REENGINEERING OF SMALL AND MEDIUM ENTERPRISES TO INTEGRATE INTO THE DIGITAL ECONOMY

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Summary: The significant issues tackled in the present original research are the following:
- Small and medium enterprises (SME) reengineering modelled in view of integrating the industrial units into the efficient digital economy;
- Modelling the SME type industrial enterprises into the concept of the operational researches applicable to the sustainable development of the local industry;
- Designing the small and medium industrial units in the concept of efficient management;
- Reconfiguring of the human resources modelled in the neurogenetic concept based on professional reengineering, based on the motivational management of labor, promoting creativity and the dialogue based on decision software engineering;
- Approaching the coping strategy in view of diminishing human stress at all the ergonomic working levels so that the specialists should work according to vocation;
- Selecting the anticipatory expert systems and applying neurogenetical informatics to diminishing the vulnerabilities within the renewed SME;
- The concept of the new structures of profitable business by calling upon the Hammer concept regarding the rendering dynamic of sales of all the products offered to the intelligent agents assisted competitive market.

Starting from the experience of the authors developed of a new type of SME. We hope that this innovation will extend in view of bringing closer Romanian SME units to the relevant European enterprises which requires a collaboration between ISPE as designer and the new specialized SME developers so that the profit of each investor should ensure starting from the elaboration phase of the feasibility studies of the new operational structures with minimum economic risk.

Key words: SME reengineering, sustainable development modelled in operational researches, efficient project management, humaqn resources reinventing in the neurogenetic concept, anticipatory expert systems of holistic vulnerabilities, business reinventing in the digital economy, assisted by intelligent agents

1. MODELLING THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF SMALL AND MEDIUM ENTERPRISES BASED ON INDUSTRIAL REENGINEERING

The new view upon the total renewal of the structure and functionality of small and medium enterprises is underlined by the following significant reengineering trends:

- The industrial reengineering innovative concept applicable to sustainable development of small and medium enterprises is underlined by the fundamental rethinking of the design and operation of the production processes connected to the business ones, with a view to improving all the technological-managerial indicators, such as quality, costs, the service, and targets the producer reaction capacity at the competitive market requirements.
- Industrial reengineering operates with the following significant attributes: fundamental, radical, spectacular processes and results. In practice, the first attribute shows what an enterprise has to do and how it should perform to open up the path towards the new efficient structure; the radical attribute refers to inventing new ways of working, rethinking the processes that create value for the client, the development of the new structures by springs surpassing the old and create the new.
- In the new trend, the hierarchical structures are replaced by new ones, based

on processes, the functional departments are replaced by process teams, the employees become decision makers at the workplace, and the managers are qualified as trainers.

- Reengineering is based on the innovative management required by the clients, by competition and renewal. These trends require designing the posts in multidimensional structures that are occupied by workers with multiple education in the field of reengineering, the renewal of the employee work motivation methodology renewal, redesigning the new charts based on computer assisted network diagrams, etc.
- The reengineering developers have the following managerial roles: the leader of the new trends authorizes the endeavor to reinvent the enterprise, the process titular tackles the designing of the new processes, the committee for elaborating the strategies for reinventing the organization submitted to renewal and the supreme reengineering coordinator, responsible for the creation of the enterprise redesigning tool. The managerial methodology of the small and medium enterprise reengineering is presented in Figure 1. The components of the design of the management of the organizations submitted to sustainable development can be followed in Figure 2. The implementation of the managerial system of the organizations submitted to renewal is presented in Figure 3.

The methodologie for redesigning the management are sketched in Figure 4. The design of the information-managerial system comprises the preparing stage, analysis, redesign, implementation and operation evaluation.

- The content of the design of the charts of some small and medium enterprises is presented in Table 2-1. Upon the analysis of this content the following significant trends are retained: the new archemo-system correlations, between the organizational variables and the functional diagram structure elements, the calculation of the work amount, the determination of the efficiency indicators based on correction coefficients, introducing new structures based on network diagrams.
- The reengineering stages underlined by the American researchers M. Hammer and J. Champy refer to the following stages: launching, process map setting, specifying the processes that have to be submitted to reengineering, the design of the links between production and business processes, the idea of operating the new in view of applying without risks of sustainable development of the archemically profitable structures.

The methodology we present below was tested in very many Romanian companies that required the remodelling of management, as an important solution for amplifying the economic and managerial economic viability potential. Figure 1 is relevant in this regard.

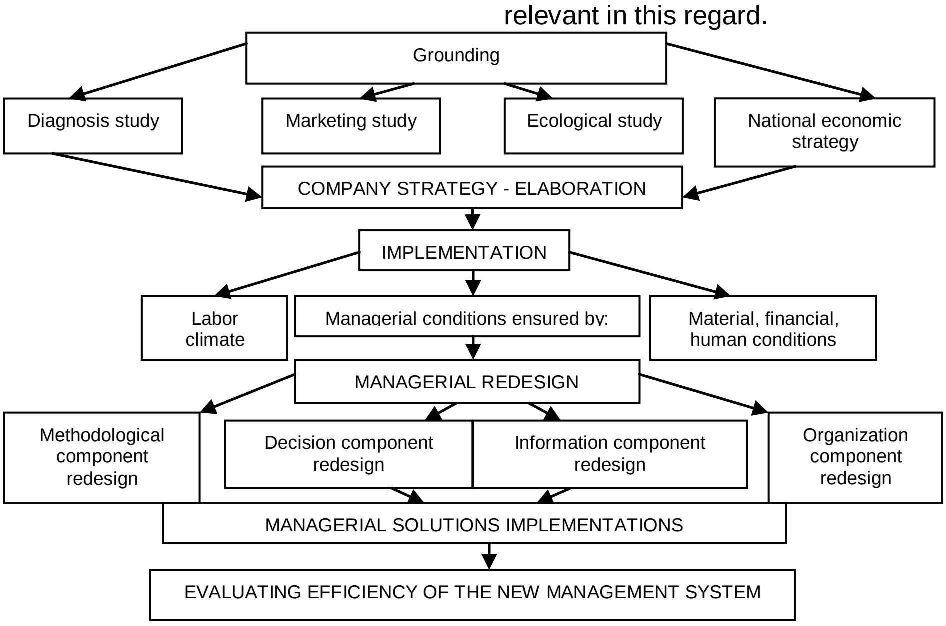

Fig. 1 – Organization management reengineering methodology

In the small and medium sized companies, we consider it opportune to call upon reengineering, considered in the developed countries a solution for increasing economic efficiency.
Secondly, the design of the methodological-managerial subsystem involves specifying the methodological elements for applying and using the mangerial tool for which the management of the organization opted. It is known that the success in implementing the management methods and techniques depends to a large extent on the methodological way used by respecting certain stages and specific phases of the operation.
Thirdly, redesigning the methodological-managerial subsystem involves the elaboration of complex methodologies for analyzing and improving the other managerial components, respectively the decision making, information and organizational components. All these are approached in the context of the global methodology for designing/redesigning the organization management.
The methodological approach presented refers to the situation in which designing the managerial methodological system is carried out in the context of designing the entire management system of the organization (Figure 2).

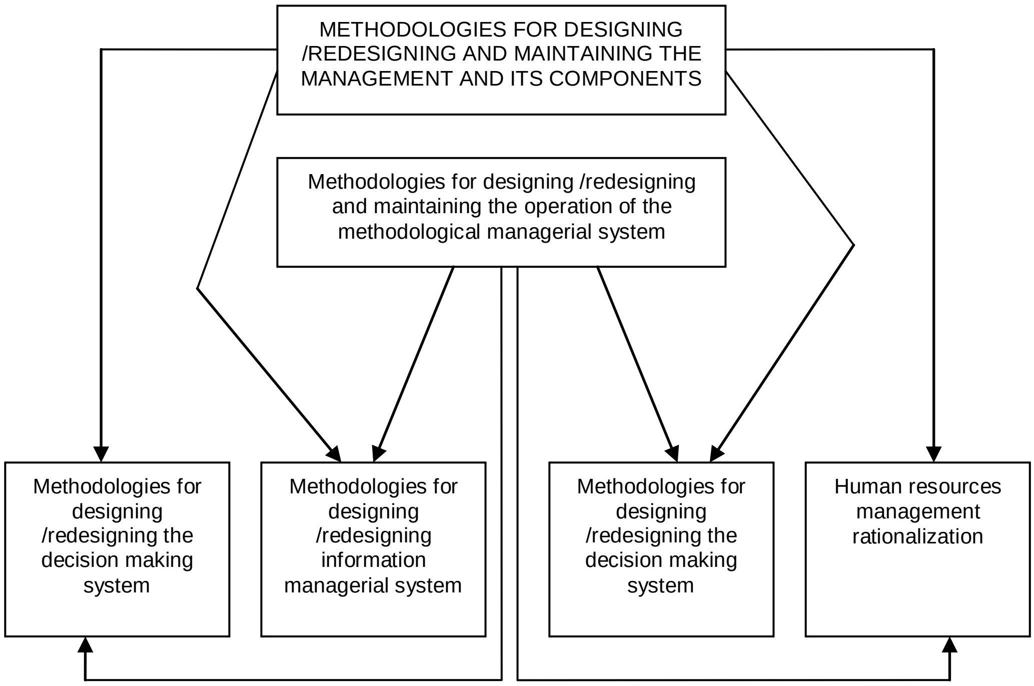

Fig. 2 – Relation between the methodology of methodological-managerial redesigning and the other managerial redesign methodologies

2. DESIGNING THE SME UNITS IN THE EFFICIENT MANAGEMENT CONCEPT

The efficient management project has to reflect from a conceptual and practical aspect the creative endeavors expressed as value with a view to carrying out products or services within an innovatively designed technological-functional structure.
The problems to be resolved in an efficient management project focuses on the following significant steps:

- Why is the project carried out and which are its innovative goals ?
- What should be done without neglecting the specific aspects of the project?
- Which are the available methods, means and resources to be called upon by the involved specialists?
- Where is the project unfolding and which is the site of the new SME type goal?
- Who finances and carries out the new management project?
- When will the new project begin and when will it end?
- How much will cost the designing, fulfillment and operation of the new SME type goal?

- What quality can be achieved at the level of the entire SME goal?
- Are there knowledge and experience to prevent the project from failing?
- We designed the concept for acquiring the material resources and reconfiguring the human ones?
- We established the internal coordinates for increasing computer assisted labor productivity?
- How are applied the SME concept-realization based on fluency graphs? We designed the business of integrating the SME into the competitive market based on the Customer Relationship Management (CRM)?

Project management has to be thought with a view to making available to the specialists the concept for carrying out the new SME and of the rational resources management methods on the steps of designing and operating the equipment generating profit. Therefore, the specialists who use modern techniques (fluency graphs, value engineering, operational research, etc.) have to involve themselves in the real process management in view of reaching the goals predetermined by purpose, cost, time, quality and participant satisfaction.

Any manager involved in the project management elaboration and application has to have a series of operational qualities in order to succeed in this SME renewal, namely: logistics based on holistic communication, motivated human resource management, the control of all the activities, the negotiation of all the problems and the real time informing of the hierarchical fora.

The success of management projects is assured if the following requirements are met:

- to be inscribed into a strategy;
- to have value for the organization that finances it, and also for who finances it;
- to be well defined;
- to have clear goals and missions;
- to be constantly monitored;
- to correspond to technological development;
- to perform all the changes upon precontracting then to remain fixed;
- to have a given time;
- to involve the trained human suitable positive resource;
- to exist technical, moral selection criteria and after the wishes of the client (when it is the case), but also an adequate motivation, in order to prevent falling into bureacracy;
- to exist a clear management organization, of the management team and a hierarchy;
- to exist an own structure (long projects), or a matrix structure: the members of an organization are taken from their functions and join the project. Thus we create a parallel structure, that of the project, during its development;
- to have control keys, fault identification methods, to exist logic cause-effect systems that are likely to allow taking correction measures on behalf of the project team or that of the financer;
- to have managerial-economic indicators for an efficient resource utilization;
- to have a monitoring system;
- to be able to foresee/assure its maintenance;
- to foresee the possible funds necessary for the futurein order to preserrve it in the sense of cycle below for development, when it is the case.

The projects are constituted out of processes formed from a series of actions leading to obtaining a result. Project management is carried out based on developing the following processes: initiation, programming, execution, control, closing, in the initiation phase the project is selected, the probable risk is approached and the requirements of the interested factors analyzed.

The project selection can be carried out by developing the sequences in Figure 3.

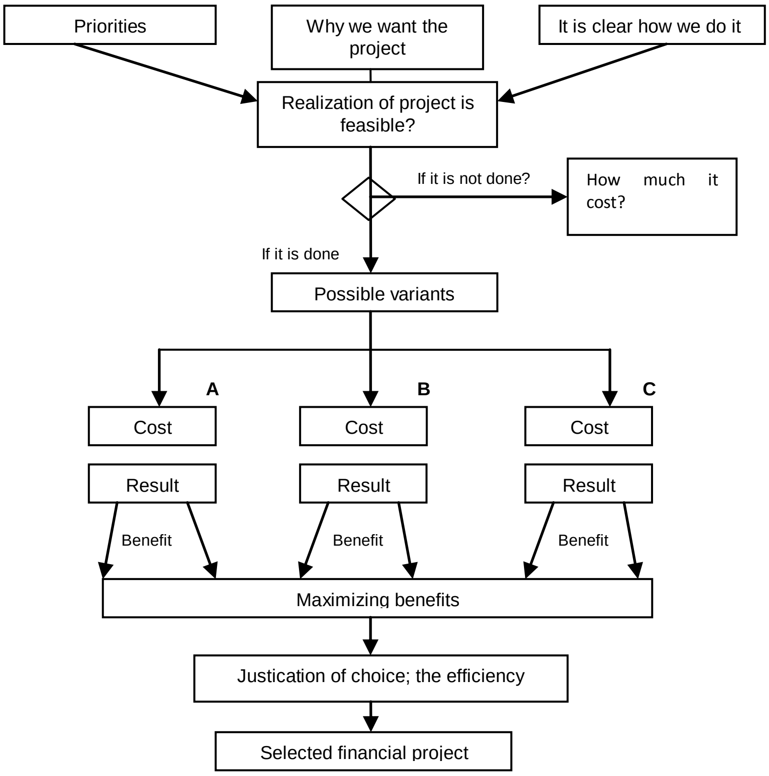

Fig. 3 – Management project selection

Process programming starts from establishing the requirements and constraints, setting the working team, the elaboration of the project structure, the identification of the vulnerabilities, the elaboration and approval of the entire content of the new project.

The management of these processes takes into account the following:

- The goal management assures us that the project includes all the works;
- Time management takes into account the completion in due time of the project.
- Cost management aims at framing the project into the budget;
- Quality management aims at attaining the archemic aspects of the finite processes and products.
- The acquisition management assures the necessary services and involved services;
- Communication management refers to the rational data management;
- Human resources management takes into account the creation of the labor conditions and wages in view of mobilizing employees upon the increase computer assisted creativity;
- Vulnerabilities management takes into account the setting of measures in order to reduce damage;
- Integration management assures us that the project elements are efficiently coordinated.

