Abstract: Requirements of the labor market in ICT require continuous and rapid qualification and retraining of staff. Simultaneously, existing conventional architecture school does not allow rapid adaptive retraining as specialists, it the majority university programs are based on solid foundation with modular floor structure. This report describes a new conceptual architecture of the academic curriculum that realizes open access to the curriculum excluding the historical relationships in forming the foundation of knowledge, and opens the market of educational services to other providers, such as colleges, private academies and practical hands on experience. Presented model permits the development of competition and does not put the operators of educational services in new entrants or dominant position, thus the concepts found in real terms realization of new undergraduate program in Network Engineering at New Bulgarian University.

Keywords: INNOVATION IN ICT EDUCATION

1. Introduction

The introduction of online technology for training results in innovations in teaching. These online technologies have already changed the educational services market globally. Disruptive effect of online innovation is a prerequisite to entry for new commers in educational services market that change the dominance of state and private universities and schools [1]. This happens worldwide (USA, Europe, India, etc.). Largest universities are actively develop online training platforms, most of them are using very simple models, such as youtube and moodle. Recently, the market of ICT education introduce some new platforms, specially created for entry operators in online training. These introduces full automation in the learning process and maintenance of individual users (students), allowing significant reduction in the price of the end product.

2. Why VERTICAL?

2.1. Problems of heritage of classical academic curriculum

The classical model of academic education implies the realization of multi-architectural concept in teaching, learning and use of knowledge. This model seems to be logical in the course of development of the industry over the past 200 years, where engineers and other medical and law students can be effective trained. This is not adequate for emerging technologies and services. Inability of this monumental model to adapt new courses makes it incompatible with the current trends in the labor market. The concept of the monumental approach is that engineering disciplines must be built on the basis of mathematics, physics, chemistry, biology, electrical engineering, electronics and more. The specific problem is not whether such knowledge is important for engineers, but in their methods of teaching exported outside the context of their application. Classical programming architecture of academic education is that in order to produce an effective engineer a 2 to 3 years study plan of fundamental education must be applied. This approach makes the classical academic education extremely boring and engineering and technology subjects difficult for students. Moreover, the classical fundamental model leaves no room for the development of new and modern courses. Thus often substantial percentage of current courses does not exceed 30% of the total courses count. During their studies the students in various engineering programs continue to receive one common base of the foundation, which forms about 50% to 65 % of the material.

2.2. Modular – major & minor approach

Modernization of classical university program in engineering is extremely complex process. These complexities come from historical interdependences created between disciplines, such as physics with mathematics, electronics electrical engineering and mathematics, biology, chemistry and more. These relationships are “hollow” and, in fact, modern mathematics teacher rarely has a real understanding of the application of the material. Multi-annual construction of university programs of isolated specialists, teaching highly diversified knowledge, that have no idea about the integrity of the physical processes underlying to most of the core technologies create opportunities to build additional complex dependencies between completely “hollow” specialized theoretical courses only to preserve of the status to teach. These dependencies on a fundamental level, gain degenerate lines in subsequent relationships of the above courses, as digital systems, strength of materials, microprocessors, etc. Over the years curricula are built on a horizontal floor method, each successive floor suggests that students have successfully built the previous floor of knowledge.

This architectural concept is similar to classical engineering approaches used to build large buildings in the near past. With the advent of technology preparation of modern engineering led to the need for a trained high-volume application skills as technology advances can not find an adequate place in the curriculum, which vary extremely slowly under the pressure of historical relationships between courses leading to large fragmentation of knowledge. Legacy of monumental academic approach, however, prevents the rapid adaptation of university programs, precisely because of the huge amount of horizontal and vertical interrelated subjects that the amendment can not be done alone. For example, the introduction of new technology courses priori implies the knowledge of the entire past technological background. This of course is absolutely impossible and uneconomical. Consequently, the advent of new technology in university programs take far more time than it was necessary for its inventive, and even more after the end drop from the same basic curriculum.

To solve this problem, introducing of modular training methods was made. This segmentation of engineering today led to a huge amount nomenclature names for basically the same curriculum. In these programs the monument continues to account for 40% to 50% of basic knowledge taught in all engineering specialties, some major differences lie mainly in the degree of use of associated with mechanics, electrical engineering or other technical disciplines (physics, chemistry, biotechnology and etc.) Due to the desire of universities to engage the attention of as many students in the past 40-50 years, a huge amount of different curricula in 30% - 35% between. This diversification of education coupled with the loss of a clear connection and analogy between seemingly disparate curricula today causing the collapse in engineering education. At the same time it evolved into a modular model within the last two years of study, university programs do not change the general architecture of the foundation. Thus a number of specialists today, mathematicians, physicists and chemists in university programs exist alone without a clear idea of their role in the realization of the final product. That these people appear a parasitic body of the same old architectural concept. For example, few mathematicians have a clear idea and a desire to understand exactly where they teach are dry knowledge is a practical engineer. Similarly standing problem of teachers in chemistry, engineering physics, mechanics and others. Highly theoretical courses covering the first two years of study the students become funerary stone of engineering disciplines. This fragmented teaching, makes the final result of the outermost notion of contemporary student for his future work. That leads to the destruction of the natural human concept for the
implementation of education, namely the provision of higher incomes in the latter part of the life of the engineer. The essence of the picture more strongly modified by the fact that the modern student, using the Internet can easily navigate in the technology world, as university curricula are becoming more abstract look and usefulness becomes more clear.

