PROPOSED MODEL OF COOPERATION BETWEEN THE BUSINESS INCUBATOR CENTER AND A LOCAL UNIVERSITY BASED ON BEST PRACTICE IN USA AND POLAND

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Abstract: This paper describes the cooperation between business incubator centers and the academic programs at local universities. Students and faculty from four different majors, Engineering, Business, Information Science Technology (IST) and Communication provided comprehensive assistance to new start-up and existing companies. At the same time, the students were gaining valuable experience learning the complexity of entrepreneurial ventures. Students were also developing the ability for cross-disciplinary oral and written communication.

Keywords: cusiness incubator, entrepreneurship, learning factory, teaching laboratory, industry-university collaboration.

1. Introduction

Observing a new start-up or existing company as a role model, students were encouraged to pursue their own ideas and business ventures. The multidisciplinary entrepreneurial program helps the university to provide the students and graduates with actual entrepreneurial experience which could not be accomplished in the classroom itself. This program also allows a university to enhance the economic develop and life in the area.

New start-up companies at the business incubator center received very comprehensive assistance in establishing successful business ventures. The assistance which was provided by the students working under the supervision of the faculty include the following:

- engineering analysis and help in product design,
- development of a business plan and marketing strategies,
- development of a website for newly established companies,
- development of promotional materials.

Successful innovation is a marriage of innovation and commercialization. It requires the cooperation of a university, government and private industry (Wolniak, and Sędek, 2009; Wolniak, and Skotnicka-Zasadzień, 2014; Wolniak, 2016; Bednarova, et al. 2017; Wolniak, 2017; Pacana, et al. 2017). A business incubator center is a common ground for a university, government and private industry. Every new business is given an opportunity to become associated with the business incubator center. The business incubator center provides many critical services to start-up companies. Some of the services are free-of-charge, but most services are offered at a discounted rate. The business incubator center provides new companies with an environment which supports a culture of innovation and celebrates research and creativity. The partnership with the local university is essential in accomplishing research and entrepreneurial goals. All partners of the ecosystem must collaborate to nurture the culture of innovativeness.

2. Proposed Model of Cooperation between the Business Incubator Center and a Local University

Both business incubator centers, TECHNOPARK and CAN-BE, maintain some kind of cooperation with faculty and students from local universities, Politechnika Śląska and Penn State Hazleton respectively.

The cooperation between CAN-BE and Penn State Hazleton is more cohesive and better coordinated. Therefore, that experience is being used as the guideline for the proposed model of cooperation between a business incubator center (BIC) and a local university. The cooperation and working relationship between a BIC and a university benefits all of the parties. It allows the university to better fulfill its educational mission. In recent years, manufacturing jobs became cross-disciplinary. As a result, there is a growing need for cross-disciplinary training to better prepare students to meet the demands of industry. The cooperation with BIC's is the perfect opportunity for students to apply "in a real-world industry setting" the knowledge that they have learned at the university. Allowing students from different majors to work together helps them to develop cross-disciplinary communication skills. Students develop a better understanding of their future role in the business world. Those skills would be almost impossible to acquire in a traditional classroom setting. The faculty members involved in the project are more visible and gain recognition in the business world. Faculty also develop a better understanding of industry and that allows them to be more effective in the classroom. Cooperation between the local university and BIC allows the achievement of the following goals (Grebski, 2018):

1. economic development goal of providing multidisciplinary assistance to start-up companies,
2. educational goals of providing unique educational experiences to students,
   a. gaining first-hand experience by applying concepts presently learned in the classroom "in a real-world environment",
   b. developing cross-disciplinary communication skills by working with students from different majors,
   c. gaining a better understanding of their role in the business world,
   d. developing professional contacts and building-up their resumes,
   e. developing an understanding of the role that different professions play in the business world,
3. university development goal of keeping the curriculum current and reflecting the needs of industry.

The model of cooperation between the business incubator center and a local university is shown in Fig.1.