The project managers' role and qualities are emphasized starting from the analysis of the following requirements: on the one hand, the managers' mission regarding the fulfillment and execution of the bydget, and, on the other hand, the maximizing of the client satisfaction and that of the working team.

The project manager qualities can be emphasized if we analyze the communication, the logistics of the activity, the conflict resolving, negotiation as a premise for motivation and team development etc.

At the level of any management project that promotes a new trend in building, respectively modernizing a small and medium enterprise can occur pertinent questions at designing and conducting the organizational activities (Table 1).

Table 1

Organizational activities	Questions
Project concept	Why are they doing it?
Project definition	Which are the risks?
Project team	What is going to be produced?
Project plan	When will it produce?
Project organization	How will it be fulfilled?
Partner stakeholders	Who will be involved?
Activities	How much will it cost?
Control	Which are the profits? Shall we do it? Can we?
Evaluation	How well was it done?
Final	What is the benefit and maybe the others?

Here is a diagram that any project manager has to take into account, search for the answer and can give answers regarding it to those subordinated. That because by management one seeks an intermingling of four processes, such as in reality human processes, managerial ones, technological and business processes, integrated into the designed unit structure.

The project management has certain more pragmatic characteristics than those of the company, within it, once the proposal was approved, the approved program has to pass to carrying out those designed.

The approach to the SME structure renewal, at the level of the national economy has to begin by the feasibility study of the management projects based on the Hamilton graphs, within those studies the following problems are resolved:

- Motivating project management as a new trend of the way to work at the project that applies convergent engineering;
- Drawing the Hamilton graphs and specifying the critical roads and those optimum based on modernizing the total present costs;
- Shortening the duration of carrying out the end products that any SME offers to the competitive market;
- Reconfiguring the human resource in view of increasing the quality of all the employees.

3. REENGINEERING THE HUMAN RESOURCES MODELLED IN THE NEUROGENETIC CONCEPT

These steps are based on the necessities of small and medium companies to train the human resource, in general, and to build up a thinking of the human factor endowed with a significant sense of approaching the future. These specialists have to be endowed with anticipatory capacities based on knowledge, that will succeed in quickly reacting to environmental changes. The success of these steps start from the training of a new generation of intelligent, pragmatic, creative, dynamic executants and managers, sustainers of computerization and disciples of an efficient management.

In this perspective, the human resource market selects the specialists based on the following defining trends: increasing the abilities of the human capital, intensifying the holistic concept of education in view of training remodelling, the continuous improvement of performance in the hope of obtaining considerable results, the users of the information systems that allow increasing up to 300% labor productivity, the knowledge management specialists able to transform the SME into organizations that learn, cultivators of profitable relations between the production departments connected to the competitive market, responsible for detecting and perceiving changes, trainers of a mobilizing working style, in view of reducing stress and costs generated by intellectual pollution, human factor quality reengineering specialists by approaching multiple intelligencies, by catching emotional abilities as sources of positive energy, by renewing education, by rethinking the mentality towards work, by specifying the factors that allow assuring the excellency (the constant listening to the client, competitiveness, organizational culture development in the entrepreneurial concept, combining suppleness with rigor in view of establishing the optimum balance between responsibility, accuracy and promptness in task execution).

The “eneagram” as a method allowing each specialist to know his own qualities, weaknesses, logistic tendencies, and to combine in a unique way. Based on these new trends we can explain the differences between the qualitative behavior and that in the stress situation, in the failure cases we will understand in which direction we are heading to reach success. We can state that the “eneagram” offers to the human factor an intellectual challenge necessary for improving significantly the own performance if we call upon the software engineering based on the structure of the neuronal networks and the evolving calculation. Starting from this improved “eneagram”, we can head towards achieving generically assigned organizations by which they signify innovation (new knowledge development), learning (efficient knowledge assimilation), partner interactivity (knowledge). The model of such a company has the following characteristics:

- computer equipment controlled by professionals;
- specialist teams interconnected by a computerized structure;
- personnel diagrams with low hierarchical-functional levels;
- convergence between the technological perspective and the managerial one;
- carrying out the “brain-organization” conscious of its performance;
- the strategy of this company is based on an interactive innovation system sustained by an efficient intellectual capacity;
- the companies endowed with intelligent knowledge processors and self-controlled specialists.

The practical aspects of the professional in the archemo-system training of the human resource take into account the creation of managers occupied in the field of business partners improvement and of specialist in fighting stress at the level of production. The professional in business partner training takes into account the following problems: market conquering; client satisfaction; quality guarantee; innovation development; technology mastering; delivery acceleration; cost cutting.

Human resources stress analysis, under the conditions of small and medium enterprise development during the transition period, emphasized the following practical aspects:

- The complex human structure can contribute both to the success, and to the failure of the company if one studies the stress impact or this negative influence is neglected.
- The influence of stress in the productive practice becomes conscious to a large extent especially in its harmful aspects.
- The transition to the market economy of the SME type companies require the development at the level of the human resource an anticipatory sense of the future based on knowing the real present and future situation.
- The reactions of adapting the enterprises to changes of the competitive market requirements require smaller and smaller response times, including an efficient interior flexibility;
- At the level of the production, stress generatese the professional health problems generated by psycho-social risks (special professional stress, harrassing at the workplace, noise and extreme temperatures at the workplace).
- The introduction of stress risk evaluation is not performed according to the European Directive, which leads to increasing the immanence of professional diseases and decreasing the quality of the products carried out by the employees.
- Avoiding the situation generated by stress can be done by selecting the valid personnel over a perspective duration of the SME and passing to establishing the optimum demand of active personnel with a high professional training and with wages according to the production results that assures the labor motivation, besides, the personnel has to be evaluated annually, based on unitary criteria faithfully reflecting the result of the performed work.
- Human resources reengineering from the point of view of knowledge management has to be accelerated in view of creating the successful situations of all small and medium local and not only enterprises.

The stress adaptation strategy that led the SME type companies to success are based on the concept of coping. This refers to the mingling of an assemblage of behaviors that the human factor interposes between himself and the threatening event in view of mastering (controlling the harmful effect provoked by the impact, aiming at diminishing the physical and psychological comfort of the involved worker. The concept of coping strategy or coping ability can be defined as an assemblage of the cognitive and behavior endeavors destined to controlling, reducing and respectively tolerating the exigencies and requirements that surpass the abilities and capacities of the individuals in the real production processes.

The stress coping strategies can model the affective behavior of the human factor by orientating the attention from the solution of adapting to the vigilance strategy; the avoidance strategy leads the human being to activities of behavior or cognitive substitution, diminishing emotional tensions.

Classification of coping strategies and their evaluation methods

The methodology for inventorying various strategies are based on identifying the reaction modalities in various stress situations, based on the large inter and intraindividual variability, as well as on using the factorial analysis on a sufficient number of subjects.

The stimulation of creativity allows extending the Brainstorming, Delphi methods, of the morphological and of the value engineering method, contributing to the anticipatory optimization of the man – labor – environment relations and the competitive market in view of increasing value of the final results offered to consumers.

The behavior of the human factor at the interface with the work environment allowed creating two views whose characteristics are presented in Table 2.

Table 2

Managerial attributes	Traditional view	Knowledge based view
Planning	The head establishes the goals of the subordinates. The participation of the employees in establishing the goals and designing the plans is very reduced. Few alternatives are exploited. To fulfill the goals and plans the commitment is minimum.	The head and subordinates establish together the goals. The participation of the employees to establishing the goals and designing plans is very great. Many alternatives are exploited. To fulfill the goals and plans the commitment is maximum.
Training	The leadership is autocratic, based only on authority. The employees fulfill the received orders, but there is lack of trust and a concealed resistance. Communication is in a single sense, from top to bottom, with a minimum feedback. The information circuit is initial.	The leadership is paticipating, based on competence. The employees search responsibility, feel important and committed to performance. Communication is in two directions, with a high feedback. The information circuit is high.
Control and evaluation	The control is extreme and rigid.The head acts like a judge. The evaluation is regarded with minimum trust. The emphasis lies upon the past, as mistakes are sought at any price.	The control is internal and based on self-control. The head acts like a trainer. The evaluation is regarded with maximum trust. People learn from the past, but the emphasis lies upon the future. The control can be encouraged in view of resolving problems in the best possible way.
Symmetric characteristics	People do not love work and if it is possible they avoid it. The human resource has to be controlled and punished if it failed to fulfill the organizational goals The human factor loves control because by this step it succeed in avoiding responsibility of the deeds	People recognize work as a natural part of life. The trained human resource does not need threats, punishment and control. -The employees reach performance when they are adequately paid. -People have responsibility if encouraged. -Most employees have a creative potential that they wish to use adequately.

- ***Human resources stress management in the industrial reengineering concept***

Stress is an intense unpleasant state that in the long run has negative effects upon health, performance and productivity. Stress is an individual reaction and the result of the interaction between the exigencies of the environment on the one hand and the resources, capacities and individual possibilities, on the other.

At the workplace, stress occurs whenever the professional exigencies surpass the resources available to the human being.

It is important to remind that stress is not only the result of major negative events, but also of daily tensions and pressures. The latter, by their frequency have an important role in the professional environment and effects more the individual than the major negative events but more rare.

Sometimes, professional stress is considered to be a positive element, with a benefic effect upon performance. That refers to “eustress”, meaning the activation, mobilization of the individual resources.

It is important to make a distinction between “eustress” and “distress”, as a stress state with benefic effects, respectively with negative effects upon health, in the conditions in which an exigency of the professional environment is motivating for the individual, that acts as a positive stress factor, at the same time, if a constraint is perceived as unpleasant, difficult and manifests constantly, it can lead to stress (“distress”) and to its negative effects.

Meanings of the term in the relevant literature: According to the *Explicative*

Dictionary of the Romanian Language, stress is defined as a "pathological state consisting in overloading a live organism, when upon it act strong negative factors <English, Fr. Stress".

- ***Defining the general stress concept***

Any situation that claims the adaptation mechanism generates stress, a phenomen that Selye defines as being any response of the organism consecutive to any requirement or claim exerted upon the body by a wide range of causal agents – physical, chemical, biological, psychological, etc. In case of a long action of this stress agent, this response takes the form of the SGA, being possible – in an extreme case – to pass through the whole range of SGA modifications and overlapping completely its entire "surface". An aspect envisaged by the critics formulated towards the Selye theory is the exagerated emphasis laid upon nonspecificity and neglecting the specific elements. Today the unspecific reactions are added by the three types of situaiton specificity, personality and response (L. Levi, 1972).

Besides the term of stress, Selye introduces also the notion of "adaptation disease". It recognizes that there is no disease whose unique and exclusive cause could be stress. But a too strong stress can determine the fall of the defense mechanism of the body/organism.

Contemporary attempts of defining stress in general (irrespective of its physical, biological or psychological nature) lead to a diverseness of meanings of the word "stress", understood as:

- element of the external world inducing reactions of intense constraint on behalf of the human being;
- a physiological feedback process induced by these external aggressions;
- a lack of equilibrium between the external exigencies and the possibilities of the body to cope.

As fundamental components of the stress occur:

- stressors (stress sources);
- reactions to stress and/or its consequences;
- individual peculiarities that mediates the stress behaviour.

Stress symptoms can be classified into:

- physical (headaches, cardiovascular disturbances, gastrointestinal deficiencies, allergies, dermatological problems, sleep disturbanes and breath ones, etc.);
- psychological (emotional and cognitive problems, as well as labor non-satisfaction, depression, anxiety, boredom, frustration, isolation, resentment, etc.);
- behavioral: 1) referring to the person (work avoiding, use of alcohol and drugs, an exaggerated or diminished apetite, aggressiveness towards the colleagues or family members, interpersonal problems, etc.); 2) organizational impact (absenteeism, professional fluctuation, accident prone, low productivity, etc.)

4. ANTICIPATORY EXPERT SYSTEMS DEDICATED TO DIMINISHING HOLISTIC VULNERABILITIES WITHIN THE RENEWED SME

Anticipatory systems structure (SEA of the SME process incidents)

Broadly, the architecture of a SEA differs from the general architecture of an expert system, its attributions being:

- estimating implications, in the perspective, of the outlined and durable trends;
- appraising the probable evolutions by taking into consideration both the trends and other conditional factors;
- identifying the possible-variant solutions, with the advantages and disadvantages of each;
- offering judgment elements for choosing the optimum variant;
- suggesting the convenient pertinent elements for the intervention and influencing of the economic activities for correcting the possible deviations from the anticipatory trajectories, considered to be preferable;
- offering a wide range of possibilities, quantitatively determined, for the elaboration of other predictions, on shorter deadlines or in more detail and more operational.

Consequently, the requirements of a SEA are mainly the following:

- to result from plausible hypotheses;
- the provisions to be always the result of tests (simulations) as possible repeated;
- the phenomena and processes to which they refer should be repeated, that is they should not be unique;
- to relate the past, present and future (not the designing of a future without a base in the past and present realities and experiences);
- the provisions can never be fully unconditional, which involves risk and

uncertainty;
- to be grounded on correct relevant data;
- in case of failure in resolving a problem, the inference engine should work in two ways: returning, that is it returns to the inference achieved in the cycle earlier to the failure in order to explore another way of resolving, backtracking and irrevocable, if it stops, considering the return to the previous cycle as futile;
- to be able to be applied and used by the real time beneficiary;
- to allow the combination of more control algorithms, the possibility of easily modifying the period of sampling and using the adapting optimal algorithms.

The knowledge base components of a SEA include:
a) knowledge on the fact material submitted to observations, that is the significant data on the dynamics of phenomena and economic-social processes the results obtained following their study;
b) hypotheses formulated with regard to the evolution in the future of the economic-social life, as well as the expected degree of probability, by taking into account the objective conditions and the purpose function/functions.
c) the conclusions drawn from the generalization of the retrospective and prospective tests performed, expressed by notions, laws and theories, confirmed in practice;
d) methods used.

The inference engine of a SEA uses the knowledge in the knowledge base for building up the reasoning. The reasoning of theinference engine unfolds as a sequence of base cycles, each made up of 4 stages: selection, filtering, conflict resolving and execution phase.