Another major problem of the modular approach built on a common foundation is unable to be built open educational model that ensures the mobility of students and professionals in need of retraining. This historic obsolete approach can not meet the current requirements of the labor market. It is useless precisely because of its clumsiness, lack of interdisciplinarity, withdrawal and virtually no adaptation to the needs of both the labor market and to the individual needs of the student. Using this fundamental approach in education an engineer can not be professional qualified for a period shorter than two years, thus it raises serious questions about the usefulness of such a qualification in the context of the ongoing development of technology. Separation of the various engineering disciplines in different nomenclatures, without any real justification works only public universities, whose maintenance is provided on market principles, state subsidized and aimed at preserving the featherbeds Army Senior scientists in dozens of different nomenclatures.

At the same time, you want to become more involved in their student universities generate huge amount of minor programs. This stems from the idea of reuse of existing product and selling it at lower prices, good quality second to customers who would not have bought it at the original price, but would prefer to receive it within the total user level. This model, however, seriously harass the administration of educational programs, worldwide, each more university within the last few years, now offers dozens or even hundreds of minor programs in almost all professional fields. Seemingly cheaper program for the end customer, it becomes more expensive for the provider of educational services. Objectively speaking, this marketing gimmick to artificially maintain unprofitable programs a lot like selling hladimni machines Eskimos. The essential terms of the possibility of continuous training and mobility is the possibility that this be done dynamically with the requirements of the labor market, not all together. This is like a bonus menu to each portion ordered in the restaurant. You understand that this is not only unhealthy but also extremely wasteful.

2.3. Vertical versus horizontal

Characteristic of the ICT sector is that it is the fastest growing sector of the economy. Innovations made in it, such as computer, software and electronic technology have led to innovations in several classical areas such as mechanics, medicine, chemistry, physics and more. The leading ICT companies quickly found the inability of the classic academic model of education to prepare and re-training people in new and emerging industrial areas. Due to these facts, a number of companies such as Cisco, Microsoft, VMWARE, HP, Siemens, IBM and others. network of its internal corporate academies [3]. Moreover, by developing the role of their academies in the world of cloth they managed to seize large market segments in their main activity: computers, networks, software and more. Typical benefits of these corporations Medel is its high efficiency, clarity meters hierarchy and complete information about necessary steps that a person should not go to be able to take a certain professional exam. And this model is something very different from the academic educational approach. It implements the vertical structure of the curriculum. This means that for a network engineer does not need to know all the math and electronics, but only that part of the technology with which it directly will work, when the level of his knowledge becomes insufficient, he can easily add to your arsenal knowledge and skills acquired from other certification courses to the same or another company. It is because of its flexibility this vertical model is particularly effective in conditions of high competition in technology. He is also a modular because it implies a gradual stepwise accumulation of knowledge by students.

Naturally, this model is open, as the same skilled can study one or another technology or another provider, or prefer to prepare their own. This makes learning open and accessible to a much wider circle of people, even those with extremely low incomes, who generally have absolutely no chance to get quality education and training to ensure their professional growth and a better life. Increased chakestvo of life should be a key element in leading the implementation of strategies for the development of higher education. That universiteta academy and individual educational service provider should provide such conditions, a set of technological tools by which obuchavashiyata to be able to improve their social status and consequently their quality of life. It will make a number of currently sighted unattractive curricula again interesting and preferred by students.

2.3. Verticalisation process is costly

At present we do not have objective information about how successfully can be accomplished architectural conversion in higher education. All we know that this model works well in corporate academies and specialized training programs on the market of educational services from third party suppliers. Historical shape vazimovazisimosi across disciplines from the foundation of engineering programs makes them extremely difficult to reform. The main problem is not with this savrazn teachers to be convinced of the reality of this process, and in how to make it as inclusive and provide maximum mobility of students.