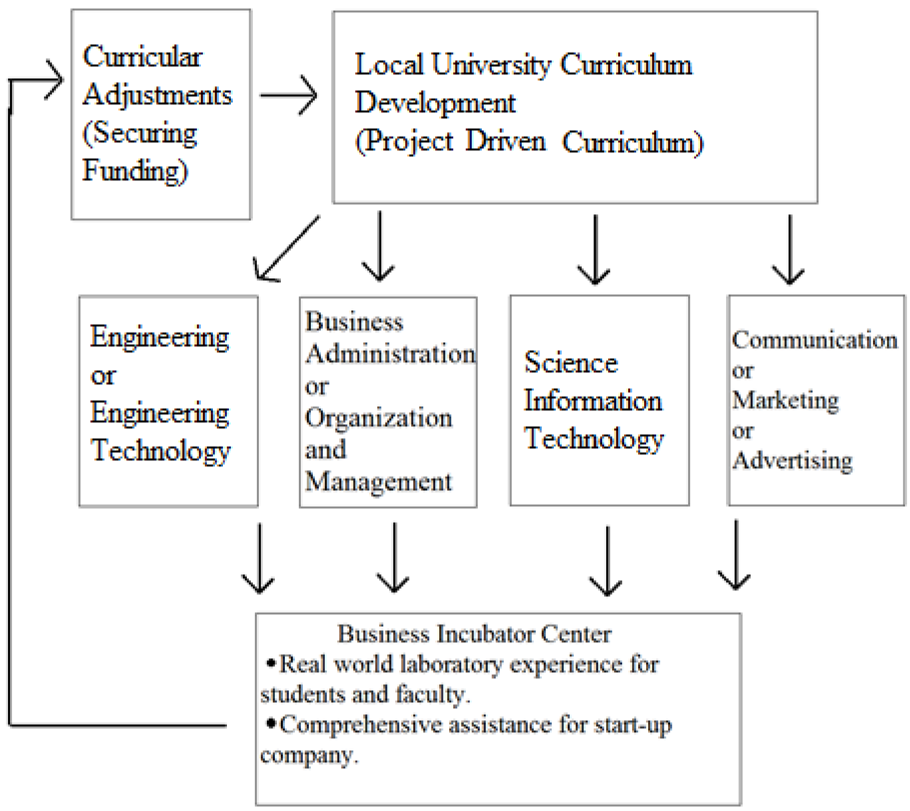

Figure 1. Model of multidisciplinary cooperation between a local university and business incubator center.

The cooperation between a local university and the business incubator center provides very comprehensive assistance to new startups and/or existing companies. At the same time, students are working alongside inventors who become a role model for creativity. Students are also developing cross-disciplinary communication skills. Observing the start-up companies as role models, students are encouraged to pursue their own business ventures. There should be some university courses linked to the Entrepreneurial program. Students should be given credit for those courses. There needs to be at least one faculty member from each discipline to supervise the college students involved in the Entrepreneurial program. Students are required to submit a final report for the project to the faculty members supervising the project. The project report will also be submitted to the client company. The client company will comment on the benefits of the project from the company's perspective. It is very beneficial to apply for external funding to financially support more complex projects (Wolniak, and Grebski, 2017).

3. Business Incubator Center as a "Learning Factory"

In 1994 the National Science Foundation (USA) awarded The Pennsylvania State University (Penn State) a grant to develop a "learning factory". This was the first time that the term, "learning factory" was used. The term "learning factory" refers to "interdisciplinary hands-on senior design project with strong links and interaction with industry". Penn State's learning factory is a hands-on learning facility for engineering students to be used in conjunction with the capstone design course and other courses (If.psu.edu 2018). The learning factory is also being used for student research projects and student clubs. It provides modern design prototyping and manufacturing facilities, including machining (CNC and manual), 3-D printing, welding, metallurgy and CAD/CAM. Student design projects benefit industrial clients. The company from industry which sponsored the project interacts with students and faculty to help create world class engineers. This has made a significant difference for engineering education at Penn State. Since the establishment of the learning factory, students have completed 1800 projects for more than over 500 sponsors. Around approximately 800 students at Penn State-University Park have participated in the projects. Fig. 2 illustrates the scope of activity at the learning factory.

