p_{C(\bullet)}$, are undefined. The undefined probabilities will be defined later.

5. WEIGHTED CASE STATEMENT

The weighted case statement differ form the classical one by that in accordance with predefined repartition of probabilities the selector variable get a value from the sample of numbers. It is obvious that the existing linguistic tools can emulate such weighted case. To do this, initially is needed to generate the value of selector, then, after this, to jump on the corresponding variant.

5.1. Model

The model of weighted number generator is the probabilistic binary tree (P-tree). Figure 4 depicts the binary tree of code of a 2-bit number and corresponding to it P-tree. The probability of an outcome is the product of the probabilities on the path from the root to the vertex. Starting from the known repartition of the probabilities on vertex (leafs) of the P-tree it is easy to restore the
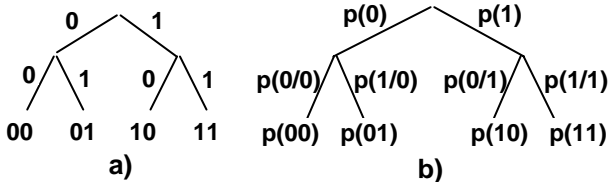
Figure 4. Binary (a) and probabilistic (b) trees of the 2-bit number.

conditional probabilities on each tree's branch.

From the practical point of view it is more suitable to represent the P-tree by a weighted binary tree (W-tree). In this case the weighted choice of a bit value consists in performing of one VHDL-statement:

if Weight> LFSR then return('1'); else return('0'); (5)

where LFSR is a state of the linear feedback shift
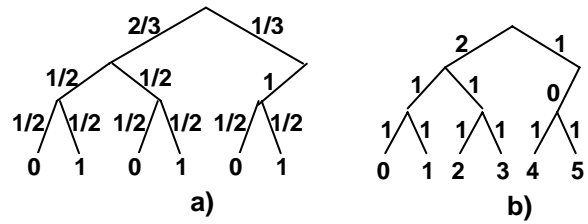
Figure 5. P-tree (a) and W-tree (b) of equiprobable generation of numbers from 0 to 5.

register of size n, $0 \le$ Weight $\le 2^n$-1

5.2. Implementation

The weighted generation of a number is based on recursive execution of statement (5). For example, if it is needed to equiprobable select of a number from 0 to 5, then the corresponding P-tree and W-tree will looks as it is shown in figure 5. Note that the arcs of W-tree in figure 5 (b) are labeled by the *relative* weights.

On implementing the W-tree, each of its level is coded by a string of weights. Because each fan-out node contains the complementary probabilities then the i-th string contains 2^i weights, namely weight of the right branch, where $i= 0,…,r-1$,
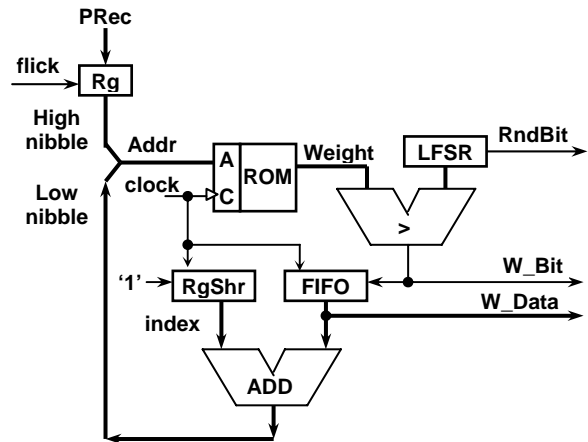
Figure 6. Block diagram of the weighted number generator.

$r=\lceil \log_2 N \rceil$, N is the maximum value of the number. The resulted record of strings is stored in the (RAM) array from where the weights are conditionally read. Thus, was described the (recursive) weighted number generator (WNG) unit, which diagram is shown in figure 6.

The behavior of WNG-unit is the following. Let be the W-tree shown in figure 5, b) and size of

LFSR equal to n=10. So, the corresponding record of weights is:

$$\textbf{levels} \begin{cases} \textbf{0:} & \textbf{341} \\ \textbf{1:} & \textbf{512,} \quad \textbf{0} \\ \textbf{2:} & \textbf{512,} \quad \textbf{512,} \quad \textbf{512,} \quad \textbf{0} \end{cases}$$

which is written in the ROM as **PRec**=0, where **PRec** points to the base address of a record.

Functioning of the WNG-unit starts with flicking the feeding value of the PRec, that is the high nibble(pointer to) of the record address. Also, the flick signal reset the shift registers RgShr and FIFO. The register RgShr indexes the string in the record: 0, 1, 3, 7 etc. The register FIFO indexes the relative address in the string. The sum of RgShr and FIFO contents form the low nibble of the weight absolute address in the record.

On the clock rising edge the first weight 341 is read from ROM. The comparator (>) applies the rule (5) and compares this weight with the LFSR state. The returned value of the W_Bit is stored in the FIFO. Next weight that can be read is 512 or 0. After r clocks of time FIFO will contains the resulted binary code W_Data of the number. This number will be the value of the case statement selector. The RndBit is a logic value, '0' or '1', generated with the probability 1/2.

In such a way can be generated the number with an arbitrary distribution of the probabilities. The discrepancy between the expected distribution and the one resulted from W-tree model (or generated by WNG-unit) will depend on the measure scale, i.e. on the weight (the same LFSR)

Figure 7. Block diagram of the concurrent WNG.

size (but this problem is the subject for another discussion).

In our implementation we have designed the concurrent (one-shot) version of the WNG unit as well. Figure 7 depicts the scheme of the concurrent weighted number generator (CWGN), which implements a three-level W-tree. On the clock edge the weights $w_{10},\ldots, w_{33}$ are read from ROM and are compared with states of the general linear feedback shift register (GLFSR). GLFSR contains the shift register with n-bitwise cells [32]. Feedback performs the multiplication and addition operations over extended Galois field $\textbf{GF}(2^n)$. The GLFSR outputs are the uniform generated n-bitwise data RndWord as well as r-bitwise weighted random data W_Data.

5.3. VHDL-description

If one-shot WNG-unit is used then it is enough to feed the value of PRec and flick it. This operation can be performed in parallel with other statements of the selected case variant. So, state machine design of the test stochastic generator encoded in the VHDL language will be the following:

```
process (clock, reset, W_Data)
begin
  if reset = '1' then  State <= S;
  elsif rising_edge( clock) then
    case State is
      when S=>
        clkAM2901<= '1'; -- generate clock of time for MP
        flick<= '1';
       --equiprobable jump
        if   RndBit='0'  then   State<= A;
        else State<= B;       --if RndBit ='1'
        end if;
      when A=>
        clkAM2901<= '0';
        flick<= '1';
        dst_cod<= ramf;     -- destination code
        op_cod<= add;       -- ALU function code
        src_cod<= dz;       -- source code
        State<= S;
      when B=>
        clkAM2901<= '1';
        flick<= '0';
        PRec<= "000"; --set the pointer to !( 0..3)
        State<= C;
      when C=>
        clkAM2901<= '0';
        flick<= '1';
       --weighted (equiprobable) case selection
        if   W_Data ="000"  then State<= D;
        elsif  W_Data ="001" then State<= G;
        elsif  W_Data ="010" then State<= H;
        else State<= Z;      -- if  W_Data ="011"
        end if;
      ………………….
    end case;
  end if;
end process;
```

In above listing is presented a fragment of the state machine description that implements the test

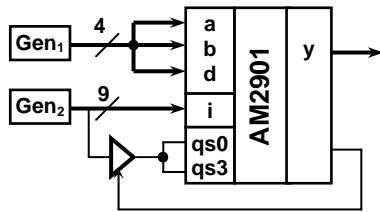
Figure 8. Test bench scheme of AM2901.

program stochastic generator described by grammar G_{St}.

6. TEST EXPERIMENTS AND RESULTS

The efficiency of syntactic approach will be estimated in comparison with other methods of generation, namely, deterministic and pure random.

In [26] is described an AM2901 deterministic test bench based on procedural approach. In the Quartus waveform editor we have created the verification test cases that must be generated by this test bench. We run the simulation. For 185 executed instructions the resulted simulation coverage was equal to 93,73%.

Further, we have implemented a simple test bench scheme shown in figure 8. Three types of test experiments were performed where generators Gen_1 and Gen_2 were counters, or maximum-length sequence generator, or syntactically controlled stochastic generator (Gen_2). Note that the transition probabilities $p_{S(\bullet)}$ and $p_{C(\bullet)}$ in G_{St} were set up equiprobable.
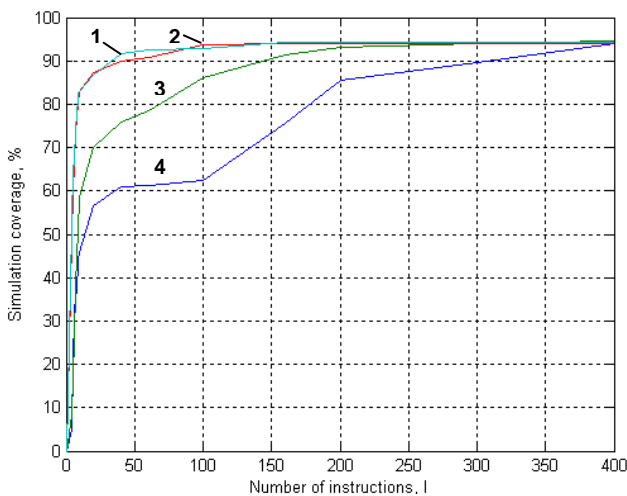

Figure 9. The AM2901 simulation coverage
for instructions generated by:
1, 2 – stochastic generator;
3 – pure random generator;
4 – counter generator.

Test experiments were executed by increasing of simulation time (parameter End Time in the CAD Quartus) step-by-step. The obtained values of simulation coverage are plotted in the figure 9, where stochastic generator is the controlled test program generator which algorithm of functioning is defined by stochastic grammar G_{St}.

The counter as Gen_2 tries all possible states like the LFSR as Gen_2. At the same time, comparing curve 4 with 3, 2 and 1 it is easy to state that the simulation coverage of the counter is worse then for the random testing. It can be stated also that the further improvement of verification quality by random stimulus can be achieved only by qualitative change of the random generator (compare curves 1 and 2 with 3).

Also was established that the variation of transition probabilities $p_{S(\bullet)}$ and $p_{C(\bullet)}$ doesn't give an essential improvement of the simulation coverage (see curves 1 and 2). This is because the AM2901 microprocessor has a simple architecture that is "insensible" to the stylistic of generated stimuli.

Now, make the comparison of experimental results with the theoretical model. Assume that apriori probability p_e in (3) is the relative frequency of "switching" on-off of the elements of memory, i.e. the registers. The AM2901 microprocessor has 16+1=17 registers. So, the number of switching is twiced and is equal to 34. Then the probability p_e of event of switching of the registers is equal to $1/34 \approx 0,029$. In the graphic 1 (or 2), shown in figure 8, for test length l equal, for example, to 100, we obtain the value of confidence level λ equal to 0,93. Thus, in accordance with relation (3) the expected probability $P_e(l)$ of exercising of the MP registers on feeding l instructions is approximately equal to

$$\frac{1}{100} \ln \frac{1}{1-0,93} \approx 0,027 . \qquad (5)$$

Deviation of experimental test length from expected one constitutes about 6% that is the acceptable discrepancy between theoretical model and experimental results.

In spite of achieved high level of exercising of the nodes of design netlist, some nodes remained unexercised. Therefore, for successful completion of design verification, the CAD-system should have the "ability" to summarize the list of nodes not yet exercised.

CONCLUSIONS

In this paper a syntactic approach to synthesis of stochastic program generator has been presented.

Theoretical and design issues have been analyzed. Experimental results justify the elaborated theoretical model. The proposed design solutions and VHDL constructions are in accordance with the proposals suggested recently in [13].

Further improvement of the stochastic test program generator can be reached by tuning of the transition probabilities repartition of the grammar. In fact, if suppose that it is given an arbitrary probabilities repartition on events E then the relation (3) will be transformed to:

$$l \cong \frac{1}{\min_{e \in E}\{p_e\}} \ln \frac{1}{1-\lambda} \,. \qquad (6)$$

So, the task of test quality improvement is reduced to increase of low bound of repartition. Introduction of the Markov chain can successfully solve this new problem (because it is known that a noncontextual stochastic grammar can be adequately represented by a Markov process). In this case the principle of maximization of the entropy of Markov process should be applied to increase the low bound of analyzed repartition, and, so, to decrease the length of test-verification programs. From the other hand, when TPG structure corresponds to a stochastic context-free grammar then the branching Markov process is needed for analysis of the style of generated sentences (see birth and death processes).

What is the attractive aspect of the syntactic approach? Firstly, probabilities provide the varieties of test programs. Secondly, greater effect of synthesis of an AGP can be achieved by automation of the procedure of definition of the generator grammar rules.

The proposed tools facilitate the control of the process of the test programs stochastic generation and are ready for practical using in verification of microprocessors or complex systems on chips. These tools are good for synthesizable design as well as for (presynthesis) simulation design.

Also it is obvious, that for successful of synthesis of test program generators it is necessary to supply the hardware description language with constructions which provide not only specification of structural features, but also the properties (attributes) of behavior of microprocessor instructions.

Need to notice that the task of mapping of MP-structure to TPG-structure is not yet studied up to end. Therefore we hope that the proposed syntactic approach to construction of test program generators will accelerate the development of methods and tools of simulation-based verification of microprocessors.

