

Development of entrepreneurship education at universities of applied sciences

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INTRODUCTION

To maintain and to develop the welfare and all the societal services of a nation and of all the Europe the technology industry and the export are essential. Largely they are the means to achieve the needed assets. In this situation it is essentially important to find and develop new innovative products based on technology. Nevertheless, it is not enough. Enterprises are needed which execute the process of successful product development, production and marketing. The only one who is able to build up an enterprise and perform all actions of this combined chain is an entrepreneur. During the last ten years big companies have been densifying their activities and reducing the personnel. That is why small and medium sized enterprises (SMEs) are crucial for the nation. This has caused a big need for new start-ups. Nowadays the products are based on advanced technology and it is more and more important that the entrepreneurs have a deep technical education. That is why engineering skills are essential in running a successful enterprise. [1]

In the end of the 20th century, the world and industry have been production-oriented. The demand was bigger than the production capacity. The engineers did not need so much other skills than technology. That has influenced the engineering education of that era. Later in the 21st century, the production orientation has changed towards diversification of the activities needed. Nowadays there are significantly more players which a company is dependent on. There are more infecting matters, more issues to take into consideration, e.g. globalization and different cultures. The needs of skills have become wider. Earlier engineers have been working mainly in big companies. Now the employment shifts to smaller enterprises. [1]

In Oulu region there has been education of technology for 120 years. The main need for engineering skills has been in big industry. The life force of the society has been based on technology. This has formed the curricula including mostly technology and the spirit of education towards technology. During the latest decades there has been a strong change in industry. Big companies have been downsizing and leaving. This has caused pressure to the education to find a new direction. Smaller enterprises have to take care of the employment and the flow of tax incomes for the society.

The role of universities of applied sciences is crucial because they are educating managers and decision makers to the enterprises and to the administration. Their impact is strong on the future of the enterprises and all the region around. They can offer entrepreneurial education. The impact to the surrounding business life occurs quickly. During the last decade there has been more effort to bring entrepreneurship elements in the engineering education [2], [3]. Entrepreneurship is no longer confined to business schools. It has been noticed that it is good to offer it directly among the studies of technology [4]. According to Kriewal [3], engineers have a unique perspective on leveraging technology; therefore, a consistent emphasis on entrepreneurial engineering is desperately needed. The benefit of the entrepreneurship education has been discovered in many researches. Lo has studied the influence of entrepreneurial education on the activity to set up new businesses and has found that during 15 years after the graduation of that kind of education 48 % of the students have created their own company and only 26 % of the students did not have entrepreneurial education. [5], [6], [2]

1 ENTREPRENEURSHIP

Setting up a business can be understood as a process [7]. Entrepreneurship is a rather complex phenomenon. First, it includes psychological, social, economic and organizational dimensions. Secondly, there is a large diversity of entrepreneurial situations because entrepreneurs and their projects differ greatly. It can be talked about dual conception of entrepreneurship: On the one hand there is the functional approach of economists where the entrepreneur is described as an innovator an organizer and a risk-taker. On the other hand there is the psychological approach where the entrepreneur is defined by his/her personality, motivations and behaviors, looking for an entrepreneurial personality type.

1.1 Entrepreneurship in SMEs

Normally an engineer has been educated to work inside a company and to take care of design and production. Additionally, most of them study a fairly modest amount of economics and leadership. Nevertheless, an enterprise is a part of all the society. The first reason to have contacts outside of the enterprise is marketing because the clients are there. There are many laws which are delineating the function of an enterprise. It is one legal entity among the other players of the society and wider among other societies especially in the case of export. The entrepreneur has to understand this big picture. Engineers are not working only with engineers. Especially as entrepreneur they have to deal with different kind of people. After having more entrepreneurial education, the young engineer is more ready to understand the whole surroundings.

After working a few years especially in SMEs, in many cases the engineers have a possibility to participate in the development of the entire operation of the enterprise by working along with experienced colleagues and the owner of the company – the entrepreneur. Especially SMEs do not have possibilities to hire special people for all special purposes. A few persons have to take care of everything. In companies based on technology, mainly the engineers are in the key positions. Occasionally the entrepreneur needs an assistant in management, and s/he can delegate tasks to subordinates. An engineer educated in an entrepreneurial way is an important key person for that.