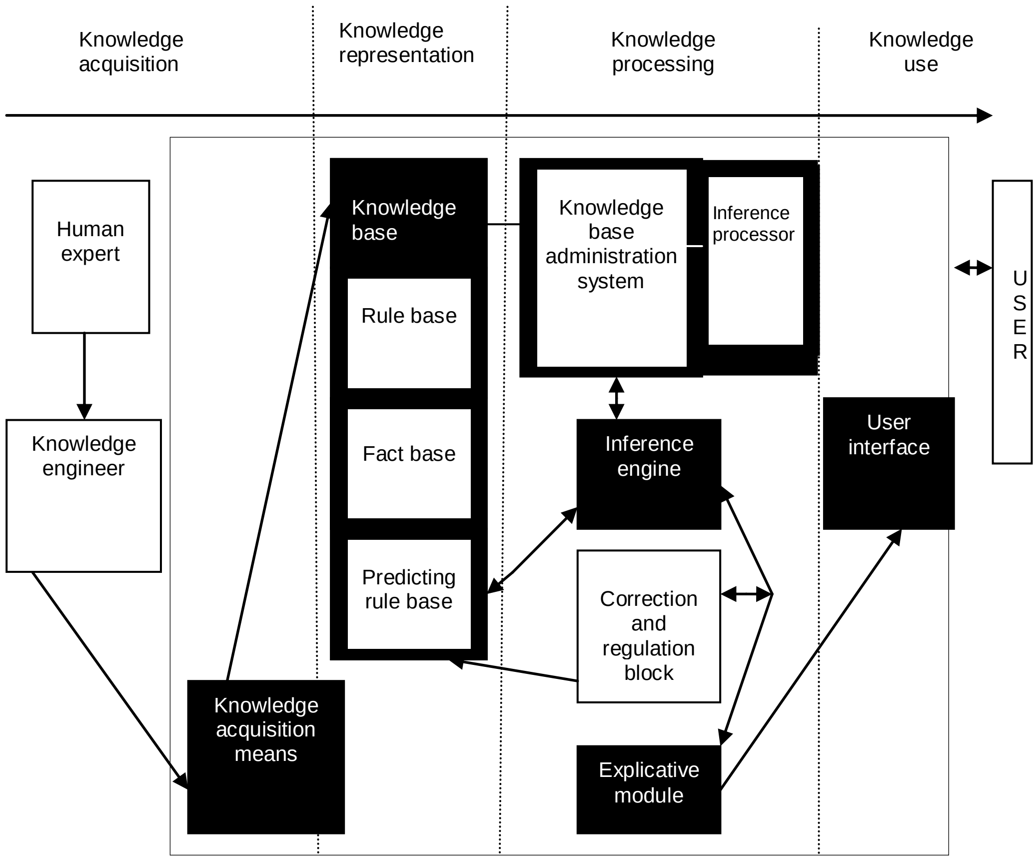

Fig. 4 – General architecture of a SEA anticipatory expert system

The originality of the SEA systems (Fig. 4) consists in the existence of the correction and regulation (self-regulation) Block and completing the knowledge base with prediction rules. For the SEA, the knowledge base contains both data taken over from human experts in the fields connected to predictions that describe obvious situations, real and hypothetical facts, as well as euristics (rules based on past experience).

The knowledge acquisition module helps the expert user to introduce knowledge in a recognized form by the system and to update the knowledge base.

The inference engine is a program that has inferential mechanisms generated for the knowledge processing with very diverse reasoning, determining the knowledge modification in order to resolve the problem. The interference engine of a SEA has in its turn two main components: the knowledge base administration system and symbolic inference processor.

The knowledge base administration system performs knowledge automatic organization, control and updating operations, initiates searches for the control of the relevance along the reasoning lines on which the symbolic inference processor works.

The symbolic inference processor offers a processing method by which the reasoning lines are provided. Whenever the real world knowledge and data are inaccurate, certain inference methods can use various degrees of certainty for conducting the inferential mechanism.

The user dialogue interface offers the user access to facts and base knowledge as well as the dialogue with them.

The explicative module aims to obtain explanations on the conducting of inferential processes, of the solutions obtained during the consulting sessions, by emphasizing some knowledge that use or are inconsistent or erroneous or even the emphasis upon the causes of certain failures. The correction and regulation block has as a policy the prevention and removal of the errors of the predictions, in performing the forecast by the SEA can appear errors that define thus the difference between the value of the forecast and effective value. The SEA will calculate the error and will make appraisals, according to its size, on the measure in which the mathematical model or used method for forecast succeeds in estimating the future forecast. The restoring process can slow down the data processing, and the conversation structure becomes more complex for resuming each prediciton variant. Upon entering the correction and regulation block we establish a resuming point allowing the restoration of the initial state. This restoration resumes the initial values of the program variables, by removing the effects produced by executing the module containing the error.

Software engineering and the modalities of applyiing in SME. The software engineering in the field of informatics covering the determination of the most adequate solutions, methods, means and tools that should lead to in the optimum conditions of profitability and efficiency to the elaboration of a program-product, so that this should meet all the requirements imposed in its definition specification.

The notion of software engineering is not related to a certain field. Software engineering is a side of information science and technology that covers programming, irrespective of the field in which the program product will be used. The computers and program products have applications in all the fields of human activities research, designing, industrial processes management, administration, management, meteorology, astronomy, defense, recording and safety of the population, medicine, philological sciences, sociological sciences, history, anthropology, archeology, philosophy, etc.).

In the field of industrial processes management, we might distinguish the following main categories of activities:

- The operative control of continuous or discrete production processes;
- The management (command and control) of industrial robots;
- Complex equipment control;
- Computer-assisted design;
- Nuclear power plants and unconventional systems management. The software technology consists in the practical use of scientific knowledge, upon the designing and developing of programs destined to electronic calculators, together with the documentation necessary for developing, using and maintaining the programs. The aim of software technology is the economic production of reliable and efficient programs. At the same time, the aim of software technology is developing methods by which the average programmer can write good quality programs.

a) Profitable SME business concepts

In promoting business, by globally bringing together the wishes of the clients with the conditions in which the business team works, we wish to find out the most efficient solutions for the contracting parties.
Optimizing the trade networks begins by studying the technical problems in view of reducing costs and with a view to diminishing tariffs. A method used in the companies with wide opening towards the market is convergent engineering that allows reducing the durations of designing and carrying out products simultaneously with shortening the time after which each product reaches the market. This convergent engineering technology gives results if the empathy of each component of the working team is maximum.

b) Innovative client management approach in the competitive market structures

At the beginning of this millenium, competition in any field of business is extremely tight and the companies are more dependent on the essence of their reason to exist, the client. The client becomes ever more informed, ever more pretentious, and more and more careful with the money he spends. These factors determined the companies that wish to survive on the market, to try to understand the client and to orientate the products, services and activities towards the client.
It should start from the principle that in the long run the success of a company depends on the superiority of the quality of its products as compared with those of the competition, in this way, the study and emphasis upon the quality of the economic processes of company management lead to benefits superior to those obtained by the competition.
Now, when:

- competition is tighter and tighter;
- the basic data undergoes extremely quick changes, it is almost impossible to gain market segments by using obsolete methods and strategies.

It is necessary for:
✓ the enterprise to react almost instantly to the evolution of the clients' needs;
✓ the leadership has to establish as a task the creation of an enterprise for which considering all the factors involved constitutes an important objective in the evolution of the product;
✓ the personnel of the enterprise has the conscience of the fact that all the endeavors have to lead to obtaining products that meet the client's expectations more, products that anticipate these expectations.

5. CONCLUSIONS

All the problems comprised in this work are based on the efficient management models and are analyzed in the concept of the need for reengineering the processes within the current market economy and are approached in the context of the evolution of the own SME business.

The original aspects of the action consist in the following:

- the modality to analyze the technological - managerial directed towards the aspects that influence directly the evolution of the proceses within the small and medium sized enterprises;
- identifying the efficient methods of the industrial systems reengineering submitted to dynamic changes, emphasizing the fact that the industrial systems do not submit to the multiple departments the reengineering process, but are redesigned the structures based on the processes;
- emphasizing the importance of reengineering, being first of all a process of convincing that begins with assimilating the need for reengineering and ends only long after the redesigned processes began to operate;
- approaching in a compared view the quality management models at the level of the renewed industrial systems, calling upon the operators of real fact research;
- reconfiguring the SME type companies on new bases of industrial reengineering by calling upon project management, without neglecting the reconfiguring of the human resources;
- elaborating three program-products regarding the sustainable development of the SME by taking into account the interface with the human operator that contributes to calculating the total present income and to setting the internal rate of return of the new SME carried out by the authors;
- emphasizing the importance of using and

integrating the artificial intelligence as a support for monitoring and adapting the decisions to various levels and within variousactivities conducted in the processes imposed to the evolution;

- offering suggestions regarding the profitability of the redesigned processes in the industrial reengineering concept.

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CALCULUS OF ENERGY PERFORMANCE FOR THE PASSIVE HOUSE IN THE POLITEHNICA UNIVERSITY IN BUCHAREST

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Summary: In this paper we made an energy performance calculus for a passive house in Bucharest that included two coupled homes made in mirror. This calculation was performed with the program Passive House Planning Package (PHPP), version 2007. It includes a detailed calculation based on input data on areas, wall composition, type of joinery, value of the thermal bridges, the ventilation air demand, type and performance of all the installation elements in the endowment, the number and type of household appliances, the number of permanent users, as well as the climatic data.
By means of this PHPP programming package we perform calculations mainly for:

- U values for the components of the passive house with high thermal insulation;
- power balances, thermal power supply and distribution, electric power demand, primary energy demand;
- designing the ventilation system;
- establishing the thermal power demand for heating (taking into account the climatic data in Romania);
- the thermal comfort for summertime;

by checking out the requirements imposed by the Passive House criterion.

At the same time, the programming package contains many other calculating tools for designing the passive house.
The evaluation criteria for certifying the Passive House, applicable to the residential buildings are:

- Power demand for heating maximum 15 kWh/m^2 x year
- The result of the pressure test n_{50} = 0.6 h^{-1}
- The primary energy demand maximum 120 kWh/m^2 x year, including the electric power consumption for domestic appliances.

Keywords: passive house, energy, thermal bridges

1. INTRODUCTION

Concepts such as durability or ecological approach (often called “green”) were deeply integrated into the national policies and strategies, in legal documents, in the general management of the companies, in our intrinsic way of thinking and acting. Under the circumstances, the general interest for diminishing the power consumed at the level of buildings led in later years to defining several architectural types of buildings, endowed with installations so that to need the minimum of primary energy in fossil fuels. Called, among other things, low consumption houses, autonomous houses, zero carbon print houses, positive energy houses, passive houses or, more recently, active houses, all represent attempts at redefining the way in which we build and use the buildings, be they residential or with another function. With the level of awareness, the level of exigence grew continuously, from considering only the major power consumptions (for example, thermal power for heating spaces), up to including all the power consumptions associated with the lifetime of a building (consumed power for producing construction materials, for building construction, for building operation and for its future demolition).
The concept of passive house was defined for the first time by Professor Bo Adamson and Dr. Wolfgang Feist in 1988. By developing a series of research projects and by benefiting from financial support from the German state, Dr. Wolfgang Feist founded Passivhaus-Institut in Darmstadt, Germany, in 1996.
The success of this concept increased enormously each year, as we can count tens of thousands of buildings as being “passive

houses", both in Europe and in the United States of America. Although initially designed for residential buildings, the concept was quickly extended to kindergarten, schools and office buildings. Remarkable is the fact that we willingly accepted a higher investment in order to achieve an energy use performance situated much higher than the minimum rated provisions by the laws in each country. Passivhaus-Institut carefully elaborated detailed provisions for carrying out clear performance criteria, granting with great scrupulosity the Passive House Certificate, both in the project phase and after carrying out and monitoring the operation of the building (www.passiv.de).
The passive house is the building in which one can maintain a comfortable interior climate, without active heating or cooling systems. It heats and cools almost by itself, therefore it is "passive". For the European climate, a building is certified as passive if a primary energy lower than the value of 120 kWh/m^2year is consumed, and the final thermal power demand for heating/cooling is below 15 kWh/m^2year, related to the useful heated surface of the building. Any other power demand has to be ensured from renewable energy resources.
Relating to the lodging buildings in Romania, a passive building, irrespective of its function, consumes final thermal power for heating representing about 8% as compared with a conventional lodging building or about 15% as compared with a rehabilitated residential building or about 20% as related to a new residential building. The limitations include also the economic sphere, as it is known that a much higher investment leads easily to a higher performance. Thus, a passive building is economically efficient if all the costs with initial investment and with its utilization over a period of 30 years equates similar costs associated to a new conventional building.
The European Community has been made aware of this concept. The European Commission financed a series of projects of which we remind the CEPHEUS project (1998 – 2001) regarding economically efficient passive houses as possible European standards (THERMIE project) and the PASS-NET project (2007-2010) [4] that contributed to the realization of a European network for promoting the concept of passive house and a new database, at an international level, for passive houses (Energy-Europe Intelligent Program). Moreover, the Action Plan for energy efficiency debated by the EC in 2007 includes the proposal that starting with 2011, all the new buildings respect the standards of the passive house or at least should be endowed with passive heating and/or cooling solutions Currently, three European directives are active that provide energy performance and clean energy measures for the entire built fund of buildings. The Directive 2006/32/EC – regarding the energy efficiency at the final users and energy services, the Directive 2009/28/EC – regarding the promotion of the use of power from renewable resources, and the Directive 2010/31/EC – regarding the energy performance of the buildings. The exigencies of the passive house that derive from the criteria that define it are the following:

- ✓ Heat insulating envelope opaque elements, with $U < 0.15\ W/m^2K$; thermal bridges $\cong 0$
- ✓ Window (glazing + frame) with $U < 0.80\ W/m^2K$, $g \cong 50\%$
- ✓ Air exchange by sealing failure $n_{50} < 0{,}6\ h^{-1}$
- ✓ Preheating fresh air in underground and/or recovery channels in the used air ($\eta > 75...80\%$)
- ✓ Hot water produced (partially or totally) passively with solar power
- ✓ Efficient interior lighting lamps
- ✓ Electrical appliances of the energy class at least A
- ✓ Efficient recovery of the exhausted air heat with air – air heat exchanger (recovery rate > 80%).

The sensitive points in building a passive house are the thermal bridges, which must be diminished down almost to zero by adequate constructive and heat insulating solutions, glazing with three glazing sheets and high thermal performance, as well as the special sealing that should prevent an uncontrolled air exchange between the interior and the exterior of the building. The fresh air and temperature corresponding to carrying out the interior comfort is provided by a mechanical ventilation system, obligatorily provided with an economizer from the exhausted used air. The supplementary heating of the preheated air in the economizer is possible only within the limit of about 10 Wm^2, a limitation resulted from the condition that its temperature should not surpass the risk value at protection of 50^{0}C. If we find out by calculation a thermal power demand higher than 10 W/m^2, supplementary heating sources must be provided (static bodies with hot carrier or radiation plasma).

2. DESCRIBING THE PASSIVE HOUSE

The present article proposes to illustrate an energy performance calculation for the passive house, a construction to be completed, situated in the campus of the POLITEHNICA University in Bucharest, as a result of the innovation project entitled "Passive houses adequate to the climate conditions in Romania" achieved within a wide partnership coordinated by the Institute for Studies and Power Engineering (contract 214/2008 financed by UEFISCDI) and with the participation of many sponsors, top companies producing and supplying equipment and construction materials (http://casapasiva.pub.ro or www.ispe.ro).