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DESIGN OF A FLEXIBLE AND GENERIC SYSTEM OF EVALUATION FOR COMPLEX INFORMATICS SYSTEMS

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INTRODUCTION

A functional, flexible and easy to maintain system's design is highly important.

The opinion of the users is highly important in order to establish how many resources are necessary. The finalization of all the project's activities in due time is to be admired, but this means a good management, that is an efficient control of the project's each stage of activity and the flexibility to adapt to the purpose and the strategy of the unit

To be in charge of such a project does not simply mean to gather these activities and resources. It also means that the project's manager is faced with a series of „*negotiations*", Sometimes the costs can be decided, influenced and sometimes the time can be the most important factor. It takes time to listen to the requested of the beneficiary, time to code, to design, to test. You can create a quality soft, but you can fail at its respond to the user's demands. You can design a perfect system, but you may not have time to test it. Time IS hard to administrate. What if we find ourselves in the situation of having „ no time"? More time doesn't always means achieving the results we expect. The message is to be careful not to prolong the deadlines.

1. THE DESCRIPTION OF THE BASIC EVALUATION AND CONTROL DATA

The evaluation of the assistance and support activity is based upon the defining processes of the levels of service, the leading of the service team, the performance management, of offering a continuous service, the security of the system, the identification of the costs for assistance and support, the teaching and training of the users, the assistance and advise of the clients, the configuration management, the organization of the problems and incidents that might appear, the data , facilities and operation management(addition, accuracy, validation, upgrading and stocking).

All the attempts in defining the leadership is centered upon the idea that the leadership is different from the management ,that leaders are different from the managers, due to certain personal qualities and abilities In a corporation, an efficient leader has a future strategy of the organization, which takes into consideration the true interests on a long term of all those involved in it Then the leader develops a strategy in order to reach that purpose by obtaining support from the employees and in the same time motivating them to reach that purpose.

In every I.S. there are four independent factors: price, quality, time and risk... We can not have the fullest efficiency from all the four factors. That is we can not have a system made by smaller costs, with high quality, quickly made and with smaller failure risks. Mainly we can talk about the first three factors. It is possible to build a quality system with relatively small costs. Anyway, the chances that this type o system to fail rise dramatically.

To make sure that a system is successful, we must take into consideration the following factors:

1. Every major product must be examined by verifying its accuracy and correctness...

2. The support of the manager to the project must be carefully supervised. We must make sure that the managers are aware of the team's progress.

3. We must have the proper technical leadership for the project...

The managers have to understand the technological impact and the informatics applications upon the business they lead, taking into account the fact that I.T. assures them the necessary information and that of being able to select that information in due and real time. Today's businesses are more and more organized , lead and aromatized around the series of processes and the relations established among them. These processes involve developments and the products and services, the interactions with the clients and the support of those processes and of human resources. Thereby, we suggest the identification of the solutions for the successful planning of the specific I.S. activities and their management in accordance with the company strategy, as well as the evaluation and control of main lines of work in accordance with: the following information criteria: efficiency, effectiveness, availability, integrity, confidentiality, accord, safety and the financial and human resources through a flexible system of evaluation.

The managers need to understand the impact of the technology and of the informatics application

upon the business they lead, taking into consideration the need to select the information in real time. Today's businesses are more and more organized, lead and aromatized around the series of processes and of relations among them. These processes involve developments and lines of production and services, the administration of interaction with the clients and the support of the processes and of the human resources.

The information are storage in a data base in order to be able to make complex operations, the access to these information being made by taking into account the manager's purposes and abilities. The application becomes efficient through the design's methods, allowing the interpretation and the manipulation of the data depending on the abilities of each user. One can describe such evaluation criteria able to understand the context, the user's medium and to respect the domain of the application.

The system can be adapted to each project manager's way of working, to the company's strategy, the financial and human resources offered by that company. The main criteria selection of the evaluation and control activities has been made after the following information criteria:

- effectiveness,
- integrity,
- confidentiality,
- availability,
- accordance,
- Trust in the information.

2. THE ADVANTAGES OF THE FLEXIBLE DESIGNED EVALUATION SYSTEM

It is a system, which allows the project's manager to establish the evaluation criteria and to concentrate upon the performances made in the administration of the specific I.S. activities.

The control of the activities is essential for the accomplishment of the projects. It is essential the role of each of the identified process in the Cobit standard for the accomplishment of the final project and the current stage of the organization, by grouping the processes in four activities:

- Planning and organization of complex I.S.:
- The acquisition of goods and services for the project;
- Delivering the designed system and the accomplishment of the paper documentation for the project.

These problems and opportunities appear as a result of the desire of the companies to adapt to changes, a major aspect being occupied by

informational processing. Due to the high degree of flexibility, the importance of the evaluation method is underlined. Starting from the observation that a main characteristic of each level is that of finalizing with a check up and a validation in order to eliminate certain anomalies, it is underlined the fact that a good security of the I.T. and the administration practice's control of the complex I.S. projects is essential. Under these circumstances, one can search new managerial solutions in order to integrate:

- Time control,
- Cost control,
- Quality control of the working team,
- Obtained results control.

Unrealistic deadlines, not wanted personnel and not working with the expert persons are reasons for which a projects fails.

The informatics solution, which is given, underlines the functionality and the easy way to handle it. The application is capable of interaction, of dividing the application as well as not synchronized interactions, divided space works.

The transformation of the company in terms of high-level processes allows the managers to have a measure as far as the determination of the successes of the processes and the comparison of their result with those of the competition. It is the ideal way to maintain a strong focus on the clients and their needs and to structure the relations with the partners and suppliers.

The processes supply a way to organize the I.T. resources and to give priority to the I.T. tasks as well. They represent the key which assures that the I.T. investments support the strategies of the unit and guarantees a reasonable retrieve of the investments.

The designed system is a useful tool for the manager because it:

- Offers a generalized frame of the processes of evaluation;
- Is a way to evaluate and self-evaluate with flexible criteria;
- Can serve as „*best practice*" for standardizations and future researches.

Most of the economic decisions are based upon financial information. However, as decedent, to have information at the right time is not everything. This information must be trustable.

The need for competent and independent evaluations is bigger every day. The given evaluation system is a tool that allows:

- the check up in order to see if the necessary conditions are fulfilled to assure the equilibrium of an organization;
- to control the disorder, to adapt to changes;
- To evaluate the degree of security and the risks undertaken by a company.

This kind of I.S. evaluation is very useful. The aims of every institution and the manner, in which they are reached, depend on the abilities and leading manner of the managers. Their integrity and attachment as far as the ethical values are concerned are reflected by their actions and judgments. The ethical values of one organization can not be better than those of the employees (the leading positions are included) that create them, that make them work and supervise them! AND All this because there are some organizational factors that contribute to credulous actions such as:

• the inexistence and inefficiency of controls within the company;

• the excessive and inefficient decentralization of the report system;

• the penalizations of some employees that weren't announced to the entire company.

But the employees' ethical manners are not enough. Their abilities are another essential element of the control medium. The ability, that is knowledge and aptitudes necessary in every line of work, must be mentioned by the leaders. It is in the interest of every company to have the best employees.

The managerial philosophy and the leading manner affect the way in which any company is administrated, no matter the field of operation. We can include in this category factors such as: taking the risks, instituted politics and procedures, giving responsibilities, the attitude in regard of financial reports.

In the end, the organizational structure represents the general frame where the necessary activities will be planned, executed, controlled and monitoring, in order to reach the targets. Most often, she is the result of the managerial philosophy and can be centralized, decentralized and structured on a functional base, in comparison with the size of the company and the nature of its activities.

On the next level we find the risk's evaluation. The company must be aware of the risks and must be able to face them. The activities and the risks involved by these activities must be evaluated and hierarchies in such a manner as to allow the company to take only the risks it can afford and in order to avoid the useless ones. But one of the prime conditions in risk evaluation is to establish some well defined and compatible targets with the company's evolution. The risk's evaluation assumes the identification and analyze of those events that can interfere in the reach of those purposes.

The identification and the analyze of the risks are continuous processes that must take place at all the levels of the company and must take into consideration the factors such as the economical changes, the needs of one society, the legislative changes, new technological developments, natural disasters, new hired personnel, new informational systems, the change in the management responsibilities.

After being identified, all the risks are being evaluated. Often enough, this process, which can be more or less formal, includes:

• the evaluation of the importance of every risk;

• the evaluation of the probability or the frequency of risk's appearance;

• The actions that must be taken in order to prevent the risks and the costs involved in these actions...

The well use of the resources assumes that the manager has pertinent data on which he can create the politics of the company. Once introduced, these politics must be monitoring and the manner in which they are followed must be supervised.

One of the most important targets of the leadership is preventing and identification of the errors and frauds. The cost of the possible control measures must be compared with the probability of appearance of such fraud or error and the consequences.

The evaluation system offers the leaders the required data necessary for the administration of that business. But it's still the job of those being in charge to create and launch such a system. In order to make a simple evaluation, an organization must take into consideration every evaluation criteria, to read the 6 levels of scaling and determine which one of the six is better suited for the company's current state. The more important is the process for the company, the higher it is situated on the scale. For example, in a relatively stable commercial environment, the growth maturity of the 13's processes from the "supply and support" field is the one that separates the successful companies from the others. On the other hand, in a very dynamic economic field, successful companies are highly depended on the maturity of the field "*planning and organization*", "*acquisition and implementation*".

One must mention the fact that there is a difference between the measurement of the abilities and that of performances. For example, the achievement of the abilities for a certain security or control of practices is one of that decisions that must be taken and done, but the consistent appliance of the abilities, once required, also demands to be measured [1].

Every project can be then labeled with a unique sequential trademark as in fig.1. The purpose in choosing the main projects is that of identification of those projects where one can have quick results and benefits. The most suitable candidates for quick benefits are usually those where the discrepancies are smaller and the closing price and the failure risks are also smaller, and the
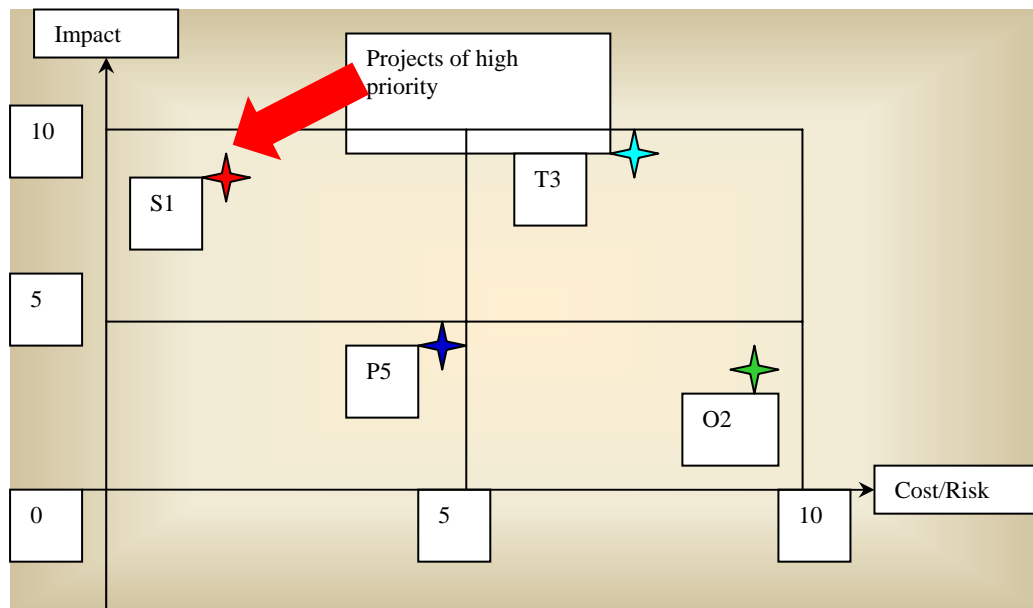
Figure 1. The position in relationship with the impact on the business and risk.

impact upon the benefits of the business is higher.

The manner in which the priority is being attributed to the projects is through the identification of the rapid benefits that can be achieved. The best candidates for rapid benefits are usually those projects in which the gaps are smaller, where the costs to close a gap are as small as possible, where the risk of failure and the impact of the benefits on the business are higher. The projects could be evaluated for impact and cost/risk on a scale from 0 to 10 for each of these variables. The projects can be pointed on a graphic that can become a support tool for the decision of the manager, showing the relative impact and the costs/risks. The projects that have a bigger impact and a relatively small price are better candidates as well as quicker winners.

CONCLUSIONS

In the recent years, the fact that there is *a need for a reference for a proper frame of work for the safety and control in I.T.* has become more evident for the moderators, users and suppliers of services.

The effective administration of the I.T. has a major importance in the success and survival of the company. For many companies, the data and the technology they have, represent the biggest values. Indeed. The information and the information systems are general for the entire company from the users' platform to the local networks and those of bigger cover, to the servers of the user within the computers. *Many companies recognize the potential*

benefits produced by technology. Yet, the successful companies understand this and administrate the associated risks with the introduction of new technologies. Thereby, the administration needs a good appreciation and a basic understanding of the risks and limitations within the I.T. in order to supply adequate controls.

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2. CONCLUSIONS

Thermal response of power semiconductor devices for a variety of one-shot and repetitive pulse inputs have been computed with the aim to offer valuable formulae for power circuit designers. A transient thermal calculation even using the relation (2), is very complex and difficult to do. So, a more exactly and efficiently thermal calculation of power semiconductors at different types of input power, can be done using specific modelling and simulation software.