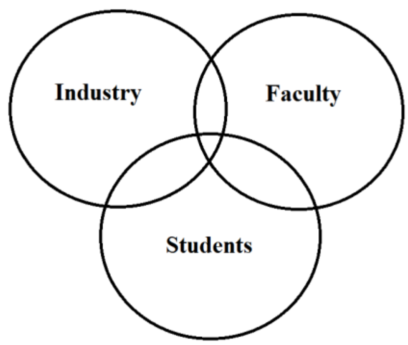

Figure 2. Scope of activity at the learning factory.

Teams of engineering students are engaged in solving “real world” problems which are sponsored by industrial clients. Students are being challenged to apply the knowledge and skills acquired during their undergraduate education to solve engineering problems. The learning factory (Galbraith, 2014; Dublin, and Licht 2005; Gebramariam, et al. 2004; Enhancing, 2018; Entrepreneurs, 2016; Carbondale, 2018) provides unique opportunities for industry sponsors to partner with Penn State in order to help educate the next generation of world class engineers. This is being done by using modern facilities for designing, prototyping and fabrication. At the end of every semester, the learning factory is organizing a design showcase. During the showcase, students display their projects. Those projects are judged by a panel of industry experts comprised of current and past sponsors as well as members of the Industrial Advisory Board. Prizes are awarded for the best projects and best posters. The event is open to the public. It is usually attended by 600 students, faculty, sponsors and guests. Penn State Hazleton students do not have convenient access to the learning factory due to the 110-mile distance.

Therefore, the local business incubator center (CAN-BE) became a substitute for the learning factory. CAN-BE is located across the street from Penn State Hazleton. By working with client companies at the business incubator center, Penn State Hazleton students are getting a very similar experience to the Penn State-University Park students who are working with the learning factory. Table.1 illustrates the comparison of the student experience at the learning factory and the business incubator center. It is very clear that students who are doing projects for companies at the business incubator center get all the experience of the learning factory.

Table 1.
Comparison of the student experience at the learning factory and the business incubator center

Objective	Learning Factory	Business Incubator Center
Interdisciplinary Projects	Yes	Yes
Hand on Projects	Yes	Yes
Modern Design and Prototyping	Yes	Yes
Connect Industry with Faculty	Yes	Yes
Understand Industry Needs	Yes	Yes
Work on Real-World Problems	Yes	Yes
Keep on Top of Latest Research	Yes	Yes
Engage in Student Learning	Yes	Yes
Pipeline for Future Employees	Yes	Yes
Link Theory and Practice	Yes	Yes
Enrich Classroom Experience	Yes	Yes
Increase Student Engagement	Yes	Yes
Identify World Class Engineers	Yes	Yes
CNC and Manual Machining	Yes	Yes
3D Printing	Yes	Yes
Welding	Yes	Yes
Metrology	Yes	Yes

Source: Autor’s own research.

Therefore, the business incubator center can be successfully used as a substitute for the learning factory (Dublin, and Licht, 2005, Galbraith, 2014; Gebramariam, et al. 2004; Enhancing, 2018; Entrepreuners, 2016; Carbondale, 2018).

More and more engineering programs promote a hands-on training mode in order to better prepare students for their professional life. In the field of engineering, it is very important to provide every student with the opportunity to apply their theoretical knowledge in practice. Students need a place away from the lecture hall "to get their hands dirty". This is especially important for students who are visual learners. Competency is not only theoretical knowledge. It includes the ability to apply theoretical knowledge to solve real world problems. There must be a connection between the knowledge and the ability for practical application of the knowledge.

The learning factory is teaching the students to apply the knowledge. Students are experiencing the designing and manufacturing of the product. They are also applying the theoretical knowledge in a real manufacturing situation and environment. Manufacturing industry has undergone a big change in recent years. Students need to be more rapidly introduced to these future methods. Learning factories are future oriented educational facilities.