The building is located in Bucharest, on a slightly shadowed flat surface, oriented to the N-S and comprises two coupled homes made in mirror.

The two homes have identical constructive characteristics, but the endowment with installations is slightly different, in order to achieve two possible power supply variants. They are presented in a format generated by software simulation, in Figure 1.
The constructive characteristics for a home are the following:

- Built area 94.0 m^2
- Useful heated area 140.0 m^2
- Air volume 435.3 m^2
- Envelope area in the interior 406.6 m^2
- Glazed surface area 32.02 m^2
- Number of occupants 4 people

The homes unfold in ground floor plan and attic floor plan, being endowed with open interior staircase. On the ground floor there is the kitchen, the living room, the dining room and the technical room, where is located the economizer in the mechanical ventilation system. On the upper flor there are three bedrooms, two bathrooms and annex spaces.

Each home has a mechanical ventilation system provided with economizer from the air exhausted and supplementary heating made electrically, from the geothermal or solar source. A part of the thermal power is produced in thermal solar panels, and a part of the electric power is produced in PV panels, all located on the cover of the building oriented to the south (see Fig. 1).

One of the homes is endowed with buried channels for the admission of fresh air and correcting radiant panels for the interior temperature, and the other is endowed with soil-water geothermal heat pump and the other is endowed with soil-water geothermal heat pump and radiant panels with heat carrier. The sizing details cannot be made public and represent the intellectual property held by UEFISCDI (the former AMCSIT).

Fig. 1 - Presenting the passive building with two coupled homes

3. CLIMATE DATA

The calculation of the energy performance for any building presupposes knowing the statistical average climate data. In Romania's case, such data are published in the Romanian standard 4839, published in May 1997. However, the published data are old and obsolete given the visible heating of the climate, and their use can lead to erroneous conclusions. For that reason, we preferred using the Swiss Meteonom software for climate data simulation according to the geographical position (latitude, longitude, altitude).
The values generated by this program for monthly average or daily average temperatures were in accordance with the values measured over three years at the weather station at Afumați, close to Bucharest, thus conferring the validity and values for the solar intensity that were not measured recently. Thus, for the position of Bucharest, characterized by the latitude 44024'49'', longitude 26005'48'' and altitude 79 m, monthly average climate data were generated in Table 1, later used in energy performance calculations. For the heating and cooling heat loads we used the winter minimums, the monthly averages for the cold season and the monthly averages for the hot season, presented in Table 2. Besides, the Meteonom program provided a calculation on the number of degrees-hours for heating: 78674 degrees.h, as well as a number of cooling degrees.hours 3795 degrees.h.

Table 1 - Climate data generated by the Meteonom program for the position of the city of Bucharest

Month	Temp.	Int. tot_N	Int. tot_E	Int. tot_S	Int. tot_V	Int. tot_O	Dew temp.	Sky temp.	Ground temp.
-	^oC	kWh/m^2l month	kWh/m^2/month	$kWh/m^{2/}$month	kWh/m^2luna	kWh/m^2month	^oC	^oC	^oC
Jan	-1.5	14	31	74	30	44	-3.2	-12.7	12.0
Feb	0.9	19	41	89	42	66	-2.7	-11.4	11.3
March	5.4	29	67	106	68	107	-0.3	-8.2	11.4
Apil	11.3	37	86	98	82	140	4.7	-1.8	12.2
May	17.7	52	115	98	101	184	10.1	4.4	14.8
June	21.2	58	119	93	109	197	13.9	8.2	16.4
July	23.2	57	125	99	110	202	15.1	10.2	17.7
August	22.5	46	108	112	104	178	14.8	9.9	18.4
Sept	16.6	32	78	111	80	128	11.3	5.3	18.3
Oct	11.2	24	57	109	58	89	7.2	0.5	16.2
Nov	5.8	15	27	65	31	45	3.4	-3.3	14.9
Dec	-0.4	12	23	59	25	34	-2.3	-11.6	13.3

Table 2 - Climate data for the calculation of the heating and cooling loads for the city of Bucharest

LOAD	Temp.	Int. tot_N	Int. tot_E	Int. tot_S	Int. tot_V	Int. tot_O
	^oC	W/m^2	W/m^2	W/m^2	W/m^2	W/m^2
Heating load 1	-8.8	19	40	83	32	54
Heating load 2	-3.7	12	16	30	19	29
Cooling load	22.6	63	156	148	142	250

4. CALCULATING ENERGY PERFORMANE

This calculation was performed with the Passive House Planning Package (PHPP) program, version 7. That includes a detailed calculation based on input data regarding areas, volumes, wall composition, type of carpentry, the value of the thermal bridges, the ventilation air demand, type and performance of all the installation elements in the endowment, the number and type of electrical appliances, the number of permanent users, as well as the climate data mentioned above.

All the aspects considered to be calculated are presented in the annex. The partial results are illustrated in the copies of the sheets in Figures 2-7. We calculate the unidirectional heat transfer resistances, as illustrated in Figure 2 for an opaque exterior wall and for plaque on soil.

Assembly No.	Building Assembly Description
1	Exterior wall

Heat Transfer Resistance [m²K/W]	
interior R_{si} :	0.13
exterior R_{se} :	0.13

	Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1.	Interior plaster	0.800					22
2.	Cellular Concrete Ytong	0.270					250
3.	Mineral wool	0.040	Brown timber & insulat	0.061	Blue timber & insulation	0.059	300
4.							
5.							
6.							
7.							
8.							
			Percentage of Sec. 2	7.0%	Percentage of Sec. 3	7.0%	Total 57.2 cm

U-Value: 0.122 W/(m²K)

Assembly No.	Building Assembly Description
3	Floor slab

Heat Transfer Resistance [m²K/W]	
interior R_{si} :	0.17
exterior Rse:	0.00

	Area Section 1	λ [W/(mK)]	Area Section 2 (optional)	λ [W/(mK)]	Area Section 3 (optional)	λ [W/(mK)]	Total Width Thickness [mm]
1.	Parquet	0.200					22
2.	OSB board	0.130					8
3.	Lightly reinforced morta	1.100					50
4.	EPS high density	0.040					150
5.	Reinforced concrete	1.740					120
6.	XPS polystyrene	0.040					180
7.	Lightly reinforced morta	1.100					50
8.							
			Percentage of Sec. 2		Percentage of Sec. 3		Total 58.0 cm

U-Value: 0.114 W/(m²K)

Fig. 2 – Unidirectional heat transfer resistance calculation for the opaque elements of the envelope

The heat transfer through the opaque elements of the envelope is corrected by the effect of heat bridges, even if by design they are of a very low value. Figure 3 illustrates a heat bridges calculation characteristic of the analyzed design. In the case of the windows, we specify the type of glazing and frame, the sizes and orientations, and then we calculate the heat bridges associated to the installation of the window and to the existence of the spacer, and, finally, the heat transfer coefficients U (Figure 4).

Length l [m]	Input of Thermal Bridge Heat Loss Coefficient W/(mK)	Ψ W/(mK)
7.85	Corner N	-0.031
7.78	Corner S	-0.030
7.85	Corner-neighbour N	0.010
7.78	Corner-neighbour S	0.010
7.30	Pole - complex E1	0.018
6.91	Pole - complex E2	0.018
15.62	Pole-complex S+N	0.018
27.80	First floor-wall junction	0.006
8.00	Roof junctions along E-W	-0.114
11.96	Roof junctions along N-S	-0.052
11.96	Roof-wall neighbour junction	0.002
4.65	Ground floor perimeter terace	-0.002
23.15	Ground floor perimeter	-0.001
16.00	Ground floor centre E-W small	0.032
11.80	Ground floor centre N-S small	0.032
11.80	Ground floor centre big N-S	0.034

Fig. 3 – Quantification of the effect of heat bridges upon the heat transfer by the opaque elements of the envelope

g-Value	U-Value		Window Frame Dimension				Installation				Ψ- Value		Results			
Perpen-dicular Radia-tion	Glazing	Frames	Width - Left	Width - Right	Width - Below	Width - Above	Left 1/10	Right 1/10	Sill 1/10	Head 1/10	Ψ_{spacer}	$\Psi_{installation}$	Window Area	Glazing Area	U-Value	Glazed Fraction per Window
–	W(m²K)	W(m²K)	m	m	m	m					W(mK)	W(mK)	m²	m²	W(m²K)	W(m²K)
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	1.4	0.78	0.83	0.58
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	1.4	0.78	0.83	0.58
0.5	0.6	0.77	0.09	0.09	0.12	0.09	1	1	1	1	0.032	0.019	2.6	2.0	0.76	0.78
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	2	1.33	0.79	0.65
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	2.3	1.57	0.78	0.67
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	2.1	1.39	0.78	0.66
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	2.4	1.58	0.78	0.67
0.5	0.6	0.78	0.09	0.07	0.12	0.09	1	0	1	1	0.032	0.019	3.2	2.51	0.74	0.80
0.5	0.6	0.78	0.07	0.13	0.16	0.13	0	1	1	1	0.032	0.019	1.8	1.22	0.78	0.67
0.5	0.6	0.77	0.13	0.13	0.16	0.13	1	1	1	1	0.032	0.019	1.3	0.71	0.83	0.57
0.5	0.6	0.79	0.09	0.07	0.12	0.09	1	0	1	1	0.032	0.019	2.2	1.65	0.77	0.76
0.5	0.6	0.79	0.05	0.05	0.07	0.09	0	0	0	1	0.032	0.019	0.8	0.5	0.87	0.62
0.5	0.6	0.79	0.07	0.09	0.12	0.09	0	1	1	1	0.032	0.019	2.2	1.65	0.77	0.76
0.5	0.6	0.81	0.07	0.08	0.16	0.07	0	0	1	0	0.032	0.019	1.7	1.28	0.75	0.73
0.5	0.6	0.81	0.08	0.07	0.16	0.07	0	0	1	0	0.032	0.019	1.7	1.28	0.75	0.73

Fig. 4 – Coefficient calculation of heat transfer and heat bridges to carpentry elements

The annual thermal power consumption calculation for heating is performed by the monthly method, according to the algorithm in the European standard EN 13790. The solar inputs and the internal ones add to the consumption in order to carry out the thermal comfort during the cold season. The extract presented in Figure 5 indicates a specific final power demand for heating of 11.9 kWh/m^2 x year. During summer time, the calculations indicated that it is not necessary to have a supplementary cooling as compared with the ventilation during the night, a usual non-costly measure. Domestic hot water is prepared in a boiler by means of the heat carrier supplied by the solar panels mounted on the cover of the building and corrected as a level of temperature with an electrical resistance commanded by a thermostat. Figure 6 presents the calculation by which we pointed out the quota of 55% that represents the useful solar power in the preparation of hot water during a year long, as well as its participation with 18 kWh/m^2 x year at the annual thermal power demand for domestic hot water. Electrical appliances, lighting and auxiliary services (ventilator, water pump) are estimated at a value of 23.4 kWh/m^2 x year the final electric power, corresponding to a primary power about 3 times higher. The check on the compulsory criteria is performed as a final stage of all the energy performance calculations, in a central calculation sheet, located at the beginning of the program for an easy access. It is presented in Figure 7 for the home located on the west side of the building (Fig. 1). In Figure 7 there is also the result of the sealing test performed after the full closing of the analyzed home. The mounting of the PV panels on the cover of the building allows producing an electrical power estimated at 178 kWh/m^2 x year. After having mounted the mechanical ventilation system, also the flow rate supplied by it will be checked, as well as the efficiency of the economizer in the exhausted used air.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Nr. grade-ore pt. incalzire ext.	16	12,8	10,9	6,3	1,7	-0,9	-2,4	-1,9	2,4	6,5	10,2	15,2	77	kWh
Nr. grade-ore pt. incalzire la sol	5,9	5,8	6,4	5,6	3,8	2,6	1,7	1,2	1,2	2,8	3,7	5,0	46	kWh
Pierderi - Exterior	1028	825	698	403	110	-56	-153	-120	157	421	657	976	4948	kWh
Pierderi - Sol	80	79	87	76	52	35	24	16	16	38	50	67	621	kWh/m^2
Suma specifica - pierderi	7,9	6,5	5,6	3,4	1,2	-0,1	-0,9	-0,7	1,2	3,3	5,1	7,5	39,8	kWh
Castiguri solare - Nord	6	8	13	17	25	27	27	22	15	11	6	5	183	
Castiguri solare - Est	68	87	133	161	206	210	222	199	152	118	59	51	1665	kWh
Castiguri solare - Sud	260	315	378	352	352	337	356	404	398	387	231	209	3980	kWh
Castiguri solare - Vest	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Castiguri solare - Orizontal	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Castiguri soalre - Opac	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Castiguri caldura intern	219	198	219	212	219	212	219	219	212	219	212	219	2575	kWh
Suma specifica castiguri solar + intern	4	4,3	5,3	5,3	5,7	5,6	5,9	6	5,5	5,2	3,6	3,5	60	kWh/m^2
Factor de utilizare	100%	100%	98%	65%	20%	0%	0%	0%	22%	63%	100%	100%	46%	
Cerere anuala de caldura	556	296	60	0	0	0	0	0	0	0	200	559	1670	kWh
Cerere specifica de caldura	**4**	**2,1**	**0,4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1,4**	**4.0**	**11,9**	kWh/m^2

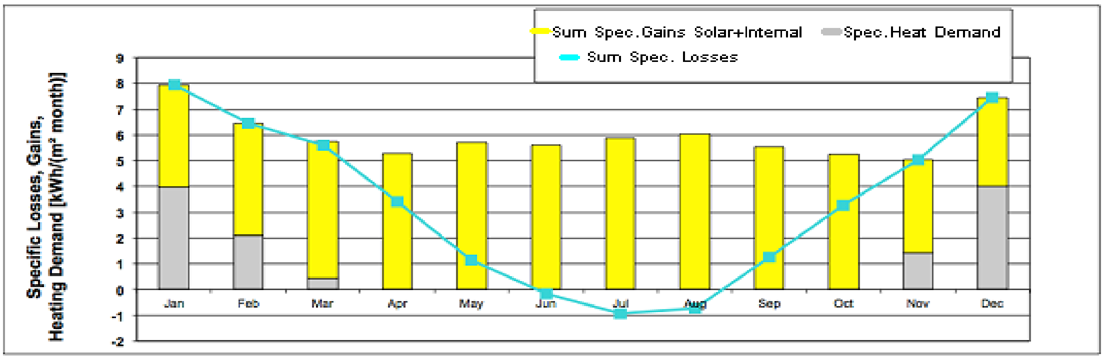
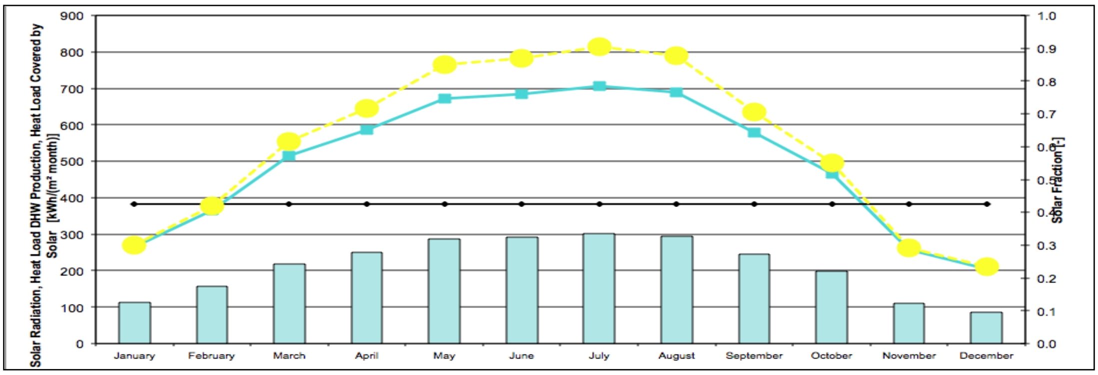