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THE WAYS FOR ENERGY CONSERVATION BY ENERGY PRODUCTION AND CONSUMPTION OF ELECTRIC ENERGY

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INTRODUCTIONS

The important part of future energy balance for all national economies represents the possible saving of energy. For example, the EU plans to reach by effective use of energy the decreasing of energy demand by 20 % until 2020. Together with the energy conservation is that manner the way for decreasing of greenhouse gases production. The paper deals about the ways for energy conservation by production, transport and distribution and consumption of electric energy, and describes main methods for decreasing energy consumption of process energy supply. The main methods are described in fields– power energy production; transport and distribution of electric energy; consumption of electric energy. The paper is a contribution for solving the energy supply in future.

1.   ENERGY CONSERVATION

Energy conservation is the practice of decreasing the quantity of energy used. It may be achieved through efficient energy use, in which case energy use is decreased while achieving a similar outcome, or by reduced consumption of energy services. Energy conservation may result in increase of financial capital, environmental value, national security, personal security, and human comfort. Individuals and organizations that are direct consumers of energy may want to conserve energy in order to reduce energy costs and promote economic security. Industrial and commercial users may want to increase efficiency and thus maximize profit.

The measures for conservation of electrical energy in the domestic and commercial sectors are identified. The need for such conservation is highlighted in the perspective of a much larger rate of growth of load in the domestic and commercial sectors as compared to the industrial and agricultural sectors. Government subsidy on fluorescent tubes, introduction of seasonal tariffs and reduction and readjustment of television timings, have a good effect in this sense.

This is how you can help conserve electrical energy with respect to the lighting at your home:

Devices like ovens and microwave and other small appliances can also be made to conserve energy by following these tips, use pots that fit the range of cooking unit, cover the pans and use only a little amount of water. Arrange the dishes inside the oven for proper flow of air. Don't line the racks with the foil; Use small appliances and the microwave oven as much as possible. They are not only quicker but even more economical than a cooking range.

Washing machines can also prove out to be power hungry devices if not utilized correctly. To make better use of them, follow these tips, do wash at full load but do not overload the machine. Avoid usage of drier unit of the machine so as to save on electrical energy; Keep the lint filter clean; Presoak heavily soiled laundry whenever possible; Use two loads one after another to dry out in the drier. This will help make use of the heat still available within the drier unit that was produced to dry out the first load; Adjustable water level should be correctly used so as to save on quantity of water used in a wash; Use fluorescent lights instead of bulbs whenever possible; Reduce usage of high wattage bulb where less light will do; Use newer variety of 36 Watts thin tube lights instead of older tube lights; Use compact fluorescent lamps in the open passages, toilets and bathrooms; Use electronic ballast/choke in the tube lights instead of electromagnetic ballasts and make use of electronic speed regulators in the fans; By using light shades of color on the walls, you can bring down the lighting requirement by 40%.

If you use air-conditioners, reduce their operational time by one or two hours per day. Also, get their filters cleaned up on a regular basis. A choked or clogged filter can result in improper cooling as well as higher consumption of electrical energy.

To keep your refrigerator running smoothly, clean the coils periodically by removing all sorts of dust that might have settled on it. Ensure that these coils are a minimum of 4 inches away from the nearest wall and their is enough room around them breath; Do not place the refrigerator near heat sources like ovens, gas stove, etc.

Renewable energy is energy generated from natural resources—such as sunlight,[2] wind, rain, tides and geothermal heat—which are renewable (naturally replenished). In 2006, about 18% of global final energy consumption came from renewable, with 13% coming from traditional biomass, such as wood-burning. Hydroelectricity was the next largest renewable source, providing 3% (15% of global electricity generation), [1] followed by solar hot water/heating, which contributed 1.3%. Modern technologies, such as geothermal energy, wind power, solar power, and ocean energy together provided some 0.8% of final energy consumption.
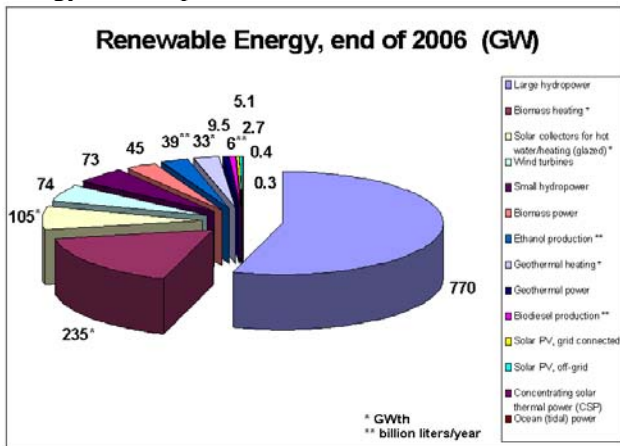

Figure 1. Renewable energy sources worldwide at the end of 2006.

One of Renewable energy sources are biomass, on a general note, developing agriculture and forestry should have priority over planting crops for energy generation purposes since biomass for energetic use is usually a valuable by - product. The land is already extensively used and there is hardly any area available for extending the agricultural area. However, there are realistic options for increasing agricultural and forestall productivity (yields) as well as for planting new forests on degraded sites unsuitable for agriculture.

It is estimated that the total biomass potential can be increased within the coming decade to some 1,900,000 tons or roughly 6,800,000 MWh, excluding biogas from animal manure (see Fig. 1). Assuming normative heat consumption in urban areas with a 'normal' heat comfort of 10 MWh/yr per average dwelling and an average efficiency of 70%, a total of 480,000 households could be heated.

Water is currently the leading renewable energy source used by electric utilities to generate electric power. Hydroelectric plants operate where suitable waterways are available; many of the best of these sites have already been developed. Generating electricity using water has several advantages. The major advantage is that water, a renewable resource, is a source of cheap power. In addition, because there is no fuel combustion, there is little air pollution in comparison with fossil fuel plants and limited thermal pollution compared with nuclear plants. Like other energy sources, the use of water for generation has limitations, including environmental impacts caused by damming rivers and streams, which affects the habitats of the local plant, fish, and animal life.

Other renewable resources-geothermal (heat energy beneath the surface of the earth), wood, waste, wind, and the sun (solar)--are energy sources that are constantly replenished.

2. ENERGY CONSERVATION IN THE EUROPEAN UNION

The European Union has set itself the goal of raising the share of renewable energy sources in the final overall energy consumption of the Union from 8.5% in 2005 to 20% in 2020. This is an ambitious objective, but it is also a necessary contribution to the global fight against climate change and towards better control over our energy dependence. Governments have a crucial role to play through their good example and their support. But each individual can also help to achieve this objective. The various uses for renewable energy sources are examined: electricity for wind and hydraulic energies; electricity or heat for geothermal and solar energies; multiple applications: electricity, heat, and bio fuel for biomass, the "Sleeping Giant". The European Union is a world leader in the use and deployment of technologies that exploit renewable energy sources, and it intends to remain so.

Table 1.

The Renewable Energy Resource Base (Exajoules per year)			
	Current use (2005)	Technical potential	Theoretical potential
Hydropower	9	50	147
Biomass energy	50	>276	2,900
Wind energy	0.12	640	6,000
Solar energy	0.1	>1,575	3,900,000
Geothermal energy	0.6	--	--
Ocean energy	not estimated	not estimated	7,400
Total	**60**	**>1,800**	**>4,000,000**

Europe has agreed a forward-looking political agenda to achieve its core energy objectives of sustainability, competitiveness and security of supply. This agenda means substantial change in Europe's energy system over the next years, with public authorities, energy regulators, infrastructure operators, the energy industry and citizens all actively involved. It means choices and investments during a time of much change in global energy markets and international relations. The European Commission has therefore proposed a wide-ranging energy package which gives a new boost to energy security in Europe (see Tab. 1).

- putting forward a new strategy to build up energy solidarity among Member States and a new policy on energy networks to stimulate investment in more efficient, low-carbon energy networks.

- proposing a Energy Security and Solidarity Action Plan to secure sustainable energy supplies in the EU and looking at the challenges that Europe will face between 2020 and 2050.

- adopting a package of energy efficiency proposals aims to make energy savings in key areas, such as reinforcing energy efficiency legislation on buildings and energy-using products.

Technology is crucial in developing and using our resources in a cost-effective and environmentally-sustainable way so our next step in the Strategic Energy Technology Plan4 will be a Communication on Financing Low Karbon Technologies. This will propose ways to support large scale demonstrations at EU level, including up to twelve Carbon Capture and Storage (CCS) demonstration plants. Europe's aim to have up to twelve commercial scale demonstration plants in operation by 2015 and the G8 commitment to launch twenty demonstration plants globally by 2020 will require greater incentives than currently available. Use of coal in the longer run is only compatible with climate challenge if highly-efficient plants predominate and CCS is widely available. The Berlin Fossil Fuel Forum5 will look at which additional measures could be taken at Community and national level, and in partnership with Norway, to promote cost-effective and environmentally-compatible access to indigenous EU fossil fuels.

3. ENERGY CONSERVATION STRATEGY IN THE CZECH REPUBLIC

Directive of the European Parliament and of the Council No. 2006/32/ES – Energy Efficiency by

end user and energy services have this strategy (see Tab. 2, 3).
- energy conversion effectiveness increase by 20% until 2020
- greenhouse gases decreasing
- increasing shave of renewable energy sources

Table 2.

Administrative buildings	(27%)
Households	(27%)
Transport	(26%)
Industry	(25%)

Decrease of average energy consumption by 9% in the period 2008-2016 as compared to 2002-2006

Table 3.

ENERGY SAVING SPLIT		
SECTOR	2016 (24.5 GWh)	(%)
Households	6048.3	30.5
Tertiary sector	3142	15.8
Industry	4852	24.5
Transport	4628	23.3
Agriculture	1172	5.9
Total energy savings	19842	

4. ENERGY CONSERVATION IN THE REPUBLIC OF MOLDOVA

The Republic of Moldova is depends on imported almost totally (98%) from energy resources from the Russian Federation, Ukraine (gas, coal, oil) and Romania (electric energy). In this situation, the energy security can be insured by diversifying foreign suppliers of electricity supply and oil products, by developing own capacities of producing electricity, as well as by creation of strategic reserves of fuel. The energy sector consumes, mainly, natural gas, residual fuel oil and coal (see Tab. 4).

Annual consumption was distributed by sectors as follows (2007):
- Industry – 871 million kWh;
- Construction – 10 million kWh.;
- Transportation – 47 million kWh.;
- Agriculture – 48 million kWh.;
- Commercial sector – 539 million kWh.;
- Service – 65 million kWh;
- Population – 964 million kWh;
- Others - 155 million kWh.

Table 4.

	2005	2006	Change (%)
Production (Mtoe)	0.085	0.087	2.4
Energy Net imports (Mtoe)	2.09	2.186	4.6
Energy Net Exports (Mtoe)	0.043	0.0035	-91.9
Total Primary Energy Supply (Mtoe)	2.378	2.464	3.6
TPES per capita	0.70	0.73	4.3

Renewable Energy potential varies much from one country to another. The Republic of Moldova disposes the following forms of Renewable Resources: wind, solar, biomass and hydraulic.

Renewable Energy, structured as follows:

Wind Energy, 25 thousand toe, respectively 5.0% of Renewable Resources; Wind energy is not well developed in Moldova. The wind power potential is available only in the open territories where unfavorable landscape impact is minimum. Upon the slopes and in valleys the wind velocities are low. As a whole only about 10% of the territory may be used in the country for wind power development.

Solar Energy, 50 thousand toe, respectively 10.0% of Renewable Resources; The first stage of solar energy use in Moldova will have the following priorities:
- Heating of water using solar collectors
- Drying fruit, vegetables and medicinal plants
- Photovoltaic conversion for pumping water and for electric energy supply of small consumers

Installation is estimated to be approximately 102,000m^2 of solar collectors designed to heat water, about 60,000m^2 for drying agricultural produce, and over 5000m^2 of photovoltaic systems with the installed power of 300 kW.

Biomass Energy, 352 thousand toe, respectively 70.5% of Renewable Resources. Moldova has sufficient biomass resource to provide significant generation if utilized. As biomass begins to be used more efficiently in communal applications, experience should allow for large scale implementation, in the range of 5 MWth and greater efficient use of the existing potential and increasing the forest surface two times by the year 2010 would insure Moldova's rural population with 100 percent of energy resources.

Hydro Energy, 73 thousand toe, respectively 14.5% of Renewable Resources. The greatest potential for hydropower development in Moldova is in small hydro construction. The Dneister River basin and the Prut and Danube river basin cover the vast majority of Moldova's territory, and technically represent the best areas for development. By the year 2010, through extending established hydroelectric plants and using the running water potential, the installed power could achieve an additional 22 MW.

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PARALLEL APPLICATION LAUNCHING ON COMPUTER CLUSTER

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INTRODUCTION

One of the most important usages of computer is scientific calculations. People make use of the high performance of computer to implement the simulation in some scientific research fields, for example, the simulation of biological process. For improving the efficiency of calculating, a new system named computer cluster was built. Computer clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability. We developed a Web-Client as a part of the three-level project, named Visual Membrane Petri Nets (VMPN) for practicing launching parallel application on computer cluster. Here, we elaborate Web-Client that offers a graphical user interface for VMPN parallel software tool. The first level of VMPN is a client level. At this level, there are two types of client, one is the normal client (User must install the client software on computer before using it), another is a Web-Client (User can use this system by simply launching browser); the second level of this system is an application level. One application server (Web-service) works on this level, the purpose of this level is collecting users' requisitions, and analyzing, organizing these requisitions in order to send to cluster to compute. The application server also receives the results from cluster and divides them in order to give different clients proper result. The third level is the computation level, since membrane computation needs large computing time, so we use Rocks cluster with 52 processors to perform it. There are several technologies used in the Web-Client such as: Web-Service, Database (MySQL), PHP, SOAP, dynamic web-page technique and so on.

