

THE EMERGING OF BIOSYSTEMS ENGINEERING

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Abstract:

The Biosystem Engineering discipline represents a real challenge for height educational process. As a result of the demands which envisage the sustainable development of industrial and agricultural process, Biosystem Engineering can be defined as a new approach of the engineering skills in accordance with the biological systems demands, referring to all the input points: chemistry, physics, agricultural, energy, environment and human health, applied engineering etc.

The Romanian educational context regarding the syllabus and the societal needs of this transition from the so called “physic” (classical or conventional) agricultural engineering to the Biosystem Engineering are presented in this paper, referring to our educational experience in Technical University of Cluj-Napoca, Faculty of Mechanics.

Our point of view regarding the definition of Biosystem Engineering is also presented, with references in our educational curricula, within national legislation engineering specialization, and last issues according with European Union demands.

Based on FEANI report and the thematic Network for Agricultural (Farm Machinery) Engineering studies, the paper refers to the European present stage and our national needs in this field.

As a national stage report the paper presents some remarks regarding the emergence of this discipline in order to ensure the same approach in different European countries, with the benefit in fast and unitary development.

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Key words: *biosystem, precission, removable. Energy.*

1. Principle and characteristics of the Biosystem Engineering

The present demands regarding the quality of life impose to know, to govern and to run the mechanisms that characterize the biochemical environmental process. The control and the management of these mechanisms may be ensured by implementation of engineering principles in biology. In this respect the biochemistry is the field which develops the environmental processes, and engineering must develop the mechanisms and technologies according with the environmental demands.

At the same time the engineering must ensure the quality and quantitative evaluation of the biological processes and products characteristics, using methods and techniques already employed in the same time with the new ones, which are developed according with the new approach in Biosystem engineering filed.

The involvement of the bioengineer as the common engineer involvement has the same level (here the same importance) and difficulty, and that implies a continuous information exchange in order to control the products and the processes, for a continuous evaluation of the risks factors in the Biosystem Engineering (fig. 1).

We cannot reduce the Biosystem Engineering to the agricultural and environmental field because in the present the discussed topic approach covers a

wide range of human, industrial and social activities, which are related to the natural resources: air, water and soil. In fact, all are related to human life.

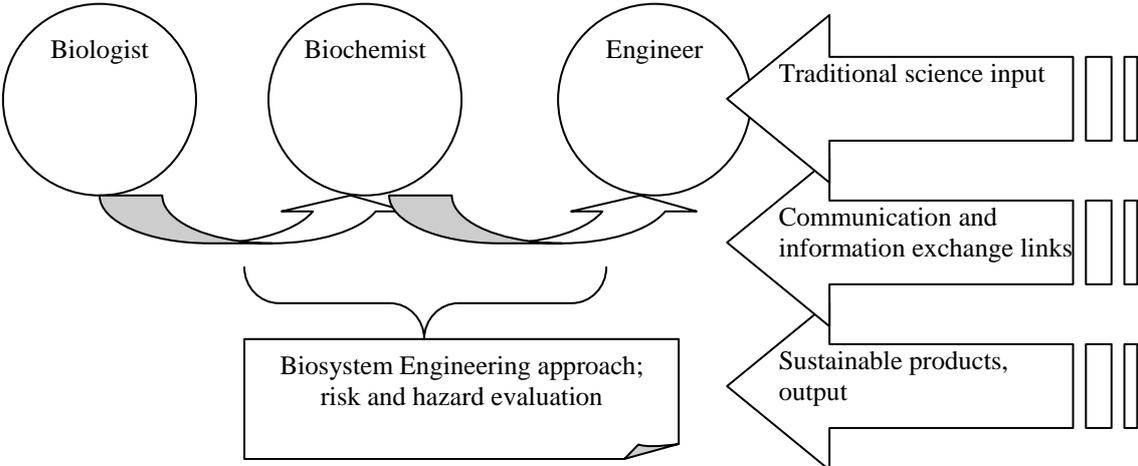


Fig. 1. The links and steps of Biosystem Engineering approach.

