

Evaluation of university-business cooperation: case examples from industrial engineering and management education

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INTRODUCTION

University-business cooperation has become an increasingly important issue in the 21st century. The reasons behind this are multiple, such as changes in innovation structures, rise of the knowledge society and national and international higher education policy. The modern “enterprized” universities are expected to fulfil their part as a builder of the productive economy. Universities are expected to be strategically oriented and pursue their goals in a planned manner. Departmental leadership and broad faculty engagement are key to successfully addressing the new and complex challenges [1]. Simultaneously enterprization can result in a sparsity of resources which must be utilized in the most effective manner possible.

Key factors for a university in achieving excellence include societal impact and the working life relevance of education. University-business cooperation (UBC) is a natural way for engineering education to approach both of these subjects. Active industry involvement is one of the three common elements in the capstone projects of the world’s top engineering universities [2]. Universities strive towards active

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learning methodologies in order to prepare students for working life [3]. It has also been argued that an overcritical perspective to keep academic independence and avoid close industry partnerships can hinder institutional growth [4].

Student gains from UBC include industry knowledge, skills development, CV development and possibly early career development and creation of spin-offs and business opportunities. Potential downsides include an increased workload, the loss of academic focus and overtly focusing on a single subject [3]. As supporting evidence for the benefits of more in-depth educational cooperation, the results of [5] indicate that project-based learning and practice periods correlate with employability. The same effect was not found regarding shorter term interactions.

A key reason why businesses seek partnerships with university is the shift towards an open innovation structure [3]. The use of external partners allows businesses to access different pools of knowledge and save R&D costs [6]. Still, businesses also often regularly approach collaboration in “an ad hoc, piecemeal manner”, as an initiative led by an individual rather than as a part of corporate strategy [6].

The synergy arising from these goals should be utilized in U-B cooperation in a way that creates value for the industry, the university and the students alike [3]. All this suggests that cooperation should be a planned effort and produce value to all involved parties. The subject of achieving the goals of university-industry co-operation has been widely studied from a strategic relationship viewpoint, as well as through presenting cases of individual best practices. However, the operational level between these two topics remains less studied, particularly in education. How should educational managers approach the topic of university-business cooperation?

This study aims to contribute in this discussion by analyzing the evaluation of university-business cooperation. A literature-based framework of success factors in university-industry co-operation is presented and tested on three varying cases from university education: a sales and marketing course, curriculum level co-operation of well-being at work and a more strategic co-operation project spanning across several curricula. The case examples are taken from the development work of the Industrial Engineering and Management (IEM) study programme in the University of Oulu. The case examples are evaluated using the framework, and its suitability for evaluating university-business cooperation in education is discussed.

1 SUCCESS FACTORS IN UNIVERSITY-BUSINESS COLLABORATION

Differences in organizational cultures and disagreement about intellectual property and technology can hamper university-business collaboration. To overcome these issues and provide value for all parties, cooperation should be structured and managed [7]. The exact level of detail required depends on the context and the type of cooperation [8].

A classification of success factors from a previous study [9] was used as the evaluation framework in this study. The framework is presented in Table 1.

Table 1. University-business collaboration success factors [9]

Breadth of interaction: Partners interact using multiple channels.
Choice of partners: Attention is paid to issues such as cultural fit, strategic fit and geographical proximity when planning partnerships.
Clearly defined roles: Roles and responsibilities are clearly defined and communicated.
Clear policy on publication and intellectual property rights: Policies and processes are

transparent and agreed upon.
Commitment to collaboration: Senior management allocates appropriate resources for collaboration and acts in a champion role. Commitment in collaboration is accounted for in people management.
Communication: Channels for effective sharing of information exist and are actively used both within and between organizations.
Working methods support value creation for both parties.
Inter-organizational trust: Mutual trust is a key requirement for success. The prerequisites for creating trust are at place.
Mutually shared mission, goals and benefits: Both parties understand and agree on the aims of collaboration.
Previous collaboration experience: Accumulating both mutual and overall collaborative experience increases the chance of success.
Project management: Collaboration projects are managed actively throughout their lifecycle.
Use of key performance indicators: Collaboration is evaluated and monitored in a balanced way.