1. THEORETICAL PRINCIPLES

Computer is an indispensable tool in the current world. The speed of computation of computer is pivotal, for some application fields that need a high-speed computation such as weather forecast, scientific calculation and engineering calculation, mainframe computers are used. However, mainframe computer are very expensive and hard to maintain, thus small consumers have no chance to use giant computer or mainframe computer on their work. However, low-cost personal computers are widely used everyplace over the world. As a result, a new technology named computer cluster were created. Computer cluster is a group of linked computers, working together closely so that in many respects they form a single computer. The components of a cluster are commonly, but not always, connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability. Computer cluster is a system based on parallel computation theory.

Parallel computation is a modern technique used for processing some computations that need a large amount of computation time. Because the limits of computational capability of single processor. We need to pay a lot of time for computing some complex operations, thus people want to divide one large computation into several small computations and calculate them in synchronization. We need to assemble the results when all of the partial computations have been done, so as to we can obtain the result in an acceptant time. In most cases, that can be seen is computer cluster as an implementation of parallel computing.

MPI (Messages Passing Interface) is a good tool for realizing a parallel program. Our parallel computing system uses MPI to implement parallel computing. The Message Passing Interface Standard (MPI) is a message passing library standard. The goal of the Message Passing Interface is to establish a portable, effcient, and flexible standard for message passing that will be widely used for writing message passing programs. As a result, we didn't need to consider too much about how to divide our high computation-time-consumed operation to different nodes when we were developing our program.

2. VISUAL MEMBRANE PETRI NETS

There is an instance of parallel computation has been done by us; this implementation is a

medical assistant managing and analysis system which uses parallel computation based on computer cluster to simulate membrane evolution. This application uses three-levels-system theory.

The first level is the client level (Figure 1). At this level, there are two types of client, one is a normal client (User must install the client software on computer before using it), another is a Web-Client (User can use this system by simply launching browser); the second level of this system is an application level, one application server (Web-service) works on this level, the purpose of this level is collecting users requisitions, and analyzing, organizing these requisitions in order to send to cluster to compute.

The application server also receives the results from cluster and divides them so as to give different clients proper result. The third level is the computation level, since membrane computation needs large computing time, therefore, we use computer cluster to perform it. We use a rock cluster with 52 processors as the third level.
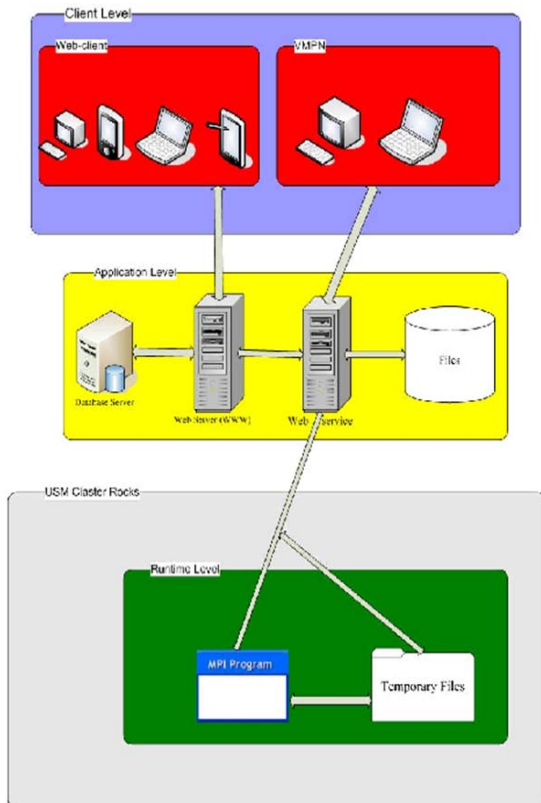

Figure 1.

The Visual Membrane Petri Nets (VMPN) is a parallel software tool for visual representation, formalization and simulation of MPN-models. This tool allows verification and validation of behavioural properties of membrane systems and their visual interactive discrete-continuous simulation. VMPN is a window-based, object-oriented parallel software tool, in which elements typical of hybrid Petri net models (discrete-continuous places, transitions, arcs, etc.) are manipulated under the assistance of basic syntactical rules that prevent the construction of incorrect models.

Visual simulation is very useful during the early stages of the construction of the model since it represents a powerful tool for its debugging. Moreover, the animation of the correct simulation model may provide important insights on the behaviour of the actual system.

The dynamic graphical facilities are used to visualize the movement of the tokens (fluid), to provide snapshots of the model, and to represent the membrane system evolution. A screensnapshot of a membrane model is represented in Figure 2.
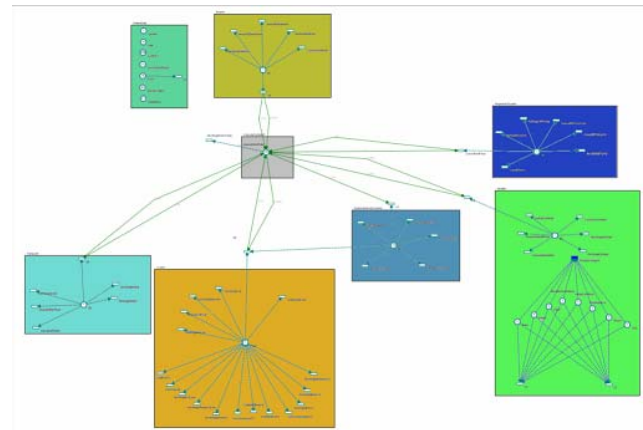

Figure 2.

3. WEB-CLIENT OF PETRI NETS

The Web-Client of VMPN is the front-end program that makes user can work on a computer cluster with a friendly and easily understood interface (Figure 2). This Web-Client is designed for clinicists. There are two main parts of Web-Client we developed for composing Web-Client of VMPN, one is the management part, and another is the simulation part. In management part, doctor can input related data after inspecting a patient, Web-Client will store those data in a database (in our project, we use MySQL as database). After the completion of a series of examinations, clinicist can use Web-Client to do simulation in order to obtain a preview of the growth of diseases. From a technical point of view, we use PHP programming language to produce HTML dynamically and to get patients data from MySQL database to produce data-message with the same values in XML format in order to Web-service can receive these data correctly. Web-service will return the result of

simulation computing to Web-Client in XML format after computing on rocks cluster. Finally, Web-Client generates 2D analysis charts and 3D analysis charts for clinicists.

The usage and mechanism of Web-Client:

1. Register a new user as a clinicist.

We added strategy of checking users input, user only can input letters and numbers as user-name and password as well as the strategy of input two times password avoiding user input a wrong password carelessly. A database is used for storing users' information including user-name and password. Password string is encrypted by MD5 algorithm and stored in the database.

2. Managing patient.

Users (clinicists) must add some data of inspections for patients by using managing part of Web-Client before processing simulation. Users can find a Manage Patient link on the current web page after login. Click Manage Patient super-link to enter managing the patient page (Figure 3).

The first page of Managing part is a patients ID input and searching page. Since we use strategy of ID, so the patients ID is the key index in database and cannot be duplicated. For the new patient, clinicists need to click Add a new patient link at bottom of this page to register a new patient in system.
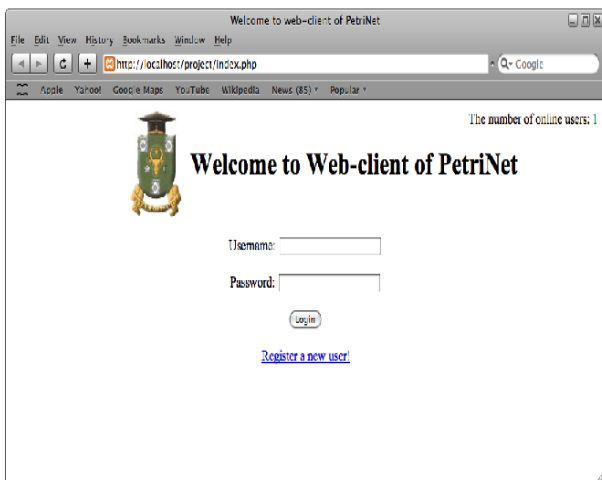

Figure 3.

On the register page, clinicists should do input the basic information (such as first name, last name, gender, age and occupation) for this patient. For an existent patient, clinicists can find his or her ID by using searching ID function on this page, we offer two ways of searching ID, by name and by age, which can help clinicists to find patients ID easily. Input patients ID and click OK button entering the main managing page if clinicists have already known the ID of this patient.

The main managing page is a framework with three pages, the title page, inspection selecting page and content page. The current operating clinicists name and patients name will be displayed on the title page, which can ensure clinicists will not do some mistakes of garbling patients.

Of course, clinicists could change to manage another patient by clicking Select another patient link at bottom right corner of the title page title. The inspection selecting page is placed left of framework, we offer models of "BASIC INFORMATION", "ROUTING INSPECTION", "ROUTING ANALYSIS OF BLOOD", "BIOCHEMICAL ANALYSIS OF BLOOD", "ROUTING ANALYSIS OF URINE", "PRESSURE" and "ALCOHOL CONSUMPTION" for the current version (Figure 4).
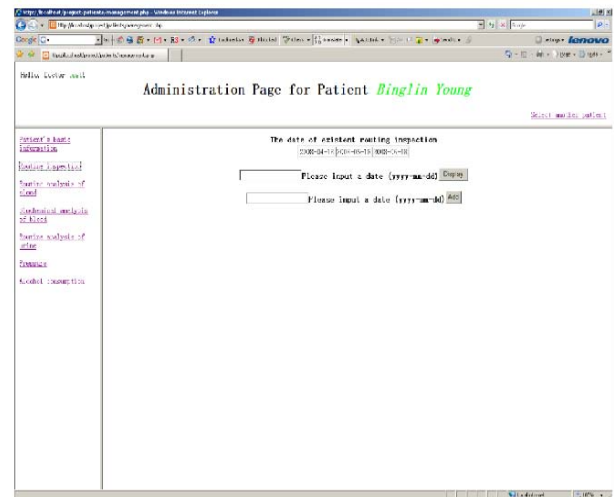

Figure 4

(a) Patients' basic information.

Click the "*Basic Information*" link on left "Inspection Selecting" area to open the content page of patients' basic information on right area. Clinicists can modify the patients basic information that has been stored after a clinicist registered this patient by clicking modify button or delete this patient by clicking delete button. Due to the strategy of dynamic creating tables of different inspections is used in this system, so clinicists will delete (drop) all of tables of this patient in database if a clinicist clicks delete button, all of information of this patient will lose and cannot be recovered.

(b) Routing inspection.

System will create tables for each inspection of each patient. In such inspection data recording tables, date of inspection is the key index and cannot be duplicated. The inspection table-names are instituted of patients ID + the name of inspection.

For instance, the name of table of the routing inspection belonged to the patient with ID 1 is "*1 routing inspection*" in database. For managing these table names, system uses a static table named "table names" to store inspection tables dynamically. The different inspection table-names will be stored in this table when they are created. These tables comply with the standard of BNF-3.

Clicking "*Routing Inspection*" super-link users could see the first page of content pages of routing inspection. System can check whether data existent or not existent, if existent, the date of routing inspection will be displayed automatically, but if no existent inspection, system will only display two command line on page.

One is for displaying data of inspection; another is for adding a new datum of inspection. Both require clinicists to input a date of inspection in format year-month-day.

If no data were input before, please input a date in second input-box and click "*add*" button to open "Adding data" page.

There are many items of related inspection will be required to input, after input, click "Add" button to store data into database. If serial data of inspection had been input by clinicists before, clinicists can find the wanted date from the above table easily and input the date into first input-box, then click "Display" button to review the data of inspection.

Clinicists also can, of course, modify or delete these data from "display data page". For this initial version, there are only six types of inspection allowed to use.

Remain models are similar to this model, because all of them are inspection models. Consequently, other models will not be illustrated here.

3. Simulation analysis pages

Clinicists should come back to simulation analysis pages to do simulation and analysis after administrating data of various inspections.

(a) Getting model by name

This is a very simple page, clinicists just need to type the name of a model on Web-service in input-box and click "*Get*" button. Web Client will get the model from Web-Service.

The SOAP technique is used to implement this process here. The key code below:

```
$client=new Soap
Client("http://localhost:1690/ServiceManag
er.asmx?WSDL");
$params=array("modelName"=>"$modelName");
$result=$client->GetModelByName($params);
$resultString=$result->GetModelByNameResul
t;
```

(b) Modify token-count and/or generate a new model.

Web-Client can analyze the data of model from Web-service and display them in a simple form automatically. Clinicists can modify these data directly, and if a clinicist wants to save the new data as a new model, he or she just simply types a new name in New Model Name input-box and click "*Simulate button*" to continue.

Next time, if a clinicist wants to review the process of model with new data, he or she can just input the new model name on "*Getting Model by Name*" page.

The XML phrasing is used in above functions. Web-Service returns data in XML format, so Web-Client has to analyze the format of XML string and show an easily understood datum to user.