Indeed, Biosystem Engineering is a new discipline which grows very fast through the diverse approaches and various examples offered every day. In fact, the Biosystem Engineering represents a new orientation and a new perspective available for the science in order to contribute to the human life.

The Biosystem Engineering consists in analysis of the biological systems and understanding of the biological phenomena, to integrate the engineering principles in accordance with sustainable needs of the soil.

The communication and the information exchange stage actually represent the symbiotic engagement of those three sciences mentioned above, in order to ensure sustainable products. In this respect the engineering has an interactive role for design the product with life cycle considering the environmental risks and special demands regarding the risk reduction (fig 2).

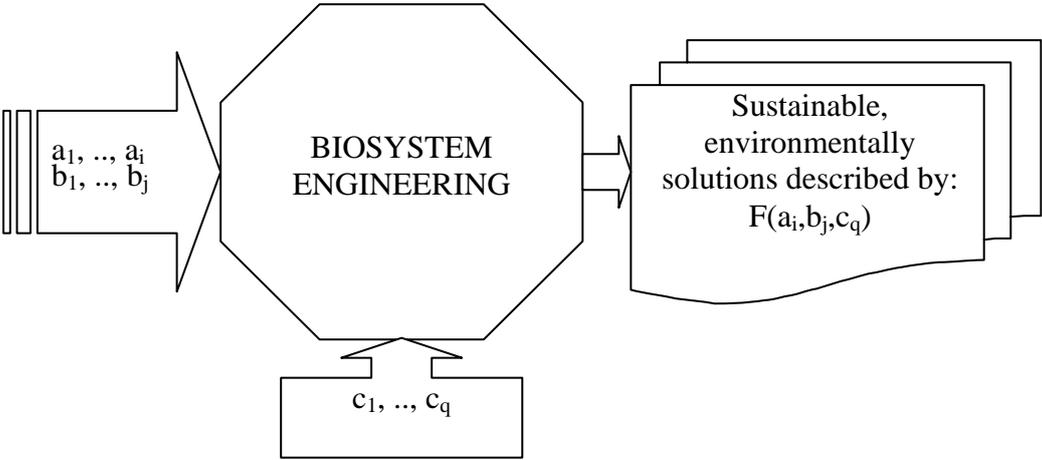


Fig. 2. Inputs and Outputs of the Biosystem Engineering

Considering the approach in this field offered by USAEE, FEANI reports and others contributors, the main characteristics of the emergence communication process can be detailed as [1], [2], [3]:

- ✓ main inputs $a_1, \dots, a_i, b_1, \dots, b_j$ - basics of biology, agricultural and engineering as an involvement of the basic sciences such as mathematics, physics, chemistry, mechanics etc.;
- ✓ output results $F(a_i, b_j, c_q)$ - enhance the state of animals, plants, and biosphere by identifying sustainable environmentally sound solutions that minimize waste and continually recycle materials, with reduced risk;
- ✓ interactions factors c_1, \dots, c_q , related to competences and any random influences (including environmental risk), consist in unexpected or expected models as a result of complex algorithms.

2. Present state of Biosystem Engineering related to the syllabus of the agricultural engineering discipline

A first remark is that the Biosystem Engineering consists in a new approach in our country, and at the transition from conventional disciplines of engineering and agriculture to bio disciplines is in progress. In fact the process is slow because it is required a small steps policy from conventional stage to the new one. Something must happen in the attitude of the society related to the new discipline, and a continuous development of this issue (topic) must progress in accordance with a small steps policy.

The engineer specializations and the engineering fields are stipulated by Govern Act no. 676/28.06.2007. According to this act, the Biosystem Engineering is a part of Applied Mechanics field. This classification is actually in accordance with the previous definition. But in the same time the specialization of Agricultural (Farm Machinery) Engineering is known as a part of mechanical engineering. It is this good or bad? We can accept the fact that for the moment this situation represents an opportunity to let new biosystem disciplines to grow up with the possibilities to achieve good results in different activities: medicine equipments, environment, bioenergy, energy supply, agriculture etc. At the same time, the conventional engineer education enrolls by master studies, and the graduate students have the opportunity to specialize themselves in Biosystem Engineering.