Fig. 5 – Calculating the specific final thermal power demand for heating



Monthly Solar Fraction	January	February	March	April	May	June	July	August	September	Octomber	November	December	
Radiation Tiled Collector Surface	270	378	554	646	766	782	815	791	636	494	262	210	kWhm^2/ month
Monthly Solar Fraction	0.29	0.41	0.57	0.65	0.75	0.76	0.78	0.77	0.64	0.52	0.29	0.23	-
Total Monthly Heat Load DHW Production	363	383	383	383	383	383	383	383	383	383	383	383	kWh/ Month
Monthly Heat Load Covered by Solar	112	156	219	250	288	291	300	293	246	198	109	87	kWh/ Month

Fig. 6 - Calculating the solar power used for preparing domestic hot water

	Applied:	Monthly Method		PH Certificate:	Fulfilled?
Treated Floor Area:	140.0	m²			
Specific Space Heat Demand:	12	kWh/(m²a)		15 kWh/(m²a)	Yes
Pressurization Test Result:	0.5	h^{-1}		0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	119	kWh/(m²a)		120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	75	kWh/(m²a)			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	178	kWh/(m²a)			
Heating Load:	15	W/m²			
Frequency of Overheating:	0	%	over 25 °C		
Specific Useful Cooling Energy Demand:		kWh/(m²a)		15 kWh/(m²a)	
Cooling Load:	1	W/m²			

Fig. 7 – Checking the passive house criteria for the analyzed home

5. CONCLUSIONS

The concept of passive house is applicable at the climate conditions in Romania, both as technology, and as design and construction technique. The economic efiiciency analysis of the investment was not yet performed as the construction is not wholly completed. Its results will indicate in which field of long term profitability it will participate next to the investment in the conventional buildings. The present article presents a calculation by the input data supplied by various members of the project team.

However, the authors are responsible for carrying out the energy performance calculation of the building, a calculation approved by the specialists at the Passivhaus-Institut in Darmstaft. The final certification of the building will be possible, however, after having completed the construction and monitoring its operation over the period of a year.

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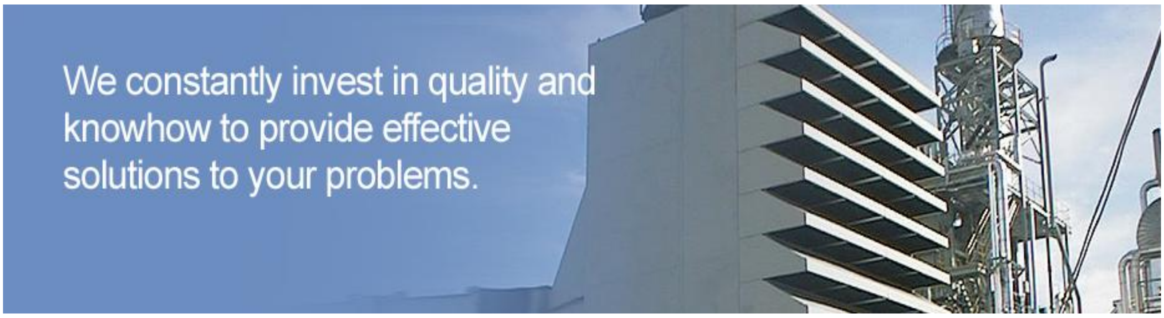

REVIEW OF WORLDWIDE ACHIEVEMENTS AND TRENDS ON OPTICAL CURRENT AND VOLTAGE MEASURING TRANSFORMERS USE

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Summary: The necessity and appropriateness of using the optical measuring transformers within ETN (Electrical Transmission Network) require review in order to accurately meter the electric parameters (voltage, electric current, power, energy), the quality indicators of the electric power and last but not the least, to reconsider the protection and automation equipment engineering.
The main measuring systems used for the unconventional transformers are the following:

- measuring systems with electromagnetic sensor and optically transferred data via Rogowski coil;
- measuring systems with lead divider and optical transmission for voltage;
- measuring systems with optical sensor and information transfer via optical channel: using Faraday effect for the electric current intensity, i.e. Pockels effect to measure voltage.

The measuring systems based on both optical transfer circuits and optical electric current and voltage sensors have highly significant features for the high and very high voltages.
The paper deals with the features of the optical current and voltage measuring transformers which are beneficial regarding: accuracy class, measurement accuracy, frequency range, weight, operation security, environmental impact, maintenance, etc.
The paper supplies data on their use for voltage ranging between 24kV÷750kV.
The authors introduce the solution adopted for the optical current transformers in Târgovişte and Turnu Măgurele 110kV substations.

Key words: optical current and voltage measuring transformers, optical sensors, power quality

1. INTRODUCTION

The power installations operation requires permanent monitoring of the switch apparatus condition and steady state operation parameters, observance of the electric power quality parameters and achievement, through protection and control, of secure operation.
Basically, these requirements can be met by means of the information continuously received on the voltage level and, mainly, the value of the electric currents flowing through each element, under regular and incident condition.
Each electric plant is provided with electric current and voltage measuring transformers which can be considered conventional sensors.
The use of the optical current and voltage measuring transformers within ETN is appropriate and required in order to accurately meter the electric parameters (voltage, electric current, power, energy), the quality indicators of the electric power and last but not the least, to reconsider the protection and automation equipment engineering.
The main benefits of using the optical measuring transformers:

- improved measuring quality
- extended dynamic range, lack of saturation phenomena, large frequency range and output with the possibility to control via software
- significant decrease of costs by using compact construction, low wiring, and the possibility of integration with switch devices
- possibility to construct more compact substations
- the existence of international standards that guarantees the possibilities of interconnection with products of various technologies and various manufacturers
- increased availability and safety of operation
- simplified insulation system for very high voltage

- signal electronic processing provides redundancy possibilities
- environmentally friendly
- the lack of oil or gas prolongs lifetime of the device, provides complete safety and actually rules out maintenance.

The measuring systems used for the unconventional transformers can be classified as follows:

- measuring systems with electromagnetic sensor and optically transferred information using Rogowski coil or lead divider
- measuring systems with optical sensor and optically transferred information using. Faraday effect for the electric current intensity, respectively Pockels effect to measure voltage value

The measuring systems based on both optical transfer circuits and optical electric current and voltage sensors have highly significant features for the high and very high voltages.

The specific frequency features of this measuring equipment outline the disturbances specific to the up-to-date electromagnetic systems where the users of modern equipment based on circuits with power semi-conductors determine over 40 rank electric current or voltage harmonics, voltage fluctuation phenomena, transient phenomena, voltage peaks.

Relying on the data provided by the manufacturers of optical measuring transformers (current and voltage) it results that in the NPS we can use optical current transformers, voltage ones or current and voltage within the 110, 220, 40 kV voltage range for measuring and protection.

2. RESULTS OF MEASUREMENTS PERFORMED IN THE TÂRGOVIŞTE AND TÂRGU MĂGURELE 110kV SUBSTATION

Measurements were conducted in Târgovişte & Turnu Măgurele 110kV substations– where optical transformers are installed, to point out the differences on determining the values and features of the electric current (actual value, variation curve, quality parameters) between readings of the standard existing transformer and the optical transformer.

Several sets of measurements were conducted for the two sets of measuring optical transformers of the optical current sensor type, erected in Târgovişte substation, on Dumbrava 1 110kV OHL, respectively in Turnu Măgurele 110kV, on Azot 2. The optical transformers in Târgovişte & Turnu Măgurele110kV substations were erected in 2010, having the characteristics 600/1A and the 0.2S accuracy class. The standard transformers have the following technical features:

- 123kV, 600/5/5/5/5A transformers, accuracy class 0.2S in the Targovişte 110 kV substation;
- 123kV, 400/1/1/1/1A transformers, accuracy class 0.5S in the Turnu Măgurele 110 kV substation.

The outcome of measurements conducted in Târgovişte 110kV substation are provided further on. The measurements were conducted by means of two Fluke 434 analysers of identical quality, erected on the optical current transformer respectively on the standard one. The main target of the measurements was the nonsinusoidal condition.

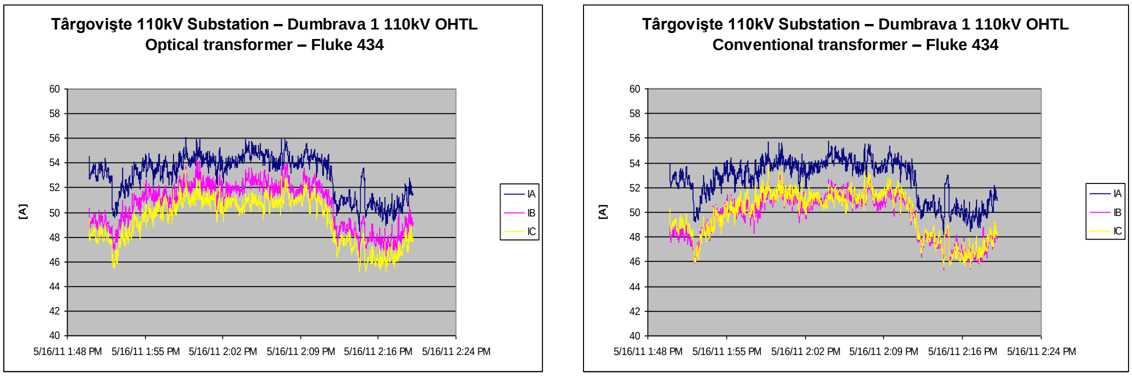
The actual values (rms) of the electric current (maximum, minimum and average values) measured by means of Fluke 434 analysers are supplied in Table 1.

Table 1

Phase	Fluke 434 – Optical transformer	Fluke 434 – Standard transformer
A	56.10A / 48.47A /53.03A σ→ 3.49%	55.76A / 48.19A / 52.61A σ→ 3.55%
B	54.23A / 46.29A / 50.62A σ→ 3.96%	53.27A / 45.35A / 49.59A σ→ 3.98%
C	53.45A / 45.19A / 49.35A σ→ 4.05%	53.83A / 45.51A / 49.78A σ→ 4.08%

The processing of synthetic data in Table 1 reveals the average electric current measured by the optical transformer is 51A while the average three phase current measured by the standard transformer is 50.66A. One can notice the optical transformer determines a plus difference, about 0.7%, which confirms that the transmission of some data on the circuit electric current was dampened by the standard transformer.

Figure 1 indicates the variations of the actual electric current values measured by the two Fluke 434 pieces of equipment.



a) b)

Fig. 1 – **Variation of the actual electric current values on line Dumbrava 1**

Data in Fig. 1 acknowledge the better accuracy in terms of values by stages of the optical transformer having a frequency feature with much higher limit frequency than the standard transformer. The standard transformer has noticeably higher differences between phases than the optical one.

The values of the active power (maximum, minimum and average values) measured by means of Fluke 434 analysers are supplied in Table 2.

Table 2

Fluke 434 – Optical transformer	**Fluke 434 – Standard transformer**
19.05MW / 16.00MW / 17.76MW σ→ 4.21%	18.86MW / 15.70MW / 17.59MW σ→ 4.47%

Figure 2 supplies the results of the active power measuring for the optical transformers and the standard transformers .

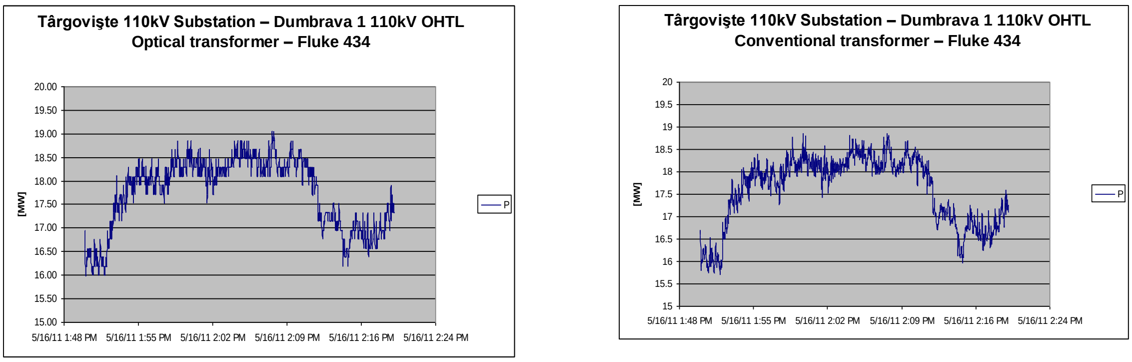


Fig. 2 – **Active power through monitoring time**

The analysis of the synthetic data in Table 2 reveals that the active power metered by the optical transformer is higher than the power by the three phases measured by the standard transformer. The average active power measured on the optical transformer is 17.76MW while the average active power measured by the standard transformer is

17.59A. One can notice the optical transformer determines a plus difference, about 1%, which confirms that the transmission of some data on the circuit electric current was dampened by the standard transformer.
The values of the reactive power (maximum, minimum) measured by means of Fluke 434 analysers are supplied in Table 3. The synthetic data in Table 3 reveal high variations of the reactive power, measured with more accuracy by the optical transformer. The reactive power measured contains no distorting power (corresponds to the fundamental) and complies with the relation (1):

Table 3

Fluke 434 – Optical transformer	**Fluke 434 – Standard transformer**
7.05MVAr / 0.19MVAr σ→ 41.67%	7.47MVAr / 0.5MVAr σ→ 28.75%

Figure 3 shows the results of the reactive power measuring.