After modifying data, Web-Client has to convert data back to XML format in order to Web-service can understand the string from Web-Client properly. The XML Parser Functions and String Functions of PHP are used for implementing this process. The selecting models page will be displayed in lockstep.

(c) Selecting locations page

There are many locations in a model, so web-service analyzed the model and give user a chance to select which locations needed to be simulated. This page is a simplistic web-page; all of locations are listed in form of check boxes. Select which locations needed to be analyzed and go on.

(d) Show charts

This is the final step in simulation. Locations that had been selected were executed on cluster in the parallel mode. Moreover, Web service got these results and returned them to Web-Client in XML format. In this case, the XML string only contains two sets of values, the values of token-count and the time of computation of related token-count. Web-Client generates charts according to the data of simulation result and display these chart for users.

Three types of chart could be generated, first of all, the normal 2D coordinate chart of each selected locations will be generated, and then the integrated 2D Chart will be displayed. The integrated 2D chat integrated all of selected locations changing lines in one chart. Finally, a 3D chart can be displayed in order to give user a more exhaustive way to analyze data (Figure5).
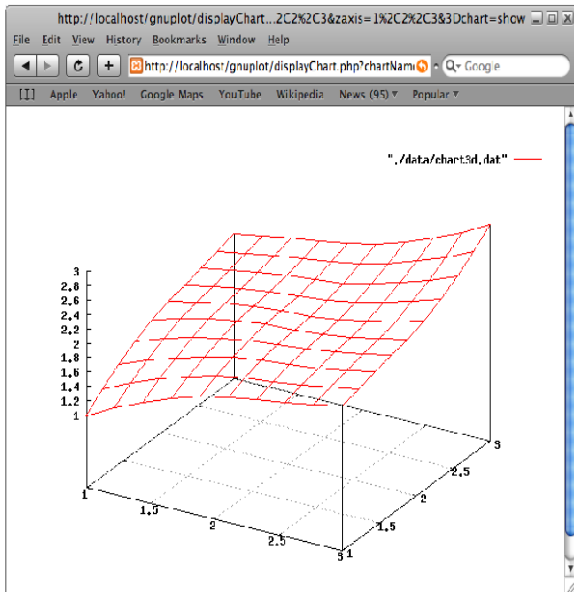
Figure 5.

4. CONCLUSION

While developing the whole system, security mechanism was always put in our consideration. Users' passwords are encrypted by MD5 arithmetic before saving into database, so nobody can know the real password of users. Avoiding some unwelcome connection entering system by typing interruptive URL, we use session technique in our system and added some special Java-Script codes in echo pages. Thus no matter URL of which page (not included homepage) unexpected guests typed in browser, system can navigate browser to the login page of Web-Client. Unauthorized users cannot use Web-Client.

The advantages of Visual Petri-Nets system are that we made the best use of parallel calculating with Rocks cluster in Moldova State University. Clinicists can manage many patients and do simulations synchronously. The advantage of high performance computing is drawn out. The two ways (normal client and Web-Client) of using this system offer the users (clinicists) great convenience. Clinicists even can work on his or her PDA or smart phone in future. The Web Client was built following the standard of W3C, so users can use Petri-Nets no matter which browser is used.

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# ELABORATION AND RESEARCH OF PLANETARY PRECESSIONAL MULTIPLIER

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1. INTRODUCTION

The multiplier is an indispensable part of the micro hydropower plant and high power wind turbine. It helps to increase rotor low speeds limited by the water flow small velocity and by the relative big placement diameter of the blades that participate in the energy conversion. For example, the microhydrostation rotor's speed is *(2 – 3) min^-1* for water flow velocity *V=(1...1,6) m/s* and for blade placement diameter *D = 4 m*.

Diversity of requirements forwarded by the beneficiaries of mechanical transmissions consists, in particular, in increasing reliability, efficiency and lifting capacity, and in reducing the mass and dimensions. It becomes more and more difficult to satisfy the mentioned demands by partial updating of traditional transmissions. The target problem can be solved with special effects by developing new types of multipliers based on precessional planetary transmissions with multiple gear, that were developed by the authors. Absolute multiplicity of precessional gear (up to *100%* pairs of teeth simultaneously involved in gearing, compared to *5%-7%* - in classical gearings) provides increased lifting capacity and small mass and dimensions. To mention that until now precessional planetary transmissions have been researched and applied mainly in reducers. Therefore it was necessary to carry out theoretical research to determine the geometrical parameters of the precessional gear that operates in multiplier mode. Also, it was necessary to develop new conceptual diagrams of precessional transmissions that function under multiplier regime.

The majority of precessional planetary transmissions diagrams developed previously operate efficiently in reducer's regime [1]. Depending on the structural diagram, precessional transmissions fall into two main types – *K-H-V* and *2K-H*, from which a wide range of constructive solutions with wide kinematical and functional options that operate in multiplier regime. The kinematical diagram of the precessional transmission *K-H-V* (fig. 1), comprises five basic elements: planet career *H*, satellite gear *g*, two central wheels b with the same number of teeth, controlling mechanism *W* and the body (frame). The
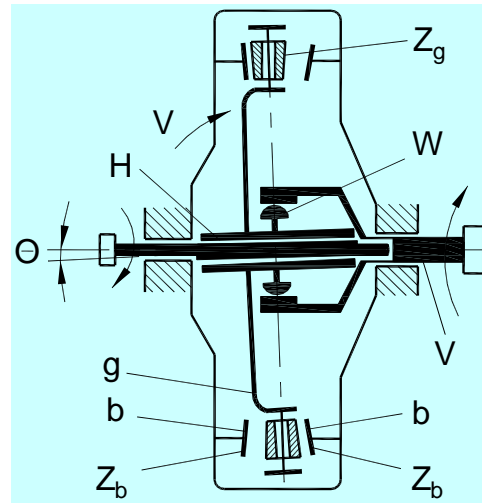
Figure 1. Conceptual diagrams of precesional transmissions that operates efficiently in the multiplication regime.

roller rim of the satellite gear g gears internally with the sun wheels b, and their teeth generators cross in a point, so-called the centre of precession. The satellite gear g is mounted on the planet (wheel) career *H*, designed in the form of a sloped crank, which axis forms some angle with the central wheel axis *θ*.

Revolving, the sloped crank *H* transmits sphero-spatial motion to the satellite wheel regarding the ball hinge installed in the centre of precession. For the transmission with the controlling mechanism designed as clutch coupling (fig.1), the gear ratio (gear reduction rate) varies in the limits:

$$i_{HV}^g = -\frac{z_g \cos\Theta - z_b}{z_b}; \quad i_{HV}^g = -\frac{z_g \cos\Theta - z_b}{z_b \cos\Theta}, \quad (1)$$

reaching the extreme values of *4* times for each revolution of the crank *H*. If necessary this shortcoming can be eliminated using as a controlling mechanism the constant cardan joint (Hooke's joint), the ball synchronous couplings, etc.

$$i_{HVmed}^g = -\frac{z_g - z_b}{z_b}. \quad (2)$$

$$i_{HV}^g = -\frac{1}{z_b},$$

For $z_g = z_b+1$, the driving and driven shafts have opposite directions.

$$i_{HV}^g = \frac{1}{z_b},$$

For $z_g = z_b-1$, the shafts revolve in the same direction.

This kinematical diagram of the precessional transmission ensures a range of gear ratios $i = 8...60$, but in the multiplication regime it operates efficiently only for the range of gear ratios $i = 8...25$. As well, in the coupling mechanism W, that operates with pitch angles of the semi couplings up to 3°, power losses occur reducing the efficiency of the multiplier on the whole.

2. ANALYTIC DESCRIPTION OF TEETH PROFILE AND JUSTIFICA-TION OF PRECESSIONAL GEAR PARAMETERS SELECTION

Teeth profiles have an important role in the efficient transformation of motion in the precessional transmissions that operate as multiplier. Multiple precessional gear theory, previously developed, did not take into consideration the influence of the diagram error of the linking mechanism in the processing device for gear wheel on the teeth profile. Functioning under the multiplication regime, these errors have major influence, which can lead to instant blocking of gear

and to power losses. With this purpose, a thorough analysis was conducted on the motion development mechanism under multiplication, and on the teeth profile error generating source. On the basis of fundamental theory of multiple precessional gear, previously developed, a new gear with modified teeth profile and the technology for its industrial manufacturing was proposed and patented [2].

Kinematically, the link between the semi product and the tool, in which one of them (the tool) makes spherical-spatial motion being, at the same time, limited from rotating around the axis of the main shaft of the teething machine tool, is similar to the *„satellite-driven shaft"* link from the precessional planetary transmission of the *K-H-V* type. The kinematical link between the tool and the stationary part of the device represents a Hooke articulation that generates the variability of transfer function in the kinematical link *„tool-semi product"*. This variation will influence the teeth profile. Thus, the connection of tool with the housing registers a certain diagram error $\varDelta\psi_3$ (to understand the deviation of the semi product angle of rotation ψ_3 from the angle of rotation of the semi product itself ψ_3^m at its uniform rotation):

$$u_{31}^m = -\frac{z_2 - z_3}{z_3}; \varDelta\psi_3 = \psi_3 - u_{31}^m = \frac{z_2}{z_3}\left(\psi - arctg(cos\theta \cdot tg\psi)\right). \quad (3)$$

Fig. 2 show the dependence of the tool position diagram error $\varDelta\psi_3$ at a revolution of the machine tool main shaft ψ. This error is transmitted to the tool that shapes the teeth profile with the
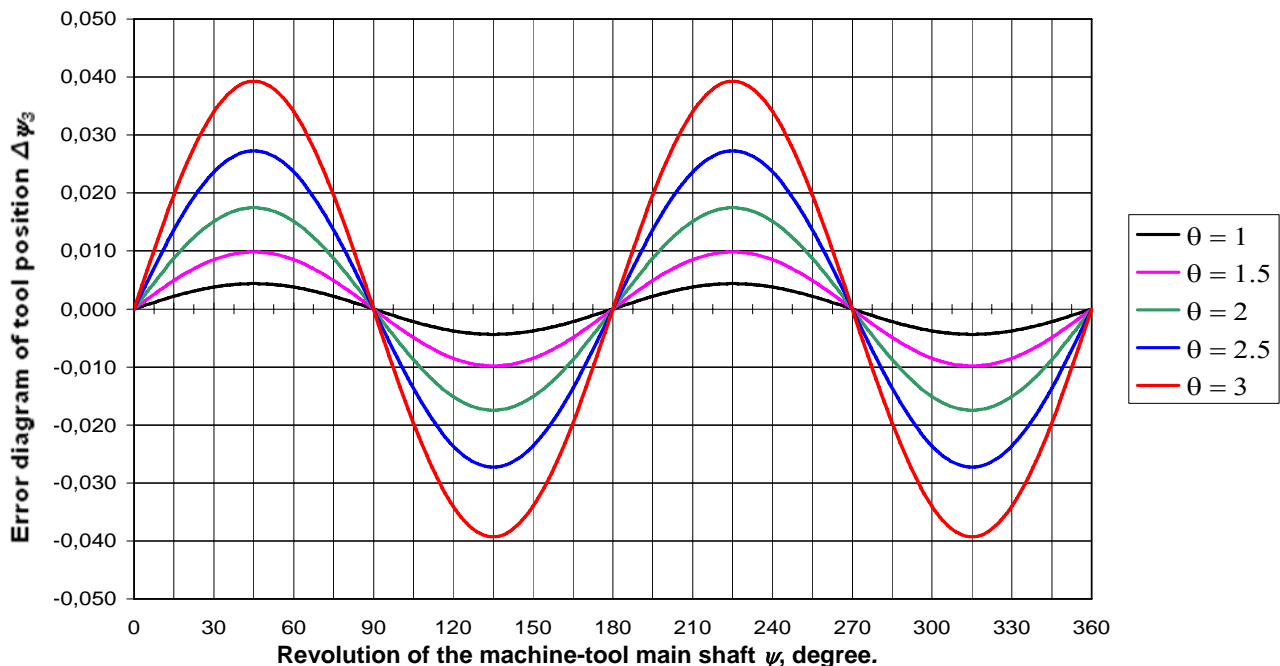

Figure 2. Dependence of the error diagram of tool position $\varDelta\psi_3$ at a revolution of the machine-tool main shaft ψ.

same error. To ensure continuity of the transfer function and to improve the performances of precessional transmission under multiplication it is necessary to modify teeth profile with the diagram error value $\Delta\psi_3$ by communicating supplementary motion to the tool. In this case the momentary transmission ratio of the manufactured gear will be constant. Usually, in theoretical mechanics the position of the body making spherical-spatial motion is described by Euler angles. The mobile coordinate system $OX1Y1Z1$ is connected rigidly with the satellite wheel, which origin coincides with the centre of precession 0 (Fig. 3) and performs spherical-spatial motion together with the satellite wheel relative to the motionless coordinate system $OXYZ$.

The elaboration of the mathematic model of the modified teeth profile is based integrally on the mathematic model of teeth profile, previously developed by the authors. With this purpose it is necessary to present the detailed description of teeth profile without modification and, then, to present of the description of modified profile peculiarities.

