INNOVATION AND ENTREPRENEURSHIP IN ICT

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Abstract

Entrepreneurship is important not just because it creates jobs, wealth and improves the standards of living. Entrepreneurship uses innovation to drive the change, to create new products, new markets and a transformed world. We describe in this paper the advance of the two main objectives of the "Computing Innovation for Technology Entrepreneurship" project developed by University POLITEHNICA of Bucharest (UPB) from Romania and Østfold University College (ØUC) from Norway, in the framework of the Education, Scholarships, Apprenticeships and Youth Entrepreneurship Programme in Romania Financed by the EEA Grants 2014-2021. It is addressed the introduction of two new courses for postgraduate programs – "Information and Communications Technology Entrepreneurship" for the Engineering and Management master students and "Information and Communications Technology based Innovation" for the Computer and Information Technology master students. We will present the necessity and the synergy of the two topics, as well as the progress in preparing the materials for them. The courses are developed collaboratively by a group of Romanian professors and assessed initially by the Romanian team, later by the Norwegian partners and finally by the Romanian students, in a lean methodology approach.

Keywords: Innovation, Entrepreneurship, ICT, Collaborative teaching, Lean Methodology.

1 INTRODUCTION

1.1 Innovation and Entrepreneurship

Innovation is regarded as the process of introducing something new (idea, method, process, device) or the subject/result of this action. It represents more than the invention, which is just the subject of the innovation process. Entrepreneurship represents the creation of an economic venture and the entrepreneurs are agents of change, operation done in many instances by innovation. Innovation and Entrepreneurship are strongly correlated and are key factors for the economic development [1,2].

Unfortunately, Romania had recently just 28 startups per million citizens, compared to 58 in the Central and Eastern Europe (CEE) region and 215 among Digital Frontrunner markets, as shown in [3] apud [4]. . On the Global Entrepreneurship Index (GEI), Romania raised from position 50 out of 118 countries (the last from the EU) in 2011 to position 46 out of 137 countries in 2018 and holds the same position in 2019, but the position inside EU was deteriorating, being surpassed by Hungary [5].

Concerning the innovation performance, Romania was placed in the last position in UE in 2021 [6].
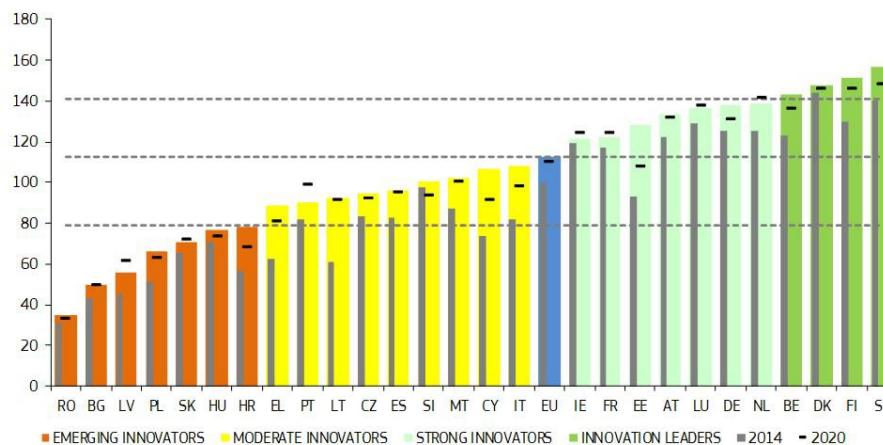

Figure 1. European Innovation Scoreboard for 2021 [6]

Nevertheless, the Romanian Entrepreneurial Ecosystem Index 2020 (REEI) shows an increasing trend since 2015 - it has increased by 30%, from 4.5 to 5.8 in 2020, on a scale from 1 to 10 [7].

The major difficulties for young entrepreneurs are the access to finance and lack of proper entrepreneurial education and innovative enterprises miss some of the traditional sources of early-stage financing [8]. To increase the competitivity, Romania must succeed in correlating superior performance of competitiveness and innovation, at the same time with a qualification of human resources, encouragement of entrepreneurship, supported by efficient and transparent governance [9]. The bridging of the gap in innovation and entrepreneurship between Romania and other European countries through proper education and cooperation with partners from abroad was the target for the authors of this paper [4].

1.2 CITE Project

Information and Communications Technology (ICT) is essential nowadays for any technology driven business [10]. In Romania, start-ups that promote digitization in a specific industry (e.g. proptech) gained momentum these years [11] and digitization could be the next driver of sustained growth in Romania [3]. Innovation holds a major role in ICT development [O4] so the interest in develop ICT Innovation and Entrepreneurship is legitimate.

The Romanian socio-economic circumstances in Romania are described in [13], where we introduced the project "Computing Innovation for Technology Entrepreneurship" – CITE [14]. The project developed by University POLITEHNICA of Bucharest (UPB) from Romania and Østfold University College (ØUC) from Norway and is regarding the development in Romania of education for Information and Communications Technology Entrepreneurship and Innovation, aiming to increase the development of new businesses, based on innovation and new technologies. It is financed through The Education, Scholarships, Apprenticeships and Youth Entrepreneurship Programme (ESAYEP), 2014-2021. part of the European Economic Area (EEA) and Norway Grants [15].

The main objectives of CITE are the introduction of two new courses for postgraduate programs – "Information and Communications Technology Entrepreneurship" (ICTE) for the Master in Business Administration and Engineering (MBAE) program and "Information and Communications Technology based Innovation" (ICTI) for the Master in Software Engineering (MSE).