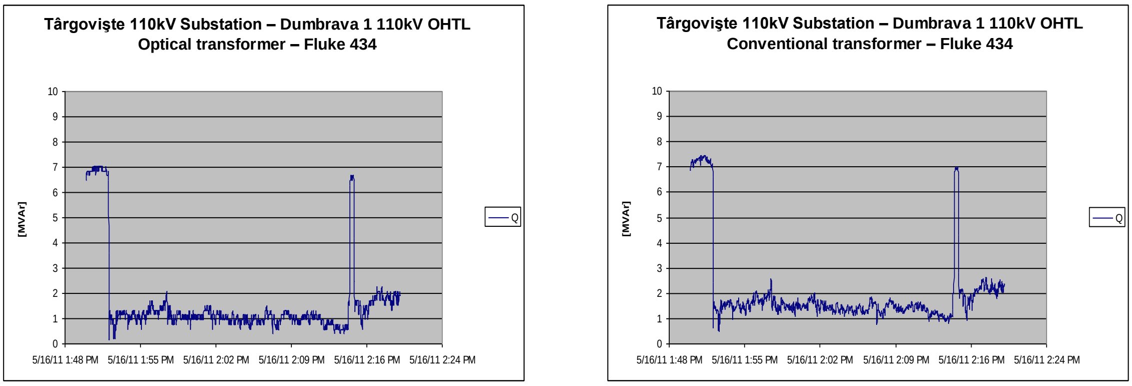


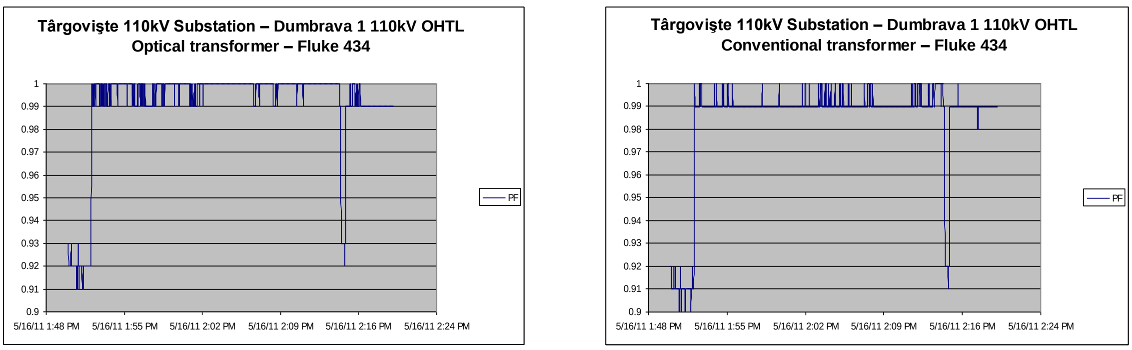
Fig. 3 – Reactive power through monitoring time

Table 4 supplies the power factor (PF) values measured (maximum, minimum and average).

Table 4

Fluke 434 – Optical transformer	**Fluke 434 – Standard transformer**
1.0 / 0.91 / 0.96 σ→ 0.5%	1.0 / 0.90 / 0.96 σ→ ~ 0.0%

The data in Table 4 show that through the monitoring time, the power factor was determined accurately by both measuring transformers. Still, the optical transformer transfers more accurately the significant variations of the power factor. This can be noticed in the curves in Figure 4 which presents the power factor through the monitoring time.



a) b)

Fig. 4 – Variation of the power factor through the monitoring time

Relying on the variation curves of the power factor shown in Fig.4, it can be concluded that regarding the standard transformer, the curve obtained is more uniform than the one of the optical transformer's which has higher variations.

Table 5 supplies comparatively the results obtained for the individual harmonics.

Table 5

Fluke 434 – Optical transformer				Fluke 434 – Standard transformer			
Phase	A	B	C	Phase	A	B	C
1	100.00	100.00	100.00	1	100.00	100.00	100.00
3	1.82	2.22	0.33	3	1.67	2.27	0.42
5	3.44	2.95	3.58	5	3.37	3.09	3.58
7	2.35	2.51	2.10	7	2.22	2.60	2.05
9	0.20	0.22	0.09	9	0.16	0.14	0.07
11	1.94	2.39	2.23	11	1.84	2.49	2.19
13	1.76	1.57	2.27	13	1.82	1.61	2.20
15	0.35	0.25	0.20	15	0.13	0.36	0.21
17	0.17	0.26	0.35	17	0.18	0.25	0.34
19	0.36	0.33	0.17	19	0.34	0.33	0.19
21	0.18	0.19	0.23	21	0.05	0.14	0.20
23	0.43	0.49	0.27	23	0.45	0.55	0.31
25	0.75	0.56	0.55	25	0.82	0.63	0.65
27	0.27	0.17	0.23	27	0.23	0.15	0.17
29	0.46	0.29	0.43	29	0.38	0.35	0.54
31	0.34	0.22	0.23	31	0.28	0.30	0.17
33	0.22	0.24	0.07	33	0.20	0.25	0.06
35	0.30	0.32	0.40	35	0.26	0.37	0.42
37	0.33	0.20	0.43	37	0.36	0.18	0.44
39	0.24	0.23	0.13	39	0.21	0.27	0.14
41	0.36	0.34	0.72	41	0.34	0.41	0.72
43	0.49	0.56	0.23	43	0.37	0.54	0.27
45	0.44	0.53	0.08	45	0.50	0.47	0.09
47	0.50	0.68	0.97	47	0.63	0.70	1.07
49	0.78	0.92	0.40	49	0.85	1.04	0.42

The average values for the total current distortion factor for the three phases, measured by Fluke 434 analysers are presented comparatively (optical transformer/standard transformer) in Table 6.

Table 6

Phase	Fluke 434 – Optical transformer	Fluke 434 – Standard transformer
A	5.63%	5.41%
B	5.68%	5.87%
C	5.58%	5.53%

The maximum, minimum and average values and the values corresponding to 95% probability, for the rank 5 current harmonic, for all the three phases, measured by Fluke 434 analysers are comparatively presented (optical transformer/standard transformer) in table 7.

Table 7

Phase	Fluke 434 – Optical transformer	Fluke 434 – Standard transformer
A	3.83% / 2.25% / 2.96% 95% → 3.35% σ→ 8.14%	3.63% / 2.22% / 2.94% 95% → 3.30% σ→ 7.65%
B	3.94% / 2.17% / 2.85% 95% → 3.22% σ→ 7.75%	3.75% / 2.33% / 2.89% 95% → 3.23% σ→ 6.97%
C	3.96% / 2.85% / 3.34% 95% → 3.69 σ→ 6.02%	3.83% / 2.79% / 3.29% 95% → 3.63% σ→ 6.10%

The data in Table 7 emphasize rather low values of the electric current curve distortion, which renders the differences metered by the two transformers insignificant.

Figure 5 presents comparative results of the rank 5 electric current curve distortion. Figure 6 shows the cumulated probability curves for the electric currents on phase A of the analysed line.

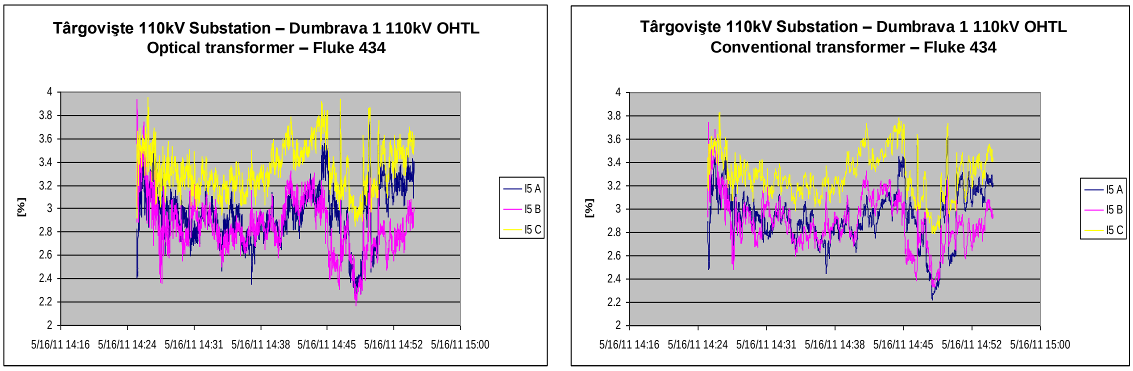


Fig. 5 – **Variation of the rank 5 electric current for all the three phases through the monitoring time**

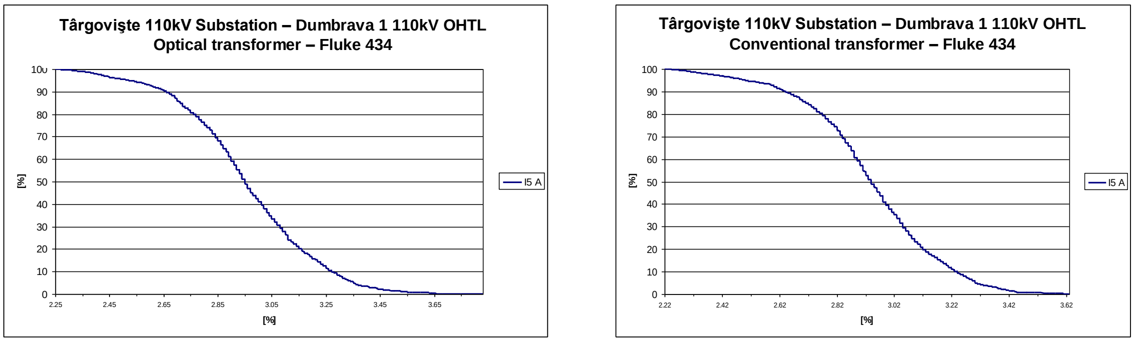


Fig. 6 – **Cumulated probability curves for the rank 5 harmonic currents in the electric current curve on phase A of the analysed line**

The maximum, minimum and average values and the values corresponding to 95% probability, for the rank 7 current harmonic, for all the three phases, measured by Fluke 434 analysers are comparatively presented (optical transformer/standard transformer) in Table 8.

Table 8

Phase	Fluke 434 – Optical transformer	Fluke 434 – Standard transformer
A	2.90% / 1.80% / 2.42% 95% → 2.75% σ→ 10.84%	2.75% / 1.83% / 2.36% 95% → 2.67% σ→ 11.11%
B	3.63% / 1.54% / 2.87% 95% → 3.48% σ→ 21.64%	3.67% / 1.74% / 2.96% 95% → 3.58% σ→ 21.27%
C	2.98% / 1.30% / 2.32% 95% → 2.83% σ→ 17.68%	2.82% / 1.31% / 2.27% 95% → 2.75% σ→ 18.26%

The data in Table 8 show the rather low level of the rank 7 harmonic in the electric current curve on the analysed line, through the monitoring time.

Figure 7 presents comparative results of the measuring of rank 7 electric current harmonic, while Figure 8 shows the cumulated probability curves for the values monitored.

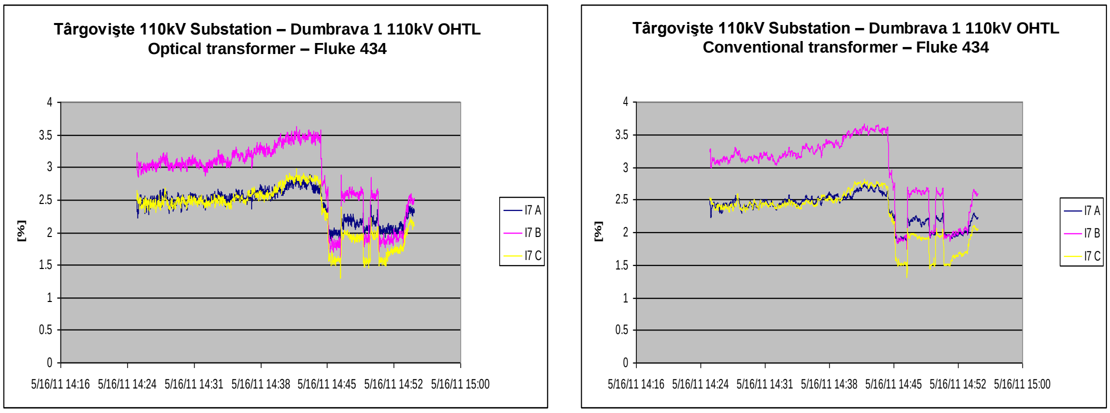


Fig. 7 – **Variation of the harmonic 7 components in the electric current curve on the analysed line**

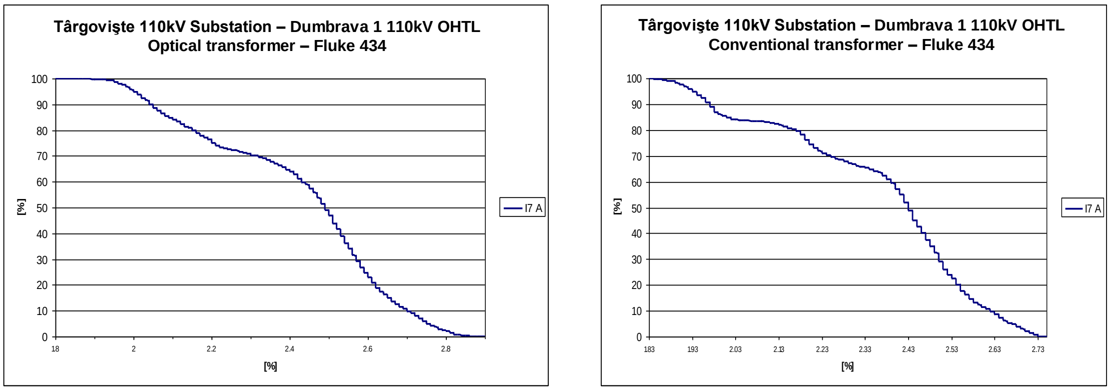


Fig. 8 – **Cumulated probability curves for the rank 7 harmonic in the electric current curve on the analysed line**

The values measured for rank 5 and 7 harmonics show that during monitoring time, the electric current curves sucked by the analysed user had no significant distortion so the two measuring devices determine actually identical values (high rank harmonics have a very low share).

The reactive power measuring is reflected in the corresponding values of the power factor.

The monitoring revealed *Q* reactive power values:

$$Q = \sqrt{S^2 - P^2}\,, \qquad (1)$$

which differ from Budeanu Q_B reactive power in distorted conditions.

The power factor *PF* was determined based on the definition relation:

$$PF = \frac{P}{S} = \frac{P}{\sqrt{P^2 + Q_B^2 + D^2}}\,, \qquad (2)$$

where *D* is the distorting power.

The power factor *PF* differs significantly from the power factor determined for the fundamental harmonic ($\cos\varphi_1$), as one can notice.

The experimental monitoring largely acknowledged the improvement of information on the occurrences within the electric network and pointed out the necessity to use standard measuring transformers upon occurrence of highly disturbing users.

The experimental study conducted underlined the following important facts regarding optical transformers use:

– frequency feature defined by high limit frequency which enables a higher response to variations of the electric values within the circuit;

– high effectiveness of the optical transformers upon measurement of electric values to highly disturbing users by accurate measurement of the electric current curves distortions, reactive power and power factor;

– accurate measurement of the low value electric current (specific for a large number of users, during the current stage), comparatively to the standard transformers, defined by a nonlinear magnetizing curve within low electric current area, which is the case at Turnu Măgurele monitoring (low load, under 25A current);
– more accurate response to significant variations of the user's load.
One should also mention the significant advantages of the optical transformer operation, through simplicity, low maintenance, lack of inflammable liquids, no hazard upon open secondary, etc.