Description of teeth profile designed on sphere. An arbitrary point D of the tool axis describes a trajectory relative to the fixed system according to the equations:

$$X_D^m = -\sin\delta\,\sin\left[Y_C^m\,\sin\theta + Z_C^m\left(1-\cos\theta\right)\cos\psi\right];$$
$$Y_D^m = -Y_C^m\,\cos\delta + Z_C^m\,\sin\delta\left[\cos^2\psi + \cos\theta\,\sin^2\psi\right];$$
$$Z_D^m = -Y_C^m\,\sin\delta\left(\cos^2\psi + \cos\theta\,\sin^2\psi\right) - Z_C^m\,\cos\delta. \quad (4)$$

Index m means „modified". The motion of point Dm compared to the movable system connected rigidly to the semi product is described by formulas:

$$X_{1D}^m = X_D^m\,\cos\frac{\psi}{Z_1} - Y_D^m\,\sin\frac{\psi}{Z_1};$$
$$Y_{1D}^m = X_D^m\,\sin\frac{\psi}{Z_1} + Y_D^m\,\cos\frac{\psi}{Z_1};$$
$$Z_{1D}^m = Z_D^m. \quad (5)$$

The projections of point Dm velocities $OXYZ$ and $OX1Y1Z1$ is expressed by formulas:

$$\dot{X}_D^m = -\sin\delta\,\cos\psi\left[Y_C^m\,\sin\theta + Z_C^m\left(1-\cos\theta\right)\cos\psi\right]\dot{\psi} -$$
$$-\sin\delta\,\sin\psi\left[\dot{Y}_C^m\,\sin\theta + \dot{Z}_C^m\left(1-\cos\theta\right)\cos\psi - Z_C^m\left(1-\cos\theta\right)\sin\psi\cdot\dot{\psi}\right];$$
$$\dot{Y}_D^m = -\dot{Y}_C^m\,\cos\delta + \dot{Z}_C^m\,\sin\delta\left[\cos^2\psi + \cos\theta\,\sin^2\psi\right] +$$
$$+Z_C^m\,\sin\delta\left[-2\cos\psi\,\sin\psi + 2\cos\theta\,\sin\psi\,\cos\psi\right]\dot{\psi};$$

$$\dot{X}_{1D}^m = \dot{X}_D^m\,\cos\frac{\psi}{Z_1} - \frac{\dot{\psi}}{Z_1}X_D^m\,\sin\frac{\psi}{Z_1} - \dot{Y}_D^m\,\sin\frac{\psi}{Z_1} - \frac{\dot{\psi}}{Z_1}Y_D^m\,\cos\frac{\psi}{Z_1};$$
$$\dot{Y}_{1D}^m = \dot{X}_D^m\,\sin\frac{\psi}{Z_1} + \frac{\dot{\psi}}{Z_1}X_D^m\,\cos\frac{\psi}{Z_1} + \dot{Y}_D^m\,\cos\frac{\psi}{Z_1} - \frac{\dot{\psi}}{Z_1}Y_D^m\,\sin\frac{\psi}{Z_1}. \quad (6)$$

The coordinates of point Em on the sphere is calculated by formulas:

$$X_{lE}^m = k_2^m Z_{lE}^m + d_2^m;$$
$$Y_{lE}^m = k_1^m Z_{lE}^m - d_1^m;$$
$$Z_{lE}^m = \frac{(k_1^m d_1^m - k_2^m d_2^m) - \sqrt{(k_1^m d_1^m - k_2^m d_2^m)^2 + (k_1^{m2} + k_2^{m2} + 1)\cdot(R_D^2 - d_1^{m2} - d_2^{m2})}}{k_1^{m2} + k_2^{m2} + 1}, \quad (7)$$

where:

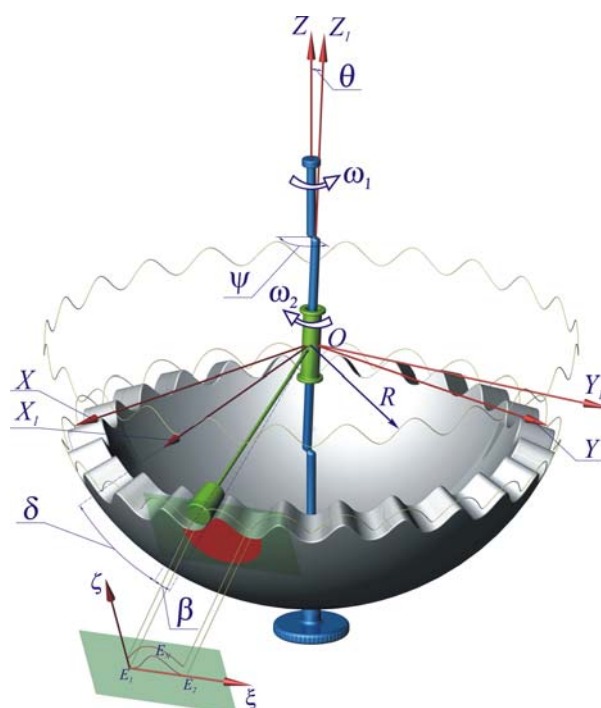**Figure 3.** Tooth profile in normal section.

$$k_1^m = \frac{X_{1D}^m\left(X_{1D}^m\,\dot{X}_{1D}^m + Y_{1D}^m\,\dot{Y}_{1D}^m\right) + Z_{1D}^{m\,2}\,\dot{X}_{1D}^m}{Z_{1D}^m\left(X_{1D}^m\,\dot{Y}_{1D}^m - Y_{1D}^m\,\dot{X}_{1D}^m\right)}; \quad k_2^m = -\frac{\left(k_1^m Y_{1D}^m + Z_{1D}^m\right)}{X_{1D}^m};$$
$$d_1^m = \frac{R_D^2\,\cos\beta\,\dot{X}_{1D}^m}{\left(X_{1D}^m\,\dot{Y}_{1D}^m - \dot{X}_{1D}^m\,Y_{1D}^m\right)}; \quad d_2^m = \frac{\left(R_D^2\,\cos\beta + d_1^m Y_{1D}^m\right)}{X_{1D}^m}.$$

According to the obtained analytical relations a soft for the calculation and generation of teeth was developed in CATIA V5R7 modelling system that allowed obtaining the modified trajectories of points Em_e and Em_i on the spherical front surfaces, both exterior and interior ones, by which the teeth surface was generated (Fig. 4).

Description of modified teeth profile projected on a transversal surface. Projection of

point E_m on the tooth transversal plane has the following coordinates:

$$X_E''^m = \varepsilon^m \cdot X_{1E}^m, \quad Y_E''^m = \varepsilon^m \cdot Y_{1E}''^m, \quad Z_E''^m = \varepsilon^m \cdot Z_{1E}''^m, \quad (8)$$

where
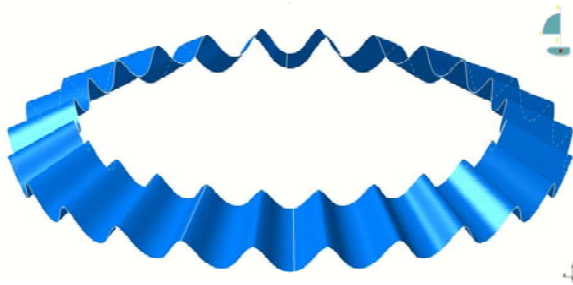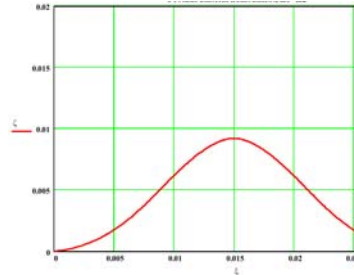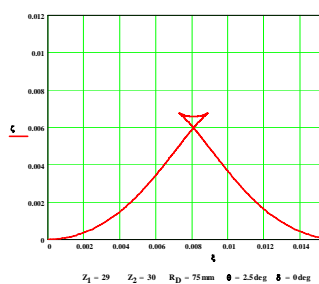$$\varepsilon^m = -\frac{D}{AX_{1E}^m + BY_{1E}^m + CZ_{1E}^m}.$$

Figure 4. Teeth generating surface.

The modified teeth profile in plane is described by the equations:

$$\xi^m = X_E''^m \cos\frac{\pi}{Z_1} + \left[R_D \cos(\delta+\theta+\beta) + Y_E''^m\right]\sin\frac{\pi}{Z_1};$$

$$\zeta^m = X_E''^m \sin\gamma \sin\frac{\pi}{Z_1} - \left[R_D \cos(\delta+\theta+\beta) + Y_E''^m\right]\sin\gamma\cos\frac{\pi}{Z_1} +$$

$$+\left[R_D \sin(\delta+\theta+\beta) + Z_E''^m\right]\cos\gamma. \quad (9)$$

A wide range of modified teeth profiles with different geometrical parameters were generated in MathCAD 2001 Professional software (Fig. 5 a,b). The solid model of a gear wheel is shown in Fig. 6. Based on the carried out research it was established that from the point of view of decreasing energy losses in gearing, in the multiplication mode of operation, the gearing angle should be $\alpha > 45^0$,

3. ELABORATION OF PLANETARY PRECESSIONAL MULTIPLIER

To avoid power losses in the multiplier and to widen the kinematical options, (Fig. 7) [4] the conceptual diagram of the precessional multiplier with wide kinematical options was designed. The planetary precessional multiplier comprises the following units: the housing *1*, inside which the fixed sun wheel *2* is placed and connected rigidly to the housing cover *3*, exterior satellite wheel *4* with the teeth in the shape of rollers, movable sun wheel *5*, linked rigidly to the input shaft *6*. The satellite wheel *3* is connected kinematically with the sloped flange of the disk *7*, connected rigidly with the sun wheel *8*, that gears with the interior satellite wheel *9* mounted unbound on the output crank shaft *10*, and linked rigidly to the rotor generator *11*. The exterior satellite wheel *4* is mounted void on gear bodies on exterior spherical surfaces of the interior wheel *9*. The pitch angle of the output crank shaft *10* axis and of the sloped flange is equal to θ. The rotational motion of the input shaft *6* is transmitted to the movable sun wheel *5*. Due to the difference in the number of teeth of wheel *5* and of the exterior satellite wheel (gear) *4 (Z6 = Z5±1)*, the last will have to carry out a precession motion around the fixed point O (centre of precession). Precessional motion around its axis is excluded as the number of teeth of the sun wheel *2* is equal to the number of rollers of the satellite gear *4 (Z2 = Z4)*. The precessional motion of the exterior satellite gear *4* is transformed, by means of an inclined flange of the disc *7*, into rotational motion around the disc axis *7*

a.

b.

Figure 5. Teeth profiles for multipliers.
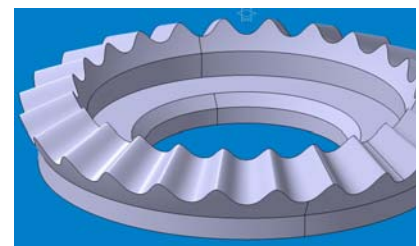
Figure 6. Computerised model of the sun gear.

and the nutation angle (the pitch angle of the crank shaft) should be– $\theta \le 2,5^0$.

This is dictated by the reverse principle of movement in the multipliers compared to the reducers: the axial component of the normal force in gear must be maximal to drive the crank shaft in the rotation movement through the satellite wheel.

that will revolve by the degree of multiplication

$$i_7 = -\frac{z_5}{z_4 - z_5}, \quad (10)$$

where *Z4* is the number of rollers of the exterior satellite gear *4*;

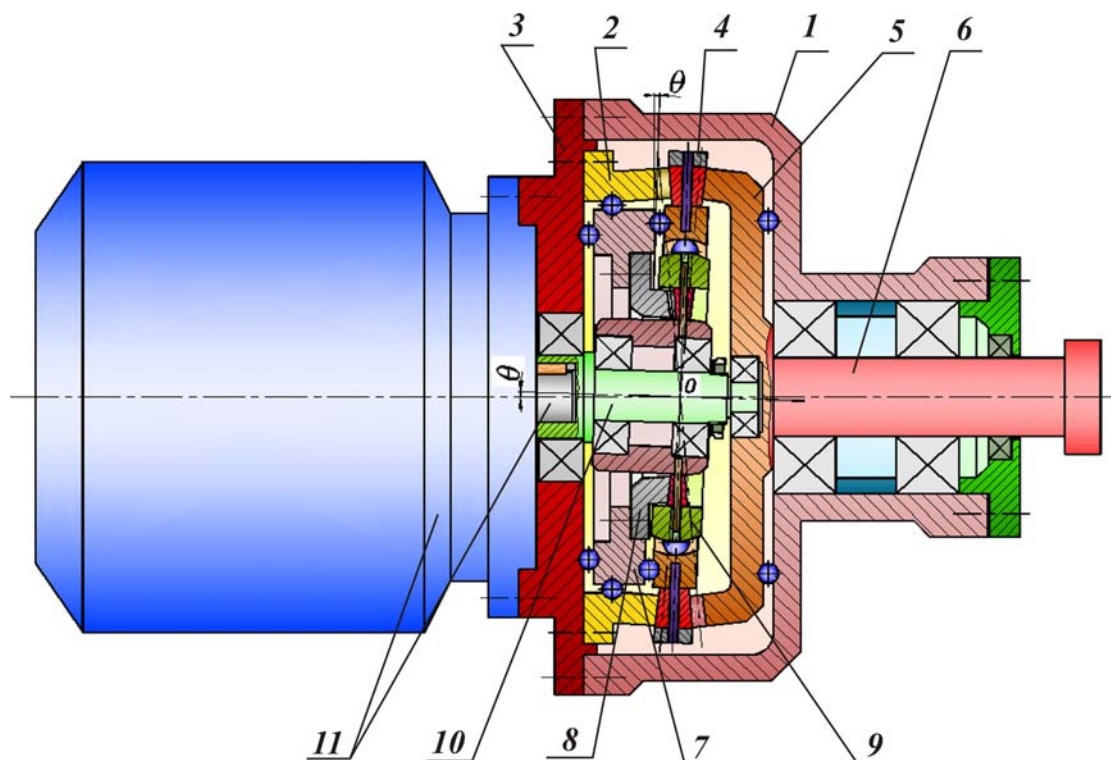*Z5* – is the number of teeth of the movable sun wheel *5*.