2 PROJECT IMPLEMENTATION

2.1 Synergies

The courses named before are not starting from nothing. The "Information and Communications Technology Entrepreneurship" course is an extension of the existing discipline of "Technology Entrepreneurship" started at MBAE in 2006 by Prof. Mark Harris. The "Information and Communications Technology based Innovation" can benefit from the knowhow of the existing course of "Innovation and Economy" from OUC.

The new courses benefit primarily from the interdependence of the subjects, proven by the large huge number of papers and books which consider together Innovation and Entrepreneurship. Each year, famous publishers and authors deal with the topic by submitting books, many of them at an advanced edition [16-18]. For this reason, the first four lectures are joint ones and are dealing with the common basic concepts.

Table 1. Common lectures

No.	Subject
1	Technology, Innovation and Entrepreneurship – Instruments for Growth and Wealth
2	Models of Innovation
3	Innovation and Knowledge Driven Entrepreneurship
4	Innovation and Technology Transfer for Business Development

A major gain is given by the componence of the teams and of the consortium. The subjects should connect the students to the state-of-the-art concepts in both subjects – Entrepreneurship and Innovation, as well as with specific local entrepreneurship knowledge for ICTE and with the latest trends in computer science innovation for ICTI. That lead to the idea of collaborative teaching – professors are preparing lectures for the subjects they are familiar with. The authors of this paper proposed subjects for the lectures and 4 subjects were selected for the common part and two sets of 10 subjects for the specific lectures from ICTE and ICTI (the academic semester has 14 weeks and it will be one lecture per week).

2.2 Lean Thinking

Lean Thinking is a methodology that aims to provide the products and services, targeting the value generation and the elimination of waste by adding value to the customers and analyzing the processes in order to remove or to reduce the non-value-added issues.

Some of the Lean development principles which can be used in Lean course development are exposed in [26]:

• Short, iterative development cycles with feedback loops.
• Minimum viable product - Create fast simple and small versions of the product to be tested by the customers in the shortest time.
• Continuous deployment - Incremental releases responding to the customer's feedback.
• Split testing – Create different versions the product to see which gets the best results.
• Use metrics which counts.
• Pivot - Change the direction of the product if needed.

Lean thinking can be applied in education as Lean Education or Lean Teaching. In Lean Education, the Lean initiatives are applied inside the educational system, making its components (like higher education providers) to work like a Lean enterprise, while in Lean Teaching, the Lean principles are applied to the teaching–learning process [23]. The CITE project addresses both categories and we will refer in the next chapter to Lean course development (as Lean startup representative [4]) and its integration with these categories.

2.3 Lean Course Development

Lean course development actions similar with the ones from [24] were performed in the process of preparing the new lectures for the CITE project:

• Identify components of the process and the value offered. The students are considered the customers and the courses are the products. They should value the information and the skills acquired with a normal cost in effort and time.

• Create a minimum viable product. The first stage was the selection of lectures subjects and immediately after that, presentations were prepared for them. They are making the minimum viable product and they are in a continuous process of improvement, as specified below.

• Analyze the process to find waste sources [23]:

        • Overproduction. We focused on the minimal number of lectures, each one prepared by an expert in the field. There are several assessment stages – before it is presented to the students, a lecture presentation is assessed by the Romanian team, by the Norway team and by the students, after it is posted on the web site. The final assessment will be done when it will be given in the classroom, in a dynamic way. Students will be asked to asses the courses and to suggest details or improvements and changes will be performed if necessary.

        •Inventory. The subjects of the lectures is closely monitored. Changes were made to the subjects in the preparing stages, by adding elements or changing the direction, at the request of the authors. For example, the second common lecture subject was initially "Technology-driven vs. Market-driven Innovation" and was changed to "Models of Innovation" and consistent content regarding competition was added to the lecture "Technology Entrepreneurship and Target Market Selection", changing it to "Technology Entrepreneurship, Competition and Target Market Selection"

        •Waiting. The materials will be prepared the beginning of the next academic year. Subjects not presented in good time are to be replaced.

• redesigning the process using Lean techniques that eliminate waste, improve flow and better meet constituents' needs. If better solutions come into sight, they are replacing the existing lectures. For example, two of our colleagues, fresh PhDs, won recently scholarships from the Romanian Employers' Association of the Software and Services Industry (ANIS), which awards yearly twelve innovative tech courses. They accepted to prepare presentations/lectures from their winning very actual courses – "Technologies for Big Data Analysis" and "Virtual and Augmented Reality".

• implementing and regularly evaluating the updated processes using metrics relevant metrics. The courses will be evaluated yearly by the students. More than that, they will be offered as optional subjects in a group from where the students are selecting a single one. There will be send questionnaires to the graduates to find the practical value of the courses. An important metric is the performance of the students to the subjects. Good results show interest and validated learning, while small grades are a sign to make changings.

• split testing. There are different versions of the presentations. For example, the "Virtual and Augmented Reality" lecture from above will compete with the existing one. The lectures which are eliminated are making a corpus of knowledge for the web portal and can be selected and revived at a later stage.

• continually improving the process with the ultimate goal of achieving perfection in the eyes of all constituents. The lectures will be evaluated not just by the students, but also by the university and national forums.

3 CONCLUSIONS

The CITE project addresses foremost a change of habits in the Romanian education system. Professors should prepare the students for the professions required by the market and provide them with the ability to innovate and to compete, since a good training represents a welcome advantage for the graduate on the labor market or in launching a business. "Information and Communications Technology based Entrepreneurship" and "Information and Communications Technology based Innovation" are two multidisciplinary subjects which will prepare the master students for the future.

ACKNOWLEDGEMENTS

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