1.2 Skills needed in entrepreneurship

As discussed before, running an enterprise requires diverse skills. According to Fredholm et al. [9], engineers without an entrepreneurial attitude are educated to be “tools” for an enterprise. They will only be used as a resource for engineering skills and

left out of the larger decision making process. The perception has become increasingly stronger that engineers could be strongly beneficial for societies as independent entrepreneurs as well. In their paper Fredholm et al. have presented a three-path model for entrepreneurial engineering education. The first choice means that students want engineering and entrepreneurship to have an equal priority. The second possibility is to choose the engineering content to have priority while still achieving a solid grasp of entrepreneurship. The rest of the students have only a flavor of entrepreneurship due to focusing on other studies.

1.3 Traits of an entrepreneur

In his report Kriewall [3] has defined an entrepreneurial engineering. He makes a difference between teaching entrepreneurship and instilling the entrepreneurial mindset into the engineering education. The attributes characteristic of an entrepreneurial engineer include integrity, tenacity, ethics, creativity, intuition, a deep knowledge of engineering fundamentals, the ability to engineer products for commercialization, a penchant for lifelong learning and an ability to see how his/her ideas fit into the larger context of society, and proficiency in communicating his/her ideas. Pendergast [10] has presented that they are opportunity focused, they face unstructured, uncertain and dynamic, turbulent circumstances, and scarce resources are available. On this basis typical traits of an entrepreneur are inquisitiveness, opportunity-recognition, action orientation, need for achievement, tolerance of ambiguity, uncertainty, independence, self-starting, internal locus of control, individualism, risk propensity, creativity, innovative, networking, coalition building, teamwork, hero-making, belief in personal efficacy, niche-craft persistence, determination, improvisation, empirical, pragmatic experimental and muddle through.

1.4 Entrepreneurial education

Kriewall [3] has described the institutional support of a university and divided it into four issues. The first is the institution including administration, faculty members, and cultural fit. The second are curricular factors like classroom didactics, courses, modules and case studies. The third part consists of co-curricular actions. Those are workshops, seminars, lectures and co-operation. The fourth part are the extra-curricular matters including e.g. business plan competitions, technology competitions and internships. Every professor should instill in students a sense of how an engineer contributes to society and through the use of examples show how the entrepreneurial engineers are working. Alumni could support them by their own experiences.

Many writers, among the others Verzat & Bachelet [7], suggest a real-problem solving method in the training of entrepreneurs: action learning, learning by doing, learning through experience, learning from one's own mistakes, learning from other people, etc. They have found a result that links between an active teaching method and the training to achieve an entrepreneurial spirit. Profitable methods have been projects or placements, as opposed to lectures. One supporting method in entrepreneurial education is to use real cases as complementary material integrated into existing engineering fundamental courses [11].

2 RESEARCH ABOUT ENTREPRENEURIAL CULTURE AT OUAS

In this study an inquiry was made to 281 students of the School of Engineering of Oulu University of Applied Sciences (OUAS) in different semesters, to 15 teachers and to six entrepreneurs. Additionally, the curricula of the university was studied to find out how much there are entrepreneurial courses available.

2.1 Engineering students

In this research connection to entrepreneurship was asked about - if they have been considering the possibility to create an enterprise, the motive for that and how much they already have received information about the entrepreneurship and if they would like to have more education in it. The inquiry reveals that students have been interested in the entrepreneurship (70 %) and they have been thinking and discussing it (73 %) Some have had an idea in their mind (31 %) but they have not made any concrete actions to develop it to a marketable product (68%). It came up that young students have not worked earlier in entrepreneurial way. Mainly, they have not made sales work or they have not made bigger independent work performances (65 %). They are curious but careful to say that they are planning to set up a business. They would like to have more information about it (68 %). Students want to have more entrepreneurship in their studies (56 %). The result is supported by the finding of the earlier studies [2], [8]. For a considerable part of the students (70 %) the entrepreneurship is a worthwhile career option. They have considered to create a business of their own in the future. The study of Duval et al. [2] supports this result. Obviously, there exists entrepreneurial potential.

2.2 Incubator students

The interviews of the students participating in the incubator of the university expose that without any exceptions they have been satisfied with the possibility to gain the practical guidance when they have studied the implementation possibilities of their own business idea and when they have made plans and actions to set up the enterprise. On a yearly basis, 35 – 40 of the students of technology have been attending the incubator studies at OUAS. In the first stage they have made a business plan for their own idea. Most of them have not led to a set-up. Two to four real new foundations of an enterprise have occurred in a year. There is a clear difference between bachelor and master students. Master students already have 3 – 15 years of working experience and the business ideas processed in the incubator are more realistic and the set-up rate is higher. The new foundation rate during the incubator studies has been four percent by bachelor students and 50 percent by master students.