Fig. 7. Planetary precessional multiplier with satellite gear mounted radially.

The multiplied rotational motion of the disc *7* is transformed into multiplied precessional motion of the interior satellite gear *9*, due to the difference in the number of teeth *Z8=Z9±1*. At the rotation of disc *7* of the sun wheel *8* at an angle equal to the teeth angular pitch, the interior satellite gear will perform a complete precession cycle around point „*O*". The precessional motion of the interior satellite gear *9* is transformed by means of output crank shaft *10* into rotational motion, multiplied to the degree of multiplication

$$i_{10} = -\frac{z_8}{z_9 - z_8},$$

(11)

where *Z8* is the number of teeth of the sun wheel *8*,

Z9 – is the number of rollers of the satellite gear *9*.

The multiplied rotational motion of the output crank shaft *10* is transmitted to the electrical generator rotor *11*.

CONCLUSIONS

It is necessary to point out the series of peculiarities of the planetary precessional transmissions that ensure higher performances compared to similar planetary transmissions with cylindrical gears: precessional transmissions do not demand conditions of distance equality between the axis. This factor widens the area of their optimal design; precessional transmission kinematics does not limit the selection of the gear couples modules or of the rollers placement pitch. This factor increases the possibilities of shaping teeth pairs and of the transmission ratios interval; the peculiarities of the designed precessional gears allow increasing in the number of teeth that transmit the load simultaneously and this fact reduces significantly the dimensions and mass for the same loads compared to the traditional involute gearings.

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PUBLIC UTILITY EXPROPRIATION

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INTRODUCTION

The property has been and always remain an indispensable element of society. Being guided by the state, it is firmly attached to her owner and is as shown in the "citizen" Declaration of Human Rights is the most sacred of his rights. Ownership is considered to be the most important component of the legal system.

I chose this research topic because Moldova is a country that is developing and the need for state acquisition of private property, motivated by the public is welcome to further achieve the goals of general interest. Republic of Moldova and other countries in transition is confronting with such problems as: how much property is, where it comes from, who belongs, who deserve it, on who should be given on.

I. EXPROPRIATION –GROUNDS FOR TERMINATION OF PROPERTY

1.1 Ownership, it's characters

Ownership characters is a property right that gives the holder the right of subjective exercise their own power and self-interest of the attributes of possession, use and dispose of his property within the limits set by law. Property is very current issue in Moldova, the state is in transition from primarily state ownership to public and private property. This period is characterized by division and redistribution of property.

Characters can be listed ownership:

a) **absolute** by the meaning that all the attributes of what legal form the content holder and are recognized by their fullness belong to the copyright holder without the need for other people. Also in absolute terms means that title is enforceable against all (erga omnes), the holder being able to oppose its right of all people, they are obliged to recognize and respect the prerogatives of ownership. Thus, the property is absolute in comparison with other real rights, as against all, but not absolute in itself.

b) The **exclusive** character of ownership allows the owner to do what they want with their property within the limits prescribed by law. Exclusive nature of property rights excludes the idea that outside owner in the same time another person has the same asset ownership rights. This does not exclude competition but the same good property rights belonging to different owners as common property rights. In this sense, only the owner or co-owners in case of individuals are entitled to exercise this right of property attributes that are its object.

c) **Perpetual** nature of ownership, requires firstly that lasts as long as there are both good and secondly, that ownership does not go by unused perpetual nature of ownership and it is revealed by the fact that this is a hereditary right is inalienable in terms of extinction it, is inviolable and may not be transferred by force. However, although this character is assumed that ownership as long as there is good is, not excluded that it may be assigned by court documents certifying the need for the declaration of public utility.

d) **Individual** character of ownership, explains itself by its nature it is an individual right in the sense that its attributes belong and are exercised by one person. An exception is the joint ownership to individual character, in which ownership belongs simultaneously to two or more persons, carrying both its characters.

e) **Legal** character is also characteristic of ownership, meaning that the law establishes both the content and limits the powers as owner. The property is exercised within the limits determined by law, holders of property rights requires respect for its rules and tasks that are stipulated by law as a restriction. Therefore, ownership can not be considered free in its content, but rather limited by law. Furthermore, attributes and methods of execution are by their nature governed by the law that means restricted.

1.2 Principles for the public expropriation

Expropriation can be considered as a mechanism of rights owners as strange it can be seemed, although it leads to settle ownership. They say this because expropriation must be made in compliance with legal and political principles.

Different legal systems treat different the expropriation, but a principle which should persist in all the systems would be under the owner must have paths that would allow it to challenge the expropriation. Establishing such a principle will allow once again to say that in this way is trying to find the point of tangency between the state and expropriated. Because of private property can be expropriated and pass into the public domain, it is necessary in the public interest. The necessity of public declaration is based and provided in art. 46 of the Constitution, Art. 316 of Civil Code and Law on expropriation for public utility. Declaration of public utility is made only after research prior to the power of committee appointed by the Government for works of national or local interest. Another applicable expropriation principle, is the existence of a just and prior compensation expropriated. As stated in the literature, the public interest can justify the expropriation, but not exempt the payment of compensation to expropriated loss suffered by the owner and possibly other holders of real rights over property expropriated." Compensation must be right, that is to represent the true value of the property expropriated. Thus, the content of the constitutional guarantee of property rights is included mandatory condition for expropriation compensation. Moreover, the conditions expressly stated compensation. The conclusions are that the compensation is on a hand a justification, and on the other hand, is a limit.

1.3 The objects subjects to expropriation

Accordingly to the point 2 of the Law of the public utility expropriation, as the object of expropriation can be:
- objects of national interest;
- items of local interest;
- movable established by organic law, in case of emergency, martial law and war.

In the category of objects of national interest are:

a) real property, at which is reported: land, underground water basins, forests, buildings, constructions and other objects related to land,

whose permutation is impossible or irreparable harm, so can not be used at the destination,

b) the rights to use the term real estate of up to five years, unless the parties agree on another term ,

c) property rights and personal non-related inventions that can directly contribute significantly to ensuring defense and security interests of the country,

d) cultural and artistic values and historical o exceptional importance for the national feelings of the people and showing the country's statehood;

e) ownership of the representatives of flora and fauna, for the natural area of Moldova is its development and reproduction and which are endangered in the world where there is real danger of extinction.

In the category of objects of local interest are:

a) real property;

b) rights on immovable property referred to in letter. a) and b) the category of objects of national interest. As for category movable expropriation, expropriation law for the public, states that they may be expropriated only in case of emergency, siege and war, established by organic law. I think that will be passed a law stating exactly what can be expropriated moveable in these situations should be other than those provided for requisition of goods.

II. PROCEDURAL ASPECTS OF RESORTING TO THE PUBLIC

2.1 Public utility and its declaration

Declaring it is a real administrative act, an act-condition that triggers the procedure of expropriation. Although, expropriation can only be for public works and art. 5 (1) of the Law on expropriation for the public, lists these works. As we stated, they are public works of national interest which, by their functions, meets the objectives and interests of the whole company or a large part of it. In contrast, local public utility works that are by their function, meets the objectives and interests of a social group or locality, a group of municipalities within a territorial-administrative units.

Declaration of public utility is made only after a preliminary investigation and only if there are any conditions for expropriation, as provided by law. The prior research establish supporting evidence of national or local interest, the economic preconditions for social, environmental or other

work of necessity, their enrollment in urban and spatial planning.

Previous research works of national interest are made by committees formed by the Government, which includes one representative of central government coordinating the industry for which the public work.

2.2 Measures for expropriation

After a preliminary declaration of public utility, expropriators which, according to art. 4 of Law nr.488/1999 on expropriation in the public interest, not by bodies other than the State's ability or through specially designated by law to perform the action for submitting the expropriation proposal within 10 days publication of the measure to declare public utility. Expropriation proposal will contain notification holders of real rights on buildings came into sight expropriator and on which the declaration was made public, the offer of compensation, how the transfer of property and economic rights. The term resolution of greeting and the commission objections are solved within 30 days by o committee made up by the decision of the works Government of national interest and decision of the local council works by the local interest or by decision of the respective local councils for the work of common interest.

Commission Decision. After deliberation the Commission issues a reasoned decision is communicated to the parties within 5 days of adoption. Commission decision serves as a basis for determining the amount of compensation, which in no case is less than that established in the proposal for expropriation. If the Commission accept the decision, the expropriated and expropriators can agree on how to transfer the property, will determine the amount and payment of compensation. Such an agreement among the parties is notarized, the expropriation expenses being incurred. If expropriators and expropriated not reach a compromise on the conditions of expropriation, even after taking note of Commission Decision, expropriation may be made only by a court with just and prior compensation. The essence of court involvement is that the dispute will be resolved by the court will determine compensation authorized to be expropriated to return.

2.3 Expropriation itself, remedies and establishing

According to art. 14 of the Law on the public expropriation, is obliged to inform expropriators expropriated and the also court in 10 days of notification of examination of the expropriation case, of the holders or other real rights over the property, otherwise expropriated will be responsible for compensation to owners. And where third parties do not lodge claims for it will not take into account when determining the amount of compensation. In addition to the express provision of expropriation, the court decision will also contain provisions relating to, right and prior compensation. Legally, compensation should cover the actual building, combined with the damage caused to the owner or other holders of rights. Value, the compensation shall be fixed by the court, between the supply and the amount requested expropriator expropriated and can not be less than the first, but not greater than the last.

But the real value will be determined the using of scientific method, by the specialized expertise, which will be conducted by a panel of experts including a representative that may attend the expropriator and expropriated. Expropriators has the right to stop the expropriation, including where the final decision regarding the compensation court if the latter was not made. In this case expropriated, is entitled to demand compensation for damage caused. Fees and expenses of expropriation case examination shall be borne by the expropriated in accordance with the legislation. Given that decisions of the court is subject to remedies provided by law, it is possible that at the time of payment, compensation may not match the actual value of the property and the amount of damage caused, so that interested persons may require updating the amount of compensation for it to remain "right" as required by law.

CONCLUSIONS

Expropriation remains one of the most severe limitations of ownership. Being seen as a way to stop private property, doing it without a just and prior compensation, leading to damage to private property enshrined the fundamental right of the Constitution in Article 46. In spite of its deep political nature, expropriation legal method can be

regarded as the ultimate guarantee of property rights against the state. In modern legal system, the individual must be guaranteed against the State, which is one of the most important aspects of what we call the rule of law.

Disastrous impact which may result from improper implementation of expropriation is of immense proportion. This justifies to find out a medium way between individual interests and social interests can only be done through strict regulation of the conditions of expropriation for the public. Unfortunately it is clear that this is not easy to achieve as long as unfortunately, practice and reality shows that the application of rights is a high difficulty, and the laws remain just adopted, their implementation is quite difficult making.

Some findings were revealed in order to spur scientific debate expected to have the purpose to remove loopholes and improving the legislation. The open nature of legal thought can thus contribute to a greater extent, to acquire knowledge and deepen research expropriation procedure. Stimulate thinking can not and should not replace individual study at practice. Going this way was necessary to achieve the goal. I believe that the necessity of knowledge for the expropriation concept in the public interest is unquestionable, because once the person is the owner of a property he can automatically become the candidate of expropriation for the public or local interest or national interest.

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TECHNICAL CREATIVITY AND THE FUTURE OF ENGINEERING EDUCATION

With the complexity surrounding every engineering project mounting as natural resources dwindle, the world population increases, and the global infrastructure and economy grow ever more intertwined, the creativity and innovation necessary to address the big issues facing civilization - maintaining the infrastructure; providing food, water, shelter, and power to the population; and growing sustainably and safely - will only increase in importance.

What is Creativity?

The late Dr. E. Paul Torrance, a pioneering creativity researcher for over 60 years, is widely considered the "*Father of Creativity*". He made it his life's work to study the nature of creativity and how it can be taught to students of all ages. Among his numerous contributions was groundbreaking research in educational psychology that led to a benchmark method for quantifying creativity. His "*Torrance Tests of Creative Thinking*" effectively debunked the common assumption that IQ alone determined creativity. It also led to the now accepted belief that creative levels can be increased through practice. Torrance defined creativity as "*the process of sensing problems or gaps in information, forming ideas of hypotheses, testing, and modifying these hypotheses, and communicating the results. This process may lead to any one of many kinds of products - verbal and nonverbal, concrete and abstract*". This definition subsumes such creative "*products*" as works of art, but through the intentional use of scientific terminology (e.g., "*hypotheses*"), Torrance intended a more inclusive definition that included "*inventions, medical discoveries, books, monographs*". Clearly Torrance looked for creativity in science and engineering just as he did in theater and English departments. Several other educators have offered definitions for creativity as it applies to engineering. It has been described as "*the awareness, observation, imagination, conceptualization, and rearrangement of existing elements to generate new ideas*". Goldsmith described it as "*The production and disclosure of a new fact, law, relationship, device or product, process, or system based generally on available knowledge but not following directly, easily, simply, or even by usual logical processes from the guiding information at hand*". Pereira defined creativity as "*the capacity to perform mental work that leads to an outcome both novel and applicable*".