Our university develops a new orientation of Biosystem Engineering within an existing specialization: Machines and Equipments for Agriculture and Food Industry. In this respect new disciplines were introduced in syllabus, disciplines corresponding to the new approach in Biosystem Engineering. This is a complex line of study belonging to the larger field of mechanical engineering, training bachelor engineers in design and use of machines, tools and equipment from agriculture and food industry.

The subjects we offer are: post harvesting processing technology of agricultural products, engines for tractors and automotive, agricultural machines, tractors, automotives and propulsion systems, renewable energy sources, repairing and manufacturing, CAD, quality engineering, management and marketing, environment engineering.

At the same time more changes appear in the syllabus, with indubitable references, especially at the elective courses in Biosystem Engineering, such as Renewable Energy Sources, Agricultural Waste Recycling and Basics of GIS – GPS systems.

Orientation toward Biosystem Engineering is ensured by two ways, consisting in one hand in development of own researches in the field and on the other hand in previous experience by participation to an educational master program, during 2002 – 2006, supported by DAAD [4].

The own researches development was possible by international and national grants participation, in the following fields: biofuels, renewable energy sources, development of equipment for precision farming and increasing of urban mobility referring to GPS – GIS survey [5].

The benefits of the carried out grants consist in development of material basis and certain specialized laboratories, where the students can attend the applicative courses according to syllabus (fig. 3).



Fig. 3. The laboratory of Cogeneration Energy Based on Solid Biomass; a – solid biomass heating system; b – air – water heating system; c – data acquisition system for biomass heating system.

The involvement to master program “Promotion of post graduated education in Agricultural Engineering in South – East European countries” offered new experience to involved teaching staff regarding technical disciplines belonging to Biosystem Engineering.

All the new approaches are based on our educational experience regarding the Biosystem Engineering gained from a master program mentioned above (South East European Countries with the DAAD support in 2002 – 2006).

As an approach of educational development in Biosystem Engineering through certain master programs will allow to evaluate the impact and to feed back in an appropriate manner.

Aside our academic center there are two other centers where Biosystem Engineering is part of academic development. One is University "Politehnica" of Bucharest where Faculty of Biotechnical Engineering Systems was established. Within this faculty master program courses are taught in Biomedical Engineering, Bioinformatics, Biomaterials and Biotechnologies. In these fields Ph. D. students' courses are also held. The second is University "Transilvania" of Brasov, where within Food and Tourism Faculty (established 2007), Food Products Engineering is developed, having a marked orientation in promoting food biotechnologies.

3. Employability of the Biosystem Engineering graduate students

In this period universities train engineers in conventional fields, having bioengineering competences. So we cannot speak about engineers specialized in biosystems. Still, they can find where to labor, existing an encouraging attitude of the employers, related to their competences in measurement and instrumentation activity along with technological processes management.

There is also an increasing demand of engineers with biocompetences, considering the biofuels production at national level along with bioenergetic crops production (rape, sunflower and soy) [6].

Another targeted field where bioengineer can find labor is the solid biofuels production (pellets, briquettes etc.). In present, within lumbering factories waste wood recycling stations have developed, which produce pellets and briquettes.

However considering that bioenergy education just begins, the most part of graduate engineers will find a job within educational system as future forming staff. We consider the possibility offered to continue their specialization by master and doctoral programs, thus contributing to present or future bio research centers.

Conclusions

Biosystem Engineering is a challenge for education, transition from conventional approach to bioengineering must be done according to small steps policy, but in the same time with increasing of economic environment demand related to this new specialization. There still is a perception problem of bioengineer that is why the promotion of this new discipline must intensify. The argument in this respect is the decreased interest of the candidate students to conventional farm machinery engineering.

The interest related to this new agricultural engineering specialization increase and offers for graduates students large opportunities.

However, as a new approach more are focused regarding the competences area cover by this specialization in accordance with the common engineering attributes. It is obvious the fact that the biosystem engineering competences suppose an interdisciplinary specialization and in this respect the educational core curricula is different.

At the moment the discussions are referring to subject: In which way we can improve this new specialization: as a basic education starting with first study cycle or

is more appropriate to develop a master education stage for develop supplementary bio competences of the graduates students?

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