Modern manufacturing technology requires employees at every level of hierarchy to be able to function and become self-organized in unknown situations. Employees need to be able to rapidly find creative solutions to a problem that they have never previously encountered. Traditional teaching methods do not address or develop those skills. Industry demands interdisciplinary training. It is important for engineering education to identify future job profiles and correlated to them competence requirements (Blanco, 2016; Brownlee, 2018; Business Incubator, 2018, Business Incubator Prices, 2018; Chamber News, 2018; Comprehensive Economic, 2013; Cooperation Breeds, 1997; Davies, 2009).

The concept of the learning factory at Penn State was recognized by the National Science Foundation with a "Gordon Prize" for innovation in engineering education in 2006. Recently the use of learning factories has increased especially in Europe. Learning factories have many different models with one common goal. The goal is to enhance engineering education. Research has shown that learning by doing leads to greater retention and quicker mastery of the subject.

Learning factories are real industrial sites which provide students with experience in different phases of product creation. They also cover a wide variety of the learning environment. At the same time, learning can take place in the planning, realization and ramp-up phase, but also in the improvement of existing processes in factory environments.

4. Business Incubator Center as a Teaching Laboratory

Current engineering curriculum does not fully address the needs of industry. Industry requires engineers to not only understand scientific principles, but also to be able to apply them in real life applications. Most universities are already structuring their curriculums to provide students with more hands-on experience in multidisciplinary open-ended design, team work, communication skills, etc.

Ben Franklin said, "Tell me and I forget, teach me and I may remember, involve me and I will learn." Engineering education for the 21st century must be relevant to the life of students and the needs of society. New teaching and learning programs must reflect the real-world component of engineering design problems.

Students must work on multidisciplinary teams to gain real world experience through active learning. There is a tendency to bring different engineering majors together to provide students with common experiences in teaching the fundamentals of engineering, measurement and instrumentation, electronic and microprocessors, control, heat transfer, fluid mechanics, structures and materials, manufacturing and environmental engineering.

Common educational experiences force students from different engineering majors to see engineering from a big picture perspective rather than just by seeing the individual pieces of the puzzle. Most of the students appreciate the multidisciplinary approach which is easy to accomplish by crossing departmental boundaries (Carlson, and Sullivan, 1999; Feisel, and Rosa, 2005).

It has been proven that active learning is more effective than the traditional "chalk and talk" lecture. The traditional lecture format is being replaced by a student-focused interactive approach. In this kind of environment, students may engage and learn more.

To attract more high school students into engineering programs. many colleges offer dual enrollment classes. Those classes are usually offered to junior and senior level high school students. High school students and high school teachers participate in hands-on activities and learn about engineering in everyday life by designing and building solutions to meet the needs of society.

Engineers need to have skills that go beyond theory which can be developed only by laboratory experience. There are three different kinds of engineering laboratories which are developmental, research, and educational.

Engineering is a practical discipline. Before engineering schools were created, engineers were trained in apprenticeship programs. Early engineers have designed, analyzed and built their own inventions.

The first engineering school in the United States was the U.S. Military Academy at West Point. (Tadeusz Kosciuszko was one of the founders of the U.S. Military Academy at West Point.) The military academy model was designed, so that theory and practice could blend together. In the middle of the 19^{th} century, many civilian engineering schools were established, for example, Cornell (1830), Union College (1845), Yale (1852), MIT (1865) and others. Those early engineering programs were very practical and application oriented. Those programs were training civil and mechanical engineers to build bridges, railroads, canals, water pumps, mining equipment, etc. Then chemical processing plants as well as the telegraph started to develop.

Those early engineering programs had significant laboratory components as well as cooperation with industry where students were getting practical experience. After World War II (WW II), there was a period of great prosperity with many inventions based on the technology developed during WW II.

The automobile industry was booming. There was a need for a more modern highway system and new methods of communication. At the same time, commercial airlines were getting established. At that point, the engineering curriculum was being criticized for being too practical and not theoretical enough.