The creative thought, then, is something that leads to the creative act or the creation of something new - an idea, theory, or physical product. When approaching technical matters, the term "innovation" is often used instead of creativity to describe the process that leads to insight or progress in a field, with a technique, or with a physical product. While innovation connotes a sense of inventing a thing as opposed to an idea or a theory, it is essentially a synonym for the creative process. Perhaps technical people prefer to be "*innovative*" rather than "*creative*". Regardless of what you call it, both innovation and creativity should lead one to the same end: to the exciting world of inventing and creating new knowledge, processes, and artefacts that push forward our science, technology, and art.

The Creative Process

The notion of a lone genius thinking up something brilliant and changing the world is a myth that has fortunately been debunked. Most people who study creativity now accept the notion that creativity is not something that happens in a vacuum. The definitions presented above articulate the notion that creativity is a process rooted in the real world. Every process has components, and the essential stages in the creative process include:

- Sensing, testing, modifying, and communicating (Torrance 1963);
- Orientation, preparation, analysis, ideation, incubation, synthesis, and evaluation (Osborn
- 1953); and
- Problem definition, preparation, incubation, illumination, and verification (Farid et al.
- 1993).

The creative process must go through a series of four stages, beginning with:

- a notion or need (sensing, problem definition, and orientation);

- an investigation of that notion or need (testing, preparation, incubation, analysis, and ideation);

- an articulation of a new idea or solution (modifying, illumination, and synthesis);

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- a validation process of that idea or solution resulting in an idea, theory, process, or physical product (communicating, verification, and evaluation).

These four stages should be familiar to engineers, as they more or less mirror the design process itself, which never forget is (or should be) a creative endeavour. For example: the client approaches the engineer with a need; the engineering firm investigates the project parameters and potential solutions, often through a design team or charette approach; the engineering firm presents its plan to the client; after numerous iterations, the final design is formalized. Countless variations of this simplified process exist, but hopefully it is apparent that, at its base, the engineering process is compatible with a creative process.

Should Engineers Strive To Be Creative?

The insight and understanding that civil engineers possess could immeasurably enhance the effort to solve the crucial issues facing the 21st century such as maintaining the infrastructure, providing clean water and food, and protecting the environment. Creative solutions to these big issues are essential to the health, viability, and continuation of civil society in the 21st century. Yet far from leading the effort to build more efficiently, with less waste, and in a safer manner, civil engineers very often follow the age-old project model and provide valuable technical services without creative input or leadership. The market for civil engineering design and consulting services is not likely to diminish in the 21st century; the only questions are what role civil engineers will play in determining the scope of their contributions and the market value for these services. The issue quickly becomes can civil engineers afford not to be creative?

The problem of creativity in civil engineering begins at the base. Civil engineering as a profession (and engineering in general) has not been intentional about educating students to become creative in their application of their technical and professional skills. Said another way, the value of creativity is not explicitly communicated to students as a priority of their education. Yet even in the most technical of positions, civil engineers must find novel and unique ways to approach and solve design challenges, whether this means placing piping in unique formations or finding a way to stabilize soil in a nontraditional manner.

Consider for a moment a massive public works project that has taxed the abilities of the civil engineering profession and the construction industry. The Central Artery/Tunnel in Boston, known as the Big Dig, has been called "*the biggest, most complex, and most expensive highway engineering job in U.S. history*" (Vizard 2001), as well as "*the largest publics works project ever undertaken in the history of the United States*" (Bushouse 2002). Rerouting over 200,000 vehicles a day without ceasing traffic, gaining and keeping public approval, and acquiring the necessary environmental permits have been just a few of the many challenges requiring significant communication, leadership, systems thinking, and creative problem solving from many project participants. Keeping existing roads operational has necessitated innovative management techniques and construction methods, including the use of global positioning technology, laser measuring tools, and the use of slurry walls, ground freezing, and chemical stabilization of soil (Angelo 2001).

Yet for all its success - and when completed, the project will help revitalize and change a historic, economically important downtown - The Big Dig has gone way over budget and suffered from oversight, unforeseen consequences, and contractor bankruptcy. While the Big Dig may be an extreme example - clearly it is at the edge of the project spectrum - it can still serve as a touchstone and as a warning for civil engineering and engineering as a whole. In the 21st century, 20th-century solutions and thinking are not going to get the job done. How is the global community going to rebuild Iraq? How is the U.S. going to build less vulnerable and more secure facilities? How can we continue to update the aging infrastructure in our nation's cities without interrupting the flow of commuters and commerce? And how can we solve the as yet - unheard-of problems that will inevitably arise as the world grows smaller and opportunity costs loom larger?

Column written by professor Valeriu Dulgheru, Ph.D. Dr. Sc. from Technical University of Moldova

PERSONALITIES FROM THE MERIDIANS OF THE ENGINEERING UNIVERSE

Sergiu Rădăuţan was born on the 17th of June 1926 in Chişinău in an intellectual family. His grandfather, Serghei Rădăuţan, graduated the University of Sorbonne in Paris. His father, Ion Răduţan, worked as an assistant at University of Iaşi, then as a French teacher at Theological Seminary from Chişinău. His mother, Nina, was a music teacher. He attended the primary school in Chişinău, then "B.P.Haşdeu" Highschol. Life was tough with Serghei and his family. Firstly, in 1940, they were forced to take a difficult decision: to leave for Romania or to stay in Chişinău.

They stayed. In 1941 his father, Ion Rădăuţan, soldier in soviet army, died in Ukraine. Sergiu was only 15 when, due to the circumstances, fought against poverty together with his grandfather, his mother and his 8 years old brother. He faced all sorts of problems. He intended to attend the Pedagogical Institute in order to become a teacher just like his parents, but, starting with 1945, he had to serve in the military service for five years. Only later, in 1950, when he was 24, he became a student at Faculty of Physics at the State University of Chişinău. He is said to have worn only military clothes in his first three academic years because he didn't have others. He was very conscious with his studies, but he also was a good fellow who shared with his colleagues his knowledge and his experience obtained during the military service. He took part in sports competitions and in cultural activities of the faculty with great success.

Towards scientific research. It can be said that his scientific career started when he was still a student under the supervision of professor M.V.Kot, with whom he worked in the domain of physics of semiconductors. Professor Kot had been appointed the head of the Department of Experimental Physics in 1953, department that had been founded in 1951. He made there the first researches in the domain of semiconductors. In 1955, immediately after graduation, due to his excellent school results, he was awarded a Ph.D. scholarship at „*A. Ioffe*" Physics Institute from Sankt-Petersburg. He studied the solid solutions obtained from Indium (In), Arsenic (As), Selenium (Se), Tellurium (Te) for four years and he got his Ph.D. diploma on the 26th of January 1959. He used his qualities as organizer also here, creating a bridge among the young students from Moldavia. In the Ph.D. students' hostel he initiated a lot of scientific discussions. He continued his researches within the Institute of Applied Physics of the Academy of Science from Moldavia with studies regarding the diamond semiconductors with defect structure, and based on the results, he got his habilitated diploma on the 17th of June 1966 at the Polytechnic Institute of Leningrad. He developed the activity of the Institute of Applied Physics in new directions, towards the study of semiconductors and of electronics of solids. His results, published in tens of articles and 30 books, made him the chief of the research lab (1961-1964) and later the Manager of the Center of semiconductor materials of the Institute of Applied Physics of the Academy of Science of Moldova (1995-1998).

Professor and Rector. The political leadership from the '60s started to set up the Polytechnic Institute of Chişinău in March 1964. On the 6th of May 1964 Sergiu Rădăuţan was appointed Rector. The summer of 1964 was very difficult for Sergiu Rădăuţan: he carefully selected a competent teaching staff, choosing professors that had Moldavian roots in one way or another. He formed a team of leaders, he equipped the labs, he organized the teaching process, he organized the entrance examination for the Polytechnic Institute of Chişinău and he started the activity with 575 day-courses students and 500 part-time courses and distance courses students. After the academic year started, the Rector Sergiu Rădăuţan visited some universities from the Soviet Union in order to cooperate with his institute in both teaching and research activities. In this context, several young researchers went to specialize, to get their Ph.D. diploma and many scientific conferences were organized in Chişinău. Despite the recommendations made by the political leaders, youth from Moldavian villages were encouraged to focus their attention on other specializations than agriculture, and the number of Moldavian students didn't drop under 65-70%. Little by little, the number of students increased up to 7,000, and Romanian language could be heard in the trolleybuses that brought these students from Râşcani, where the hostels had been built, to downtown where there were the classrooms and the labs. There were classes with Romanian students who were taught in Romanian. The Romanian language was used even in the Rector's office. The Rector built bridges among people by taking part in social events. He maintained and he developed the scientific relation with the Science Academy of Moldova.

Up to here....!Sergiu Rădăuţan's popularity had increased too much, so the political leadership threatened him directly. On the 9th of December 1970, an academician delivered a speech about the "Moldavian language". The audience was hostile, and the situation was considered to be "morally and

politically unhealthy". The political leadership sent two committees in order to "check the situation", but the decision had already been taken. Oven 50 persons were forced to leave the Polytechnic Institute. The Moldavian groups of students were rescinded. Afterwards, Sergiu Rădăuţan was fired on the 2nd of October 1973. At that moment the Polytechnic Institute had 11,000 students and the teaching staff comprised almost 1,000 people.

Acknowledgements. He returned to the Academy where he took up his researches again, and the evidence regarding his acknowledgement kept on coming. In 1991 he was elected as an honorific member of the Romanian Academy, and in 1992 as a member of the Academy of Engineering of Russian Federation. He was awarded Doctor Honoris Causa of the Universities of Timişoara, Braşov, Iaşi, Chişinău. He established a tight relationship with the scientists from Romania. He passed away on the 6th of March 1998.

Ion I. Agârbiceanu was born on the 6th of January 1907 in Bucium-Şasa. His father, Ion Agârbiceanu was a priest in the village, and his mother, Maria, was a housewife, which was normal for a priest's wife. Later, in 1919, his father became a member of the First Parliament of Great Romania, and during 1922-1926 he was vice-president of the Senate. He was a member of the Romanian Academy, editor of the „*Transilvania*" Magazine, archpriest in Cluj, writer. As a result, Ion I. Agârbiceanu was brought up in an intellectual family that were interested in literature, but also in the evolution of physics and of astronomy. The child's intellectual qualities determined his parents to send him to school at the age of five. He was only 17 when he graduated „*Gheorghe Bariţiu*" Highschool in Cluj. He chose the Electrotechnic Institute set up by Dragomir Hurmuzescu. The institute was part of the University of Bucharest. He graduated it in 1930, obtaining a diploma in engineering. He left for Paris in the same year in order to specialize in physics. In 1934 he defended his Ph.D. thesis in spectroscopy.

A remarkably distinguished Professor . He worked for a little while in England as an engineer, then he returned to Romania and worked as an assistant and then as a lecturer at University of Bucharest, Faculty of Physics. In 1948 it was set in Bucharest the Institute of Petrol and Gas and Ion I. Agârbiceanu was appointed head of the Department of Physics. In 1955 he transferred to the Polytechnic Institute of Bucharest, where he worked until the end of his life, in 1971. Here is what his former student, back in 1961-1962, Micu Sălică, said about his professor: "A man of impeccable elegancy in his gestures and appearance. He used to wear checked brown clothes. If you had asked somebody who didn't know him what he thought about this man, he would surely have told you that he was a scientist.

In the hall where he used to teach the front seats were occupied during the previous break. I was a student at mechanics, but there were also students from electronics, cybernetics. He used to write on the blackboard with a speed that allowed the students to take notes. Many times, he used to stop, he though for a while and said: professor X has a different opinion and I am inclined to agree with him. After every class he gave us several types of problems. I believed he made them on the spot. During classes he asked questions to his students to be sure that he was understood. He used to say: "Ok, young man, I can see you think, and although you mixed up things, the important fact is that you think". I asked him once how to study for the exam and he answered "Take 2-3 books on the same subject, written by foreign authors and find the contradictions in their theories. Automatically, synapses will be formed in your mind and you will remember the essential information". Another colleague asked him how big discoveries are made and he gave up an amazing answer for us back then: "*Everybody knows that the truth is absolute. Here comes an ignorant who doesn't know this and makes an big discovery*". This reply resembles a little Einstein's statement: "*There are things about which we know that they are impossible to accomplish until somebody comes and accomplishes them*". I also remember one of his advice" "*When you are engineers and one of your subalterns makes a technical mistake, first repair the mistake and only afterwards punish the guilty person*". This was the story said by someone who was Ion I. Agârbiceanu's student almost 50 years ago.

Leading Scientist. The scientific research was a leading one in his domain, and his name is related to one of the most important discoveries of contemporary physics: the laser. The first functional laser was built in 1960 and it had a synthetic ruby crystal as active environment. The first gas laser was built also in 1960 by the Iranian physicist Ali Javan who used a mixture of Helium and Neon that produced a beam having the wave length close to infrared. Ion I. Agârbiceanu's researches in physics and spectroscopy developed a lot from 1956 by setting up the Physics Institute of Bucharest and of the Laboratory of optical methods and nuclear physics. In 1963, under the supervision of Ion I. Agârbiceanu, it was built the first Romanian gas laser, using an original patented method. For his scientific merits he was elected member of the Romanian Academy in 1963. He worked within the European Group of Atomic Spectroscopy and he represented Romania at the International Union of Theoretical and Applied Physics. He passed away on the 9th of March 1971 in Cluj-Napoca.

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