![Fig. 1 Studing technology must be very simmilat to technology self architecture.](image)

Verticalisation partly be achieved through the implementation of the so-called author masterfully schools, where a small team pepodavateli take on the task to train a relatively small group of people in a specialized curriculum. This makes the final product very expensive, as commit the resources of highly qualified special and block material resources that might otherwise be used by more teachers and students. To ensure mass scale in this approach maksimalna openness, individual courses should be interleaved not separate and distinct blocks of context-oriented strands of “elongated” educational units. This means that the model can not be realized without online innovation. Without the online approach such training would be extremely expensive and inefficient. It allows online approach to create a vertically oriented subjects that meet the specific needs of students and businesses.

For example, our application is to implement a hybrid structural model curricula. In this process, some subjects may converge with other disciplines and also to create a highly intertwined composite architecture of knowledge and skills. But for required vertical - mast elements and horizontal connecting elements forming different levels of technology teaching. This approach allows us to create programs in ICT that are open for teaching of technological subjects in the way that the technologies themselves are built Fig. 1. (ISO / OSI model for open interconnection between networks is a typical example of the realization of vertical modular architecture that can be seen as a whole and in the context of individual technologies.)
3. Why OPEN?

The vertical model combined with modular upgrades to basic training programs that can provide hybrid technology of teaching, to open the market of educational services [2]. Within this context, the presence of possible specialized operators specific educational content not only increases competition and directly affects the quality of training but also allows the construction of a specific ecosystem to better meet the demands of the labor market. So napirmer realization of hybrid vertical - horizontal modular model will instantly set us free from the legacy of the classic fundamental model and Major - Minor modular approach. Vertical model of education will strengthen the role of universities and research institutions in teaching basic subjects, but in a way that opens up these courses to the general public, making them more accessible, useful and effective for all users of the educational services market. For example, the teaching of mathematics, which is stroko specialized vertical sashkvestvo will contribute to proper and use by students in their future work. Thus mathematics courses are part of growing professionals, thus an engineer will acquire new and needed his knowledge of mathematics in the process of emergence of nuobhodimostta them. That Growing up, year after year, the future engineer can continuously be supplied with specific learning material in the relevant technological disciplines. This will get rid of the aggravating influence of fundamental disciplines and will make the engineering profession more attractive, useful and creative.

4. The NBU case?

In the context of the need to create attractive and truly effective curricula, NBU were able to build a vertical modular curriculum model in Network engineering. Within this program, we first created three vertical pillars on which we base our entire program structure. These are: mathematics, electronics, computer and software technology. These pillars start from the beginning of their studies students and instead focus on teaching fundamentals during the first two years, that form the basis of the engineering course, we teach these disciplines vertically in the process of study. This allows us to make the most flexible program that can be freely adapted course modules acquired outside the university, as it does not interfere with the core support structure of engineering education. Moreover the teaching of mathematics, electronics, and software in the context of specific technologies and their applications gives a very accessible form for students. Now mathematics and electronics are not difficulties and obstacles in acquiring specialized knowledge, but rather they are a complement of courses in specific technological fields. As a result, students learn more mathematics, electronics, computer technology and software than in the classical fundamental model. Moreover, this vertical approach can optimally be adapted to a variety of business-oriented courses such as courses like Cisco, Microsoft, HP etc. Reforming the curriculum took about 3 consecutive iterations.

A first phase was formed at technology and communications-related post-electronics. In this process several cuts school years courses in electronics were reformed so that today they are taught during the whole study of undergraduate students, close to the last year of study. Iteration required insertion of a separate element attached pylons next by previous. These were courses in computer technology and software. The introduction of applied courses in the first semester, students get a clear assurance that the expectations and what benefits you will have the choice of specific curriculum. Moreover, the introduction of this vertical model allows professional immediately after the completion of each course applied to have distinct knowledge and skills that they can immediately start working. Most complicated moment in reforming curricula verticalisation was the foundation of mathematics. Being the most important mathematics require the longest time for reform. As result however we have created a much applied curriculum, which from the beginning of their studies, students get a clear picture of the application of mathematics to decide a specific technological problems that they will encounter in practice.

5. Conclusions

At present we have no universal model, how successfully to accomplish architectural conversion in higher education. All we know is that this model works well in the corporations and that this model clearly can be applied in higher education. However, the advent of this innovation will lead to a number of difficulties related to regulation. It is possible that regulation regarding program accreditation at present will be reoriented towards accreditation of specific courses: pylons, modular, horizontal and caulking. It is also difficult to imagine without appropriate computer models how these will work in a hybrid model. At present, the authors hope to achieve a wider popularity of the proposed vertical model of innovation in higher education. We think this will achieve strengthening role of higher education in the process of training and retraining of labor resources. The main driving factor here is focused on technology, the variety of technologies of higher education, making a consumer-oriented education through the introduction of online innovation in higher education.

6. References


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