It was suggested that the engineering profession should be more focused on scientific research rather than routine design. In the mid-sixties, President John F. Kennedy revealed his plan of traveling to the moon. Many people were inspired and there was a significant growth in the number of students pursuing engineering degrees.

This was an era of emphasis on science and engineering. Academic laboratories gave way to scientific subjects. This trend continued until the 1970's. After reaching the goal of traveling to the moon, the emphasis on science and engineering decreased.

Many engineering programs were underinvested and started cutting back on the laboratory component of the curriculum. The laboratory part is normally the most expensive part of the university budget. Many engineering schools graduated engineers who were advanced in theory but poor in practice.

While engineering programs were getting more theoretical, there was a growing demand in industry for practical-trained engineering professionals. Many schools created Engineering Technology programs. These programs were application-focused engineering. Many engineering technology graduates filled positions which were previously held by engineers. Until the present time, both programs, Engineering and Engineering Technology, are offered simultaneously at most institutions. There is a significant overlap between those two programs.

In engineering education, there were no clearly defined educational objectives. This was especially true in laboratory courses. Without cohesive educational objectives, the laboratory courses were disjointed. Even though those courses were part of the curriculum, the outcomes were far from the expectations of industry.

The situation has changed for the better with new accreditation criteria (Engineering Criteria, 2000). The educational objectives for Engineering programs as well as the educational objectives for all Engineering courses are required by the Accreditation Board for

Engineering Technology (ABET). Many schools were trying to accomplish the laboratory requirements of the curriculum by computer simulation.

Most educators, however, agree that computer simulation cannot entirely replace hands-on experiments as well as practical industrial experience. Due to the rapid development of online programs, there is a tendency to replace some of the laboratory courses with online experiences.

Educators' opinions on that issue are divided. (Sevilla, 2015; Graeter Hazelton, 2018; Kyaga, et al. 2011; Lose, and Tengeh, 2015; Maclure, 2011; Owen, 2014; Pennsylvania Business, 2018; Percent, 2018). The Engineering program at Penn State Hazleton is trying to accomplish some of the laboratory components of the curriculum by its cooperation with the CAN-BE business incubator center. Table 2 shows the educational objectives of the curriculum at Penn State Hazleton.

Table 2.
Educational objectives of the laboratory courses at Penn State Hazleton

Educational Objectives	Traditional Engineering Laboratories	CAN-BE (Business Incubator Center)
Instrumentation	Very Effective	Effective
Modeling	Very Effective	Effective
Experiment	Very Effective	Effective
Data Analysis	Very Effective	Very Effective
Design	Effective	Very Effective
Learn from Failure	Effective	Very Effective
Creativity	Effective	Very Effective
Psychomotor	Effective	Very Effective
Safety	Effective	Very Effective
Communication	Effective	Very Effective
Teamwork	Effective	Very Effective
Ethics in the Laboratory	Effective	Very Effective

Source: Autor's own research.

It demonstrates the comparison between the levels of obtaining individual educational objectives using the traditional on-campus laboratory versus providing students with hands-on experiences at the business incubator center. The comparison seems to be in favor of hands-on experience at the business incubator center.

5. Conclusions

Based on the experience of cooperation between CAN-BE, business incubator center, and Penn State Hazleton, the following conclusions were formulated.

1. Cooperation between a business incubator center and the local university is beneficial to the faculty. It allows them to stay aligned with the demands of industry. It increases faculty visibility and recognition as an expert in the field.

2. Cooperation between a business incubator center and the local university is beneficial for students by providing them with real world multidisciplinary educational experiences which are not possible to achieve in the classroom.
3. A business incubator center can be used by the local university as a cost free "learning factory" or "teaching laboratory". Students first hand entrepreneurial experience needs to be incorporated into the curriculum, so that the student can receive well-deserved academic credits.
4. A business incubator center can be used by the local university to teach entrepreneurship and promote innovativeness. By interacting and networking with inventors, students develop the skill for innovativeness.
5. A business incubator center can be used by the local university to teach multidisciplinary communication, teamwork, solving problems out-of-the-box, etc.

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