3. CONCLUSIOS

Considering the above, the following can be concluded:

- it is appropriate to use the optical current and voltage transformers within the current substations in order to boost quality of information on values of the current and voltage, electric power quality in the respective node;
- it is appropriate to use the optical current and voltage transformers with the digital protection plants, mainly within the new substations, to provide, besides, better quality of the measuring, protection and control, simplified construction and reduced built area.

The construction of a 110kV substation with low number of elements, with optical measuring transformers and integrated digital protection is considered appropriate.
When choosing the supplier, one should consider both the experience in the field and the opportunity to develop competitive plants in Romania.

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ANALYZING THE ENVIRONMENTAL IMPACT OF A HOME S+P+2E IN VARIOUS STRUCTURAL VARIANTS

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Summary: The present paper raises the issue of sustainable development in constructions. The integrated design of a structure includes besides the economical sizing of the structural elements, also aspects relating to the impact upon the environment. In the future this type of design will become more and more used as the wish is to carry out sustainable buildings that are not harmful to the environment. The main factor that degrades the environment is the power used during all the stages of carrying out a building, from producing the materials to carrying it out. The paper presents a comparison between three structural variants of a home from the point of view of the impact upon the environment. The categories generated by the impact upon the environment that must be considered include the use of resources, human health and the ecological consequences. The impact upon the environment was analyzed by life cycle in which we took into account only the construction and disposal phases. Following the analysis it resulted that there is no major impact difference between the three studied structural variants. Nevertheless, the analysis of the impact upon the environment is in an incipient phase, as it offers only the qualitative environmental indicators.

Key words: Sustainable development, environmental impact, lifetime analysis, environment

1. SUSTAINABLE DEVELOPMENT

All the constructions, but especially the buildings located in urban areas, must possess, first of all, a robust structure, able to stand all the current and exceptional actions and stress it might be submitted to. Currently, more than in the past, and in the near future significantly more than at present, it must be carried out and must function in such a way as to preserve the resources of our existence and the impact upon the environment.

The concept of *Eco-Development,* was announced by Maurice Strong in 1972 at the Conference of Stockholm on the environment and man. It is considered to be an antidote to the pessimistic neo-Malthusian theories, comprised in the World Conservation Strategy (WCS), regarding the scarcity of raw matter and energy resources, and the long term sacrifices of the economies of the states. This concept emphasizes the need for mingling the economic with the ecological by launching the idea of „*economic development through the environment*”. The essential principles of eco-development, in O'Riordan's view (1992) are met if the basic necessities of people are met (food, lodging, education, selfrealization) involve the participation of the human community by developing a collective awareness regarding the environmental issues and are based on the technologies adequate to the conditions and requirements in each country.

In 1987 The World Commission on Environment and Development of the United Nations by the Report of Brundtland coined the concept of „Sustainable Development-SD” - in translation „sustainable development” known in Romania as sustainable development. The definition given in the Report of the Brundtland Commission (1987) was that „sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. This concept was resumed also at the Conference of Rio in 1992 by means of the document *Agenda 21* that underlines the practical guidelines for adopting a common strategy of world states to meet the requirements of sustainable development.

The general objective of sustainable development is finding an optimum of interaction between four systems: economic, human, environmental and technological.

The optimum level corresponds to that long term development that can be sustained by the four systems. For the model to be operational, it is necessary

for this sustainance or viability to be applicable to all the subsystems that form the four dimensions of sustainable development, that is starting from energy, agriculture, industry, up to investment, human settlements and biodiversity.
When designing the constructions, there are two basic principles: meeting the design requirements regarding reliability and functionality, and carrying out an economic structure.
The client is the one who decides if he invests more during the construction phase resulting in a decrease in the operation costs and the reverse. From this point of view, the principle defining the construction becomes purely economic.
The field of constructions is responsible for half of the noxious emissions of the planet, and the assessment of the impact upon the environment will become necessary in the future when designing the structures. ”Buildings account for one-sixth of the world's fresh water withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy flows” (Roodman and Lenssen, 1995).
Taking into account all these elements, the design is performed based on the choice of the best solution that might ensure the reliability and functionality of a building, with a minimum cost and a minimum impact upon the environment.

2. LIFE-CYCLE-ASSESSMENT

The assessment of the impact of constructions upon the environment is performed over the entire life-cycle of the LCA (life-cycle-assessment type constructions.
LCA is a technique for assessing the environmental aspects and the potential associated to a product by:
- compiling an inventory of the input and output data of a system;
- assessing the impact upon the environment potentially associated to the input and output data;
- interpreting the results related to the objectives of the study.

LCA studies the environmental aspects and the possible impact for the life of the product from acquiring the raw material, by the production, utilization and removal process. The general categories of impact upon the environment that have to be considered include resource utilization, human health and ecological consequences (according to ISO 14040). In this context we defined a number of impact categories for which we can calculate the contributions due to buildings. These represent the LCA indicators.
The principle of a LCA calculation is relatively simple, for each stage of the life-cycle we investigate the quantities of materials and energy used and the emissions associated to these processes. Then the emissions are multiplied by characterizing factors proportional to their power of causing various impacts upon the environment. Often one of the emissions is chosen as reference and the result is presented in equivalents as related to the impact of the reference substance.
In order to perform the analysis of the impact upon the environment we considered a building S+P+2E located in Timișoara that we designed in three structural variants: reinforced concrete frames, reinforced concrete diaphragms, and masonry with reinforced concrete poles.
To size and check out the structure we respected the current standards and used the SAP program (except for the masonry structure). For all three structural variants we considered the basement a rigid box, and the foundation of the general apron type. The boards are of reinforced concrete at all the three structural variants. In the frames and masonry structures we chose brick masonry enclosure.
To perform the LCA calculation we divided the structure into four assemblages:

- Infrastructure;
- Superstructure – linear elements;
- Superstructure – plane elements;
- Enclosure – masonry.

For each assemblage separately we assessed the quantities of materials needed that we introduced into the SimaPro program, as the result of the analysis was expressed in Eco-indicator points (Pt).
The standard value of the Eco-indicator can be regarded as non-dimensional. As a name Eco-indicator (Pt) is used. The absolute value of the point is not very relevant, because the main aim is to compare the relative differences between products and

components. The scale is chose in such a way as the value of a Pt should be representative for a thousandth part of the annual effect that a European citizen has upon the environment (this value is calculated by dividing the total impact upon the environment in Europe to the number of inhabitants and by multiplying by 1000 – the scaling factor).

In the current study we took into account only the construction and disposal phases. We did not take into account the impact upon the environment resulted from transport and commissioning.
In the figure below we present the impact of the building upon the environment, by assemblages and for the construction plus disposal phase.

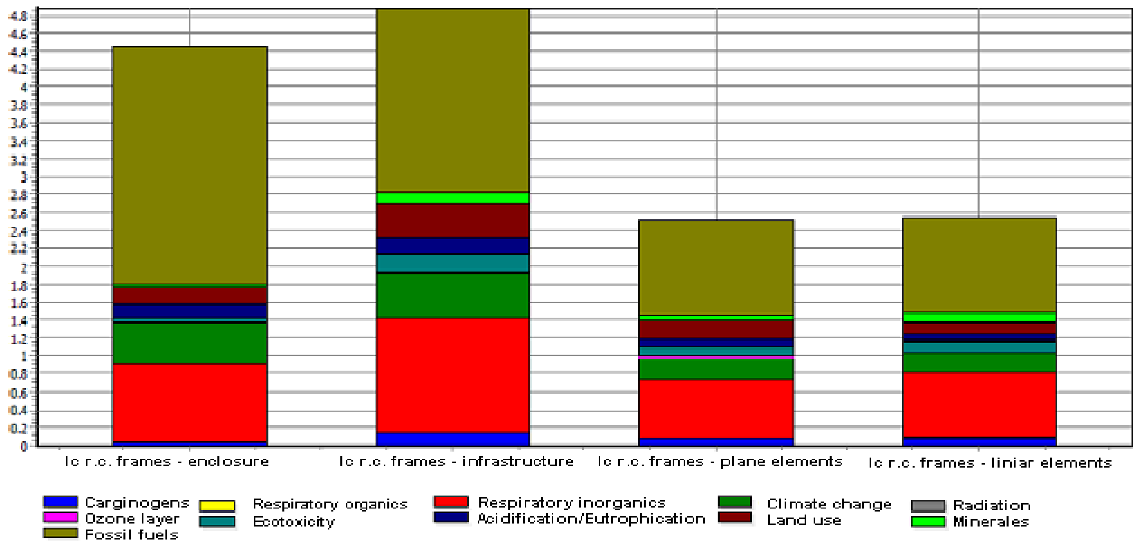

Fig. 1 – Single score for all the assemblages (the construction phase and the disposal phase)

3. COMPARISONS BETWEEN LCA

As regards the infrastructure, in the construction phase, the values for the 3 solutions are close, the reinforced concrete one having the largest share.

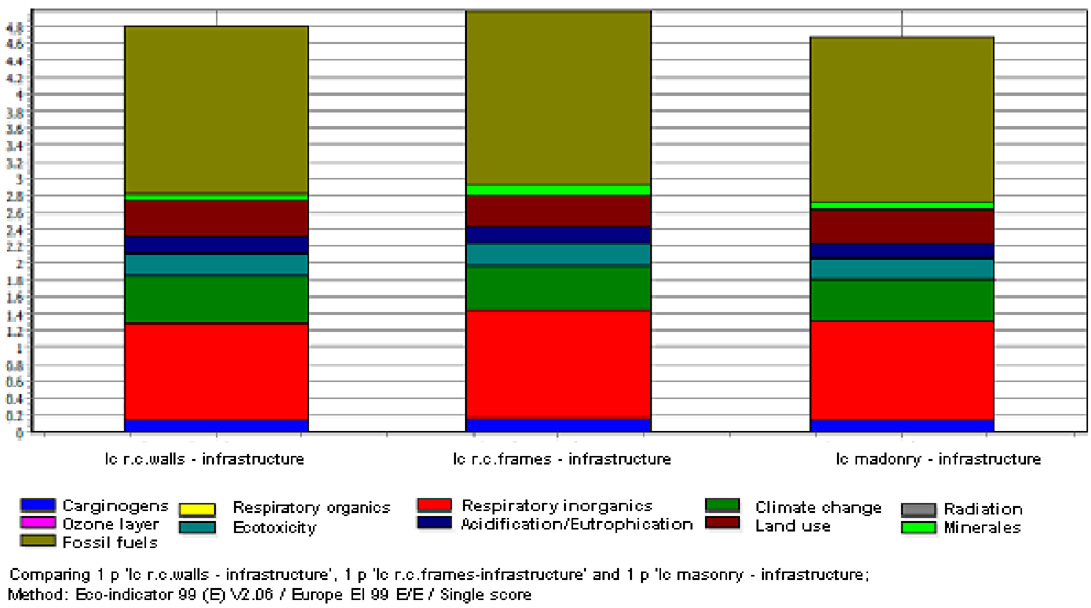

Fig. 2 – Comparison by the construction + disposal phase for the infrastructure

For the linear elements, the concrete frames structure presents the strongest impact (due to the poles and boards) followed by the masonry one (belts, poles, boards, heads of the windows) and the diaphragm one (coupling boards).

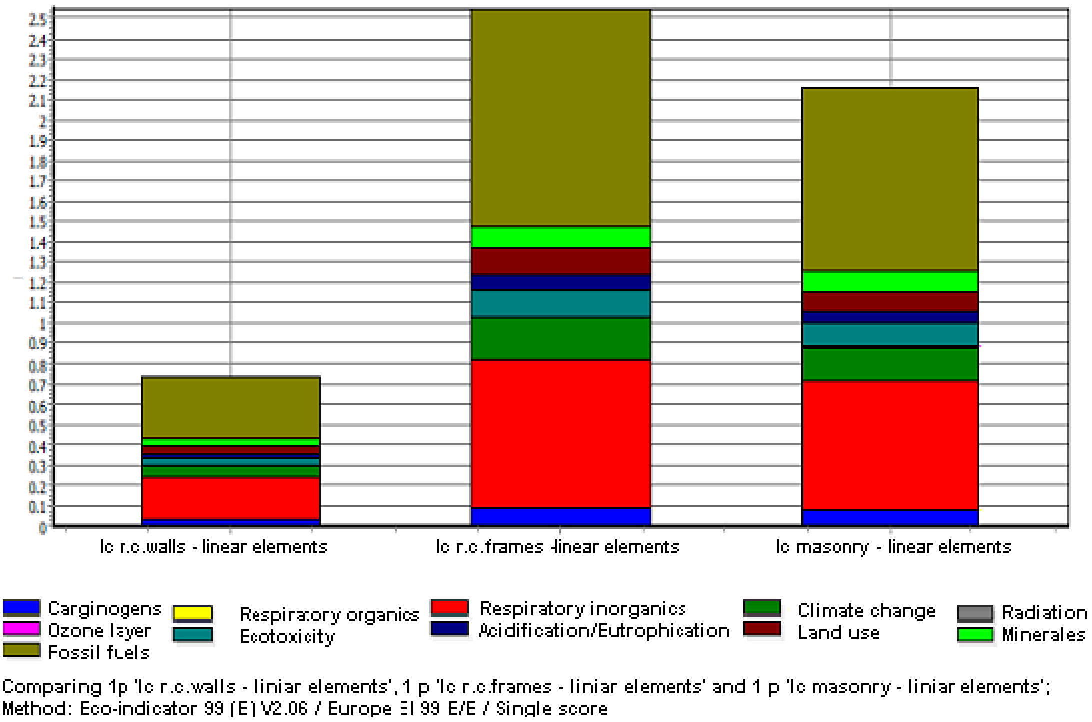

Fig. 3 – Comparison on the construction + disposal phase for the linear elements

In the case of plane elements (plates) we notice that the structure with diaphragm walls has the highest contribution (due to armature) while the masonry and frames ones have values close to the difference resulting from the plate surface.