A general opinion is that mainly the recently graduated students are not ready for entrepreneurship yet. It is better to work in a company owned by someone else who has experience in running a business. It is also important to learn an industry to be able to see a realistic business possibility and to be capable of evaluating how a new business can be initiated. Of course there are exceptions and a newly graduated student can make a set-up.

2.3 Teachers

Teachers are working on a daily basis with students and their influence on the attitudes towards the entrepreneurship is strong. Most respondents had technological education from university and working experience from technology based companies. They had worked in different sizes of businesses, mainly in big enterprises (87 %). Some of them have been working in small companies as well (67 %). In the inquiry they expressed that in their opinion the amount of studies could include 8 % of entrepreneurial elements. When teachers were asked how many of the students should be educated in the entrepreneurial direction, they answered 26 %. This reveals that teachers see the importance of entrepreneurial education. The influence of teachers to the entrepreneurial attitude is coincidental. There has not been any direction towards it from the management of the university.

2.4 Entrepreneurs

In the interviews of the entrepreneurs who have made their studies at a university of applied sciences has come up that the development to become an entrepreneur takes years. Most of them they have been entrepreneur-minded already in the age of 15-20 years. In most cases there has appeared a possibility to start a business of their own and they have been ready for that. That is why the entrepreneurs consider it to be important to gain entrepreneurial education during the studies. When the possibility appears, it is good if the needed knowledge and the attitude is ready to use.

3 ENGINEERING EDUCATION AT OUAS

Traditionally engineers have been educated purely to master technology. In the curriculum there are normally only a few courses about economics and management and rarely anything about marketing.

3.1 Contents of entrepreneurial education

In OUAS the curricula of bachelor studies include a course “Entrepreneurship” for all students - 3 credits. Additionally, they can choose three courses around development a business idea – 15 credits all together. In Department of Mechanical Engineering the students can choose a module “Industrial Economics” that includes courses “Marketing”, “Offer calculation”, “Commercial Product Development” and “Administration of an enterprise” – 12 credits all together. A course “Entrepreneurship Training” is available as well – 3 credits. All the studies of an engineer are including 240 credits.

In Department of Mechanical and Production engineering there has been included an entrepreneurial module of 15 ECTS credits in the studies of the students who desire to participate in it. As an elective course the course “Business Oriented Product Development” has been created. Students search for a business idea of their own and make a business plan. They have to analyse comprehensively through all the path from the idea to the marketplace. During the process they often notice that the first idea was not good enough. They have to think like an entrepreneur. All aspects and players have to be identified and the total success will be evaluated. Students learn much of their mistakes as well.

3.2 Methods of entrepreneurial education

In master education the study program Industrial Management has for ten years included courses of 30 credits in entrepreneurship. Additionally, the students make a thesis of 30 credits. A prerequisite is three years’ working experience after the bachelor graduation. The participants have worked in businesses 3 – 15 years before the master studies. They already have learned during their career what technically educated engineers normally are missing in management positions when the task is to make economical profit by technology as a holistic operation. The idea of the master programme is to offer entrepreneurial tools for that.

As an extra-curricular experience at OUAS half-day events have been arranged where entrepreneurs have told about what happened when they started their own companies. Mainly they have been former students of OUAS. The entrepreneurs have been telling how they found the business idea and how the process to start the business was proceeding. Additionally, they have told about the studies which would be beneficial for a new entrepreneur. The freedom of an entrepreneur to do what s/he wants in business has been crucial but at the same time they have mentioned that an entrepreneur has to be ready to work hard. After every event it has been possible to find potential business creators to the incubator studies.

During this research it has clearly come up that there is a need to offer the possibility to make hands-on projects in planning and running a business. The theoretical lessons are giving basic information but additionally, there is a need to better understand in practice how an enterprise is operating.

Most of the universities have implemented the education in a traditional way. It has mainly come from the experiences of the teachers of the main subjects of technology. Mostly their background is from big companies because in the stage when teachers have been chosen in their appointments the biggest value has been put in deep experience in technology. Mainly the candidates have been working in narrow technical positions. It is very rare that they have experience in entrepreneurship.