Thune [8] discussed these factors from the educational viewpoint. His findings were similar to the general findings presented above. He further divided the factors into contextual, process, organizational and success measures.

In the following section this framework is tested on three diverse case examples. The aim of this is to gain information on its suitability in an educational context, on different types of cooperation, and on whether educational collaboration has specific factors not addressed in the framework derived from mainly research-oriented literature.

2 CASE EXAMPLES

Cases from industrial engineering and management (IEM) education in the University of Oulu (UO) are used to test the framework. IEM offers a B.Sc. program for about 35 students and M.Sc. programmes for roughly 50 students in total. These degree programs aim at improvement of productivity, quality and well-being at work while accounting for the good practices of sustainable development. M.Sc. students can choose their scope of interest within two majors: production management and product management. The majors are supported by three supplementary modules on organization and knowledge management, project management and process and quality management. The students also complete a technical minor subject. A wide range of IEM courses are also provided for students in all fields of technology, and a minor studies package of 25 ECTS is offered for all undergraduate students and in the Open University.

2.1 Case 1

The first case example is the IEM Bachelor's level Sales and Marketing course (5 ECTS). In 2014 a need to develop a sales and marketing course tailored for IEM student needs was recognized. After initial requirements were identified, an industrial partner (Solved - The Cleantech Company Ltd) was invited to participate in the planning work. The goal was to develop and implement a course to provide future engineers with relevant sales and marketing skills. The course familiarizes the student with the basic terminology of sales and marketing, the fundamentals of a customer oriented approach, process phases of modern sales and marketing,

planning of product and service offerings, and the creation of a sales and marketing plan. In addition, group work assignments are conducted in real-life settings in case companies. The industry partner is central in the course implementation, providing contact teaching, the company cases and a platform for learning and problem solving.

2.2 Case 2

Secondly, we study a project in which the current state and future needs for education of well-being at work at the University of Oulu were analyzed. In the project the subject was approached through analyzing the present education of well-being at work in Finland and identifying stakeholder needs for this education. 112 working communities participated in a survey mapping stakeholder needs and seven focused interviews were performed based on the survey results. A detailed analysis on the stakeholder perceptions regarding the key skills of well-being at work was conducted and the results were published in [10]. A list of development proposals, including radical changes in the course portfolio, was presented based on the analysis. By now, the suggested changes have been implemented to a large extent.

2.3 Case 3

The third case illustrates an ongoing faculty level collaboration project with an industry partner (Ideal Product Data Oy). The objective of this large-scale agreement is to utilize a product lifecycle management software solution as a student learning environment as well as a research tool at the University of Oulu. This case also spreads outside IEM, particularly into mechanical engineering. Solutions for product design, manufacturing and product lifecycle management are included in the agreement. This allows collaboration during courses and assignments between students in different study programs in a manner similar to working life projects. The agreement is expected to increase the opportunities for joint development projects with industry and employability of the students.

2.4 How the success factors relate to the cases

The three cases were analysed using the framework presented in Table 1. The analysis is based on the authors' experiences as well as additional data. For case 1 the industrial partner was interviewed, for Case 2 a published report [10] was utilised as a data source, and for Case 3 the university person with a key role in forming the relationship was interviewed. The results of the analysis are presented below in Table 2.