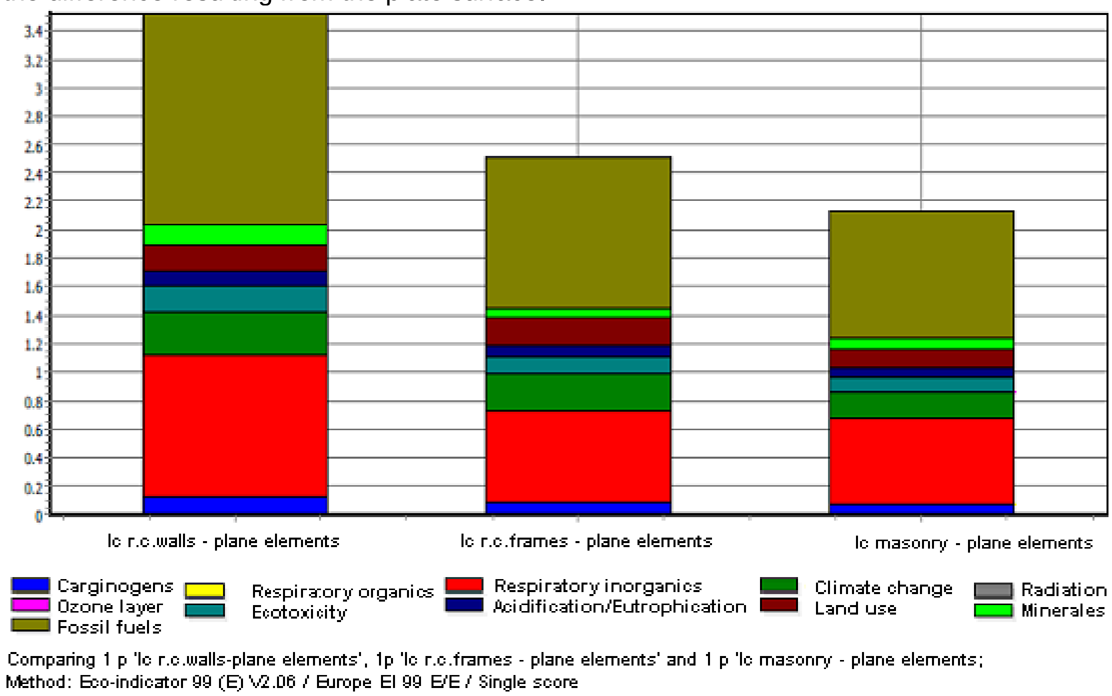

Fig. 4 - Comparison by the construction + disposal phase for the plane elements

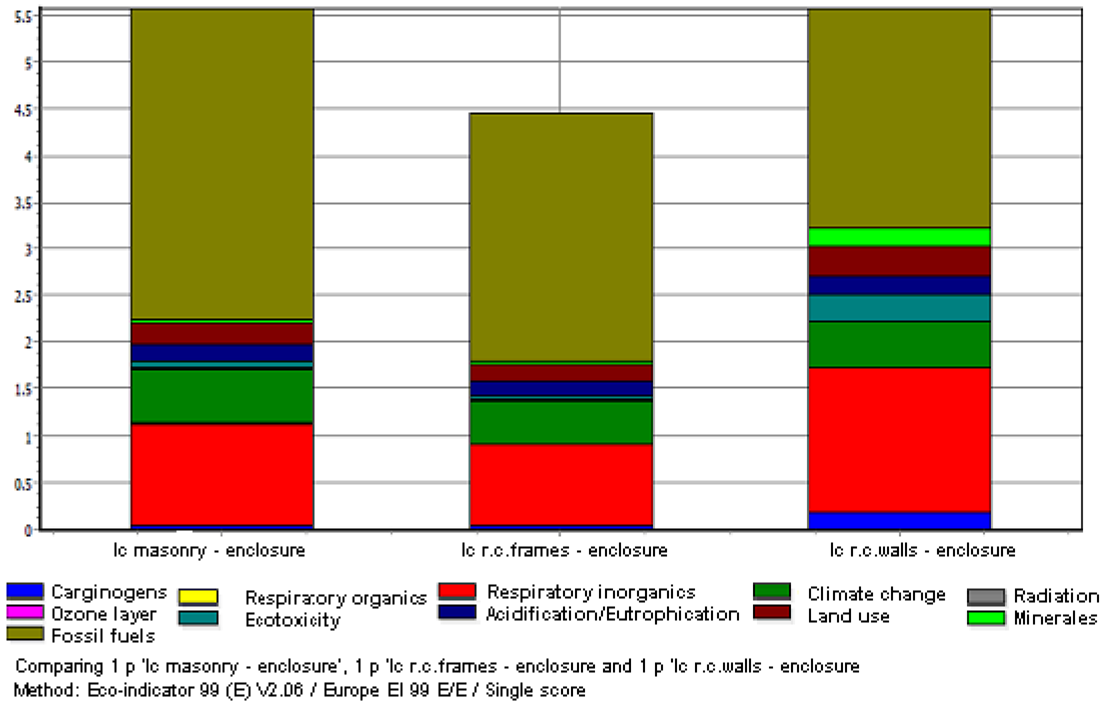

Fig. 5 - Comparison by the construction + disposal phase by closings

In the comparison of the enclosure of the three structures both the masonry structure and the concrete diaphragm one have a larger share than the reinforced concrete frames one, at the masonry one being obvious the high quantity of consumed fossil fuels (for the brick formation and cement preparation process), and at the diaphragm one the large quantity of toxins that affects the respiratory system.

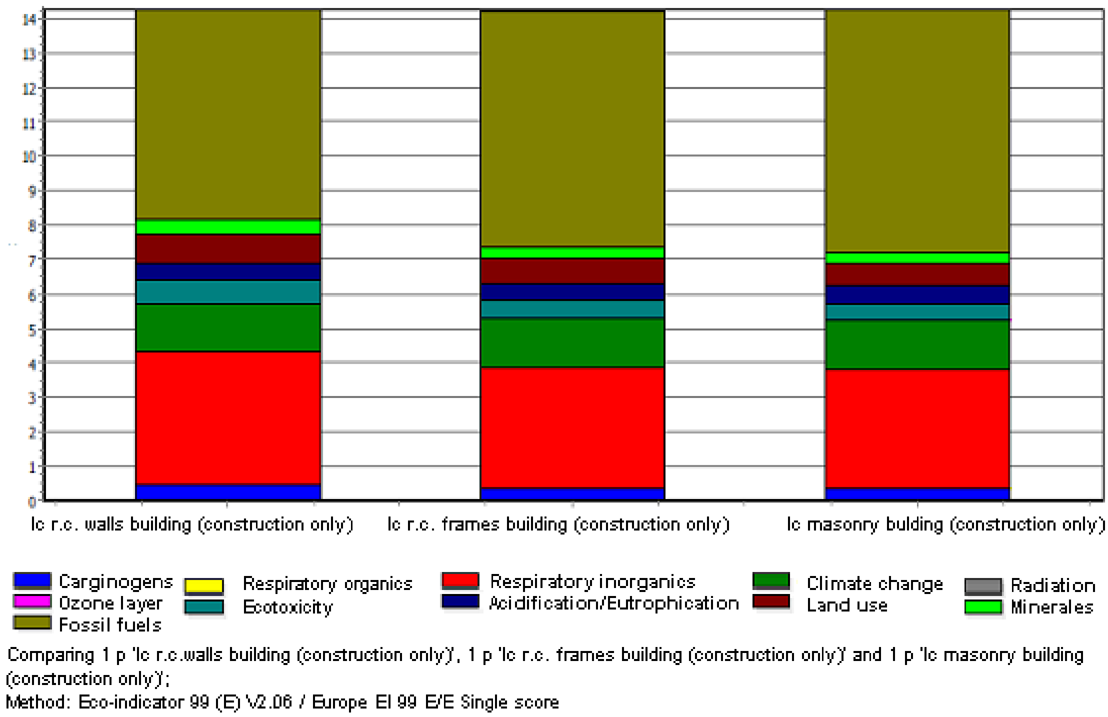

Fig. 6 - Comparison by the construction phase for the whole life-cycle for all the 3 solutions

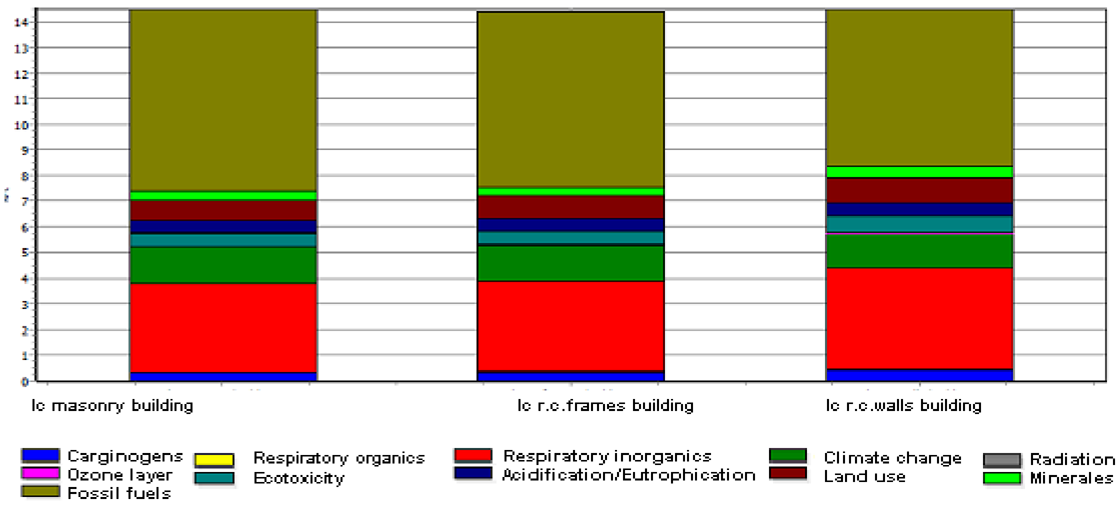

Fig. 7 - Comparison by the construction + disposal phase for the whole life-cycle for all the 3 solutions

At the same time, it can be noticed that the largest contribution has the fossil fuel consumption and the removal following the technological processes of the substances attacking the respiratory system. The emissions resulted from these processes influence climatic changes (greenhouse effect) and also a large share have also the toxic emissions released in the water and in the air and those producing cancer.

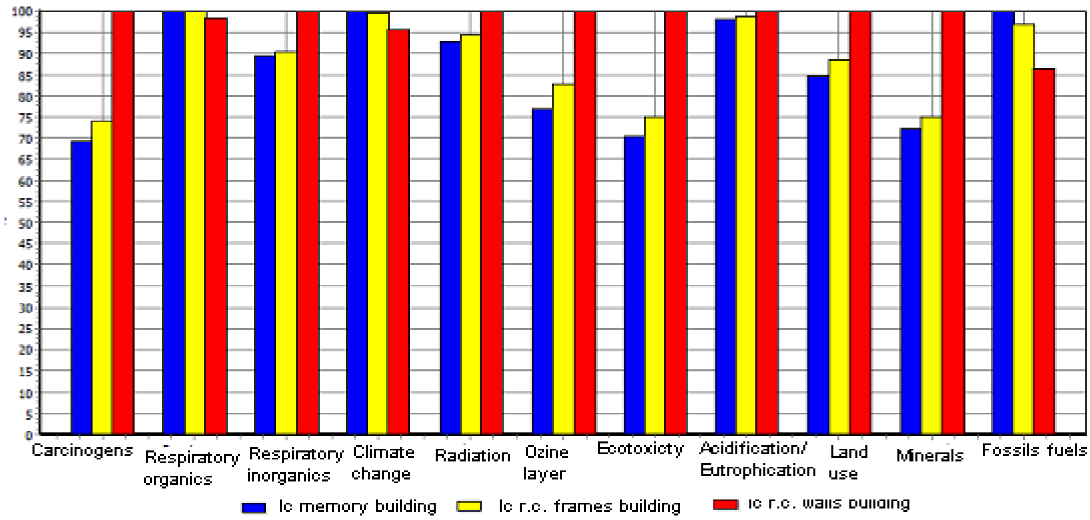

Fig. 8 - Damage – comparisons

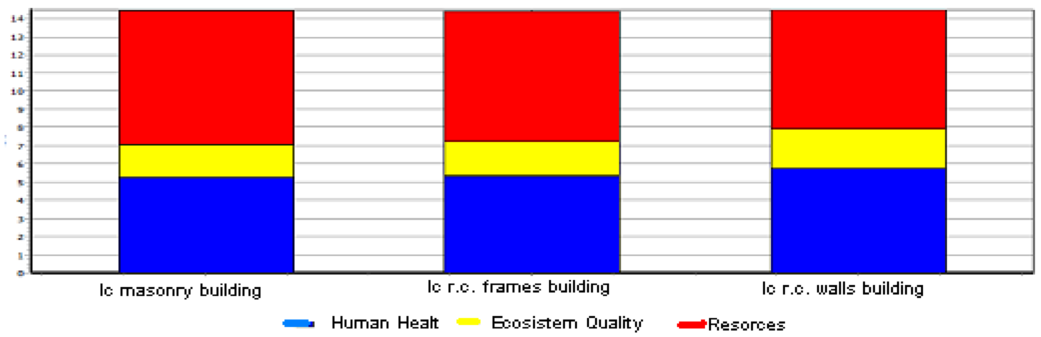

Fig. 9 - Assessing the impact upon the environment related to health, ecosystem quality and resources – comparison

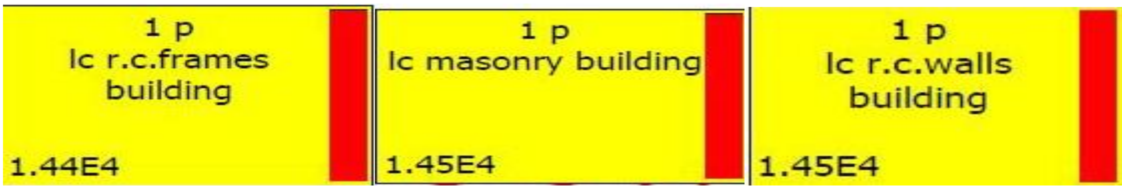

Fig. 10 - Comparison between eco indicators for the three structures

In Fig. 10 it can be noticed that following the analysis of the impact upon the environment, having as a comparing parameter the eco indicators, the reinforced concrete frames structure has the smallest impact upon the environment, but the difference is very small.

4. CONCLUSIONS

As regards the analyzed structure, it can be noticed that the strongest impact upon the environment ha the assemblage of the enclosure, as the masonry with vertical voids cannot be recycled. Following the analysis only by the construction phase we noticed that the negative impact has the assemblage of the infrastructure, with the largest quantity of concrete. The most harmful materials are the masonry and concrete, as these cannot be recycled and remain in nature also after the demolition of the building, unlike the armature that can be recycled in proportion of 80%.
The conclusions upon the comparison of the three structures are:
- In the construction phase the impact upon the environment is very similar for all the three types of structures analized;
- In the construction phase and the disposal phase, the smallest impact upon the environment has the reinforced concrete frames structure;
- The ecosystem is least affected by the concrete frame structure;
- The most "friendly" structure to the environment is the reinforced concrete frames one.

Following the studies performed on an international level it was shown that the metal has the smallest impact upon the environment, due to the fact that it can be recycled in proportion of 100% or it can be reused without too many changes in the construction of other buildings.
The environmental analysis methods are yet in the incipient phase. The impact analyses cannot provide for the time being but qualitative environmental indicators.
For an integrated design (including the impact upon the environment), the materials should contain besides physical and mechanical properties, information on the impact upon the environment.

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