3.3 Strategy of the university

In Oulu region there has been a strong ICT industry since Nokia established its operations in the city. After strong competition in the mobile phone market and the sale of the mobile phone business thousands of engineers have been laid off. There has been strong effort to achieve new employment and OUAS has included the entrepreneurship education in the strategy.

4 PROPOSALS FOR ENTREPRENEURSHIP EDUCATION

It is a challenge for teachers to instill in their students a sense of how an engineer contributes to society. It can be carried out through the use of examples or through demonstration of societal benefits via business examples like Kriewal [3] has presented.

One of the best ways to bring more entrepreneurship education to the university is that there will be chosen more teachers who have entrepreneurial background. They were concrete examples of real entrepreneurship. The motivation of students toward the thought matters is bigger when they are thought by a person who is able to tell practical examples of real business life.

The university could actively identify students who are suitable for and interested in considering the entrepreneurship as a career path. For those students it would be possible to plan their own paths to make the studies [7], [3]. It would be beneficial to arrange them co-curriculum activities more than for the non-entrepreneurial engineering students. After the tailor-made entrepreneurial education students would be ready to work in enterprises in managerial positions in an intrapreneurial way [3]. That would be a strong support especially in SMEs. In this way the intrapreneurs would gain good practice for the possible situation where they have an opportunity to set up an enterprise of their own. Naturally some of the students would be more ready to found a company of their own right after the graduation.

Co-curricular means to activate students towards the entrepreneurship could be e.g. business digital games or there could be arranged physical role game where they could play managers of an enterprise. This method is didactically more effective than lecturing and digitally realized gaming. The method helps students better to understand and more profound what all happens in an enterprise, and which are the roles of different specialists. Also international projects with students from different cultures are influencing positively. During this kind of projects the students learn how important it is to form a group where the members are influencing positively and completing each other [8].

It would be useful to try to find financial resources to use in developing further the ideas that students have presented. When the ideas have been presented there should be a professional committee that gives the evaluation about the quality of the idea. To find

the good ideas it would be useful to have experienced people available to steer the search process. In the best case the guiding persons would be successful entrepreneurs.

In implementing the education in practice it is important to place entrepreneurial elements along all the studies to make the student understand that entrepreneurship and technology belong seamlessly together. One unused resource are the graduated engineers who have founded an enterprise of their own. They are ready to come and share their experiences with undergraduate students.

5 SUMMARY

In this research it has been found out that there is a good entrepreneurial potential available. A big part of students would like to have more information about the entrepreneurship. Many of them have been thinking of entrepreneurship as a career option. It is obvious that all students will not come to the profession of an entrepreneur after their graduation. Still, there are many students who are interested in it and willing to learn more about entrepreneurship. This positive attitude is really valuable for the nation because entrepreneurs are the ones who can achieve more assets for their region. These people should be recognized and activated to study entrepreneurial skills. This should be taken into consideration while developing the education of engineers. It is crucial that the management of the university is aware about that and willing to make effort to acquire the right type of teachers and directing the curriculum and teaching methods convenient for the purpose.

There are evidences that entrepreneurially educated students want to work in SMEs and are setting up businesses of their own more than those who do not have the equal education, as mentioned in other researches as well.

An engineer educated in entrepreneurial way is quicker ready to start a business of his/her own because it requires wide understanding about the circumstances where an enterprise is acting. Also, it requires a wide variety of skills to start and run a profitable business which is able to compete globally.

During his 30 years of experience in the engineering education at the university of applied sciences, the writer has noticed that the entrepreneurship arises every now and then and becomes popular in the development of the curriculum. When and why, depends on the thoughts of the current management and the economical atmosphere and discussion in the society around. When savings are needed, the entrepreneurship is suffering because the focus is then set on pure technology. In the last years the entrepreneurship has been in the focus of the strategy of the university. The real execution has caused resistance among the elder teachers whose background is in bigger companies and purely in design and technology, not having any entrepreneurial background. This phenomenon has been presented by Zappe & al. as well [12].

In many quarters there are positive attitudes to achieve entrepreneurship among the engineers. The society around needs more working places, more tax incomes, more export and above all, enterprises that are the only actors to achieve the possibility for those. The strategic objective of the Oulu University of Applied Science includes entrepreneurship. There are good possibilities to widen and sharpen the entrepreneurial education of engineers.

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