Table 2. Analysis of the cases

Success factor	Sales and Marketing course: course level cooperation	Well-being at work education development: working with a large group of stakeholders	Case Ideal: strategic level cooperation
Breadth of interaction	The main partner is a "one-man firm". In addition, nine case companies are involved in the course. The interaction takes place through emails, phone, face-to-face meetings, and online platform.	Mail survey to 112 organizations and interviews with a few of them. Three representatives from each organization were invited in the survey. Other interaction in the project was limited.	Besides emails and meetings, interaction takes place through courses, student projects and theses, customer events, shared stakeholder events and shared professional magazine articles.
Choice of partners	Cultural fit, strategic fit and geographical proximity was essential in partner selection.	This is not a real partnering project but a study of stakeholder needs with a large sample of organizations based	The industry partner was chosen based on the university stakeholders' needs. The industry partner chose the

		in Northern Finland.	university for competence and product development and to find business opportunities.
Clearly defined roles	Content planning was a joint effort (U+B+students). The industry partner is responsible for material creation, online platform, contact teaching, case companies, group works, and evaluation. The university provides the schedule, facilities, and support in practical arrangements and recruiting case companies.	University had the main roles and responsibilities in the project planning and execution.	The business partner provides tools and creates the learning environment. The university educates, supervises student projects and theses, and utilises software (SW) in research projects.
Clear policy on publication and intellectual property rights	No publications are created. The content and distribution of group work reports are agreed with the case companies. The right to use lecture materials is asked from the industry partner on a need basis.	IPR on survey and interview results was agreed upon. The results were published and individual responses in the survey were presented on an anonymous manner.	A cooperation agreement exists. The industry partner has IPR for the tools; the university is licensed to use SW for teaching, research projects, and theses. For pure contract research or students using SW outside of university work, corporate licenses can be negotiated upon.
Commitment to collaboration	The university management provides annual funding for the course. At the beginning of the project, both parties made verbal commitment of running the course for at least three years.	Degree program and research group had a strong commitment to conduct the study. The faculty's Dean for education supported the idea; however, the study was funded by the research group - not by the faculty.	Both parties have official senior management commitment to strategic cooperation. The business partner has its parent company's consent as well and has opened a co-located office close to the university.
Communication	Phone, face-to-face meetings, email, and online platform. (Students also use WhatsApp during the course.)	Mail survey. Phone number & email was provided for potential questions regarding the survey.	Meetings, emails, web pages, customer magazines, stakeholder events.
Working methods support value creation	The aim is to create value effectively and efficiently. Communication tools are used for routine tasks. Non-routine tasks, such as planning and feedback analysis, are handled in face-to-face meetings.	The value created for university includes identifying stakeholder needs to support development and for the stakeholders the ability to influence competencies of future workforce.	The methods listed above support value creation. A future vision is to create cross-disciplinary student projects combining many aspects of the SW suite.
Inter-organizational trust	Trust exists and trust creation is supported via face-to-face meetings and open information sharing. In addition, personal trust exists.	Companies tend to trust university in this type of work. The companies selected were well-established actors in Northern Finland.	Mutual trust exists. Things agreed upon a handshake can be trusted to be done. Formal contracts are also created based on these agreements.
Mutually shared mission, goals and benefits	The mutual aims for the collaboration were agreed already at the beginning of the project.	The university defined the goals; it is unclear whether the survey participants shared them. The interviewees supported the project's goals.	Mutually shared mission, goals and benefits exist and have been communicated and agreed by the industry partner's parent company.
Previous collaboration experience	The university had a lot of experience of UBC, but no previous collaboration existed with this partner.	Previous co-operation existed with some of the study participants.	The university lead person has a wide UBC experience from the business side which has helped with the cooperation.

Project management	The development phase was managed and ended in 2015. The second implementation takes place next autumn. The project is in currently in maintenance and continuous improvement phase.	The project management at the university was moderate. However, the study results were published, so in that sense the project was managed. The communication of the results was insufficient.	The projects are based on a mutual 6-7 year vision. This vision is road-mapped and implemented through smaller projects.
Use of key performance indicators	The student feedback is used as the performance indicator. In addition, feedback is collected from the case companies but this is not systematically analysed.	None besides the project schedule.	The university tracks how many courses and theses use the SW. Do projects support employment? The industry partner presumably monitors the UBC's business effect.

3 DISCUSSION

The pilot test of the framework in an educational context suggests that the areas cover the requirements of educational UBC quite well. Due to the difference between cases we can see that with increasing reciprocal strategic interest, the use of framework such as this becomes more meaningful. Partnerships with long-term strategic cooperation or middle- to short-term projects seem like appropriate cases. For stakeholders who participate in single teaching events or just need to keep informed the framework might be unnecessarily complex.

Case 1 was a single course project carried out in a business project-like manner. Because of this, the framework seems quite suitable for the task. The nature of the project was a purchased service from the industry partner which lessens the strategic importance for the business side of the cooperation.

In Case 2 the other party in the collaboration was not one business but rather a pool of experts. In this case the applicability of the framework was identified to be poor. The reason of this is most likely that the motivation and the expectations of the non-university side are less concrete than in case 1. For cases that rather focus on aligning education than on operational activities, a tool that does not assume a strategic level of cooperation might be more applicable. A more suitable tool for evaluating projects such as curriculum planning could be the Logic Model as advocated by Davey et al. [11].

Case 3 presents a case in which both sides have an in-depth strategic interest in the collaboration. For a case like this the framework presented in our study worked well and covered all the topics that had actually been addressed during the management of the relationship. It could potentially be of use in the planning phase of a long-term cooperation project, especially when the collaborating parties are not well versed in UBC. Thune & Støren's [5] findings support the idea behind this project; in educational partnerships, long-term strategic partnerships have a greater effect on employability than just e.g. paid for single visitor lectures.

For educational managers, this framework could be useful in systematically managing UBC. It does not address what types of partnerships a study programme should strive for, including issues such as the desired amount of strategic partners and the depth of partnerships. However, once the high level goals for UBC have been established, the success factors presented here support the next stages of planning and implementation. This work can finally support creating operations such as creating a yearly UBC process and accompanying key performance indicators.

With regards to pedagogic dimensions of UBC, we found weak evidence in the literature due to its strong research-orientated focus. However, in an educational setting, the pedagogic dimension is obviously important. As the students are always a key stakeholder in educational cooperation, the framework could be updated to reflect this. Changes such as “Working methods provide value for all parties, including students” would highlight the student and pedagogical aspects of educational cooperation.

Another issue that is not directly addressed in the framework is risk evaluation and management. This topic could be highlighted further in “choice of partner” and/or in “project management”. The important issues related to this include, for example, financial stability of the partner as well as health and other personal obstacles in small companies. In addition, legal aspects, such non-disclosure agreements affect the collaboration and its success.

Jamison et al. [12] posit that engineering education can be classified between academic, market-driven and hybrid learning approaches. The hybrid learning approach underlines the skills of an engineer as a member of the society, besides academic skills and professional skills. This hybrid viewpoint is not clearly represented in the framework created from an UBC perspective. Including it could put focus on societal issues such as sustainability.

The mostly research focused literature on UBC states that one of the obstacles of success is clashing time frames. University research results are born long-term while businesses expect short-term results. Maybe this is less of a problem in an educational partnerships? Educational results tend to be quick, even though there needs to be a longer term developmental perspective, as noted by Tymon [4].

A tool like the one suggested here could be also used on a university level, for UBC relationships involving large companies this could be very beneficial. Thinking in a wider sense, education could be used as a part of a UBC relationship to reduce the conflict between long-term and short-term orientations by different stakeholders.

As noted by Thune [8] back in 2011, the main body of UBC research has focused on research partnerships, knowledge transfer and commercialization. The trend has since continued and further research on education’s role in partnerships is needed. Success factors seem to be similar, but it’s not certain whether they are fully the same. It would be interesting to conduct a multiple study based on interviews from university, business and student representatives to see what are the perceived success factors for each of these groups.

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