# Student–industry collaboration models: challenges and risks

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# Student–industry collaboration models: challenges and risks


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## ABSTRACT

Many student–industry activities have emerged in recent years, and universities have invested considerable time and energy in designing and implementing such collaboration models. However, as models differ significantly, student–industry activities should not all be bundled together. This paper examines student–industry activities conducted as integral parts of engineering study programmes. These activities allow students and industry representatives to meet. The results are based on four major components: an interview study, a case study of the *Meet with industry* guest lecture series, a case study of the *Industry link* project course, and a risk analysis of two student–industry collaboration models.

Two very well-known, but markedly different, types of collaboration models have been chosen, one collaboration model, delivering real results to industry (e.g., project) and one collaboration model, not delivering real results to industry (e.g., guest lectures). Both collaboration models have been subjected to risk analysis, leading to the identification of strategic areas specific to the particular collaboration model.

Based on the findings we suggest that, before choosing a specific model of student–industry collaboration, a risk analysis should be conducted focusing on the three key areas, i.e., Resources, Framework, and Pedagogic considerations, perhaps not primarily to identify specific risks, but to identify the *typical risk areas* for the activities to be offered



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## Keywords

Student–industry collaboration, project, guest lecture, risks, risk analysis, risk areas.


## 1. INTRODUCTION

A main concern of universities engaged in engineering education is to help students prepare for their future professional careers as engineers and to facilitate their entrance into industry. This is no trivial matter, and the gap between theory taught at universities and professional practice is the subject of ongoing discussion. As far back as 1982, Schön [1] pointed out that "professional knowledge is mismatched to the changing character of the situations of practice – the complexity, uncertainty, instability, uniqueness, and value conflicts". Using a constructivist approach to instructional design, Duffy and Jonassen [2] found that instruction should focus on "developing the skills of the learner to construct (and reconstruct) plans in response to situational demands and opportunities". The complexity inherent in professional practice is echoed in the classroom by constructivists, who strive to create rich learning environments featuring phenomenaria and construction kits [3], creating environments that let students simulate, investigate, and manipulate complex situations and occurrences. A lack of emphasis on engineering practice triggered the Conceiving – Designing – Implementing – Operating (CDIO) initiative [4], which aims to reintroduce learning activities that focus on solving tangible problems mirroring real-world engineering situations.

Many student–industry activities have emerged in recent years, and universities invest considerable time and energy in designing and implementing such collaboration models. This results in a wide variety of course constructions, the only common denominator of which is student–industry contact.

This paper examines student–industry activities conducted as integral parts of study programmes. Student–industry activities allow students and industry representatives to meet. While this in itself does not bridge the education–industry gap, it does present students with some of the characteristics of their future working environments, serving both as a component of a rich learning environment established at the university and as an introduction to real-world engineering. Student–industry activities may constitute an important building block of study programmes that seriously aim to address the matter of decontextualized learning.

## 2. THE STUDY

### 2.1 Method

The results presented here are based on four major components: an interview study, a case study of the *Meet with industry* guest lecture series, a case study of the *Industry link* project course, and a risk analysis of two collaborations models (see Figure 1).

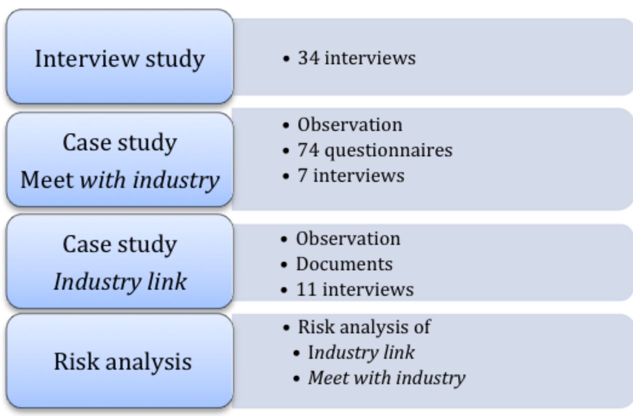



**Figure 1. The study components.**

This paper has as its starting point the interview study, from the results of which the two case study components are derived. The interview study is based on 34 interviews with university, student, and industry representatives. One main objective of the interview study was to identify the collaboration models used in universities when creating student–industry activities and to define the rewards for stakeholders in terms of Boehm's "win conditions" [5]. The initial interview study is based on interviews with staff from 13 companies, eight teachers representing four universities, and 13 students all with experience of student–industry activities (e.g., various projects, master's thesis research, and study visits). All interviews except one face-to-face interview were conducted over the phone and lasted 20–30 minutes. The interviews were in-depth, based on a flexible design incorporating open-ended (semi-structured) questions [6]. The interviewees were chosen to obtain a valid sample; from the researchers' side, the requirement was that all interviewees should have personal experience of student–industry activities. Personal networks were used to identify interviewees. As people involved in unsuccessful activities often let contacts drop and since collaborative activities are not registered, participants in unsuccessful activities are difficult to find; nevertheless, some failed collaboration activities are represented in this study.

Two main categories of collaboration models were identified: collaboration models delivering real results to industry (e.g., projects and theses) and collaboration models not delivering real results to industry (e.g., guest lectures and study visits). A third hybrid category was also identified, containing models in which the output depends on the interpretation and implementation of the collaboration model (e.g., workshops and practical training).

One example was chosen from each of the two main categories of collaboration models, that is, *projects* from the category with delivered results and *guest lectures* from the category without delivered results.

Three key data collection areas were identified (see Table 1).

**Table 1. Key data collection areas**

| Key areas | Sub-areas |
|---|---|
| Resources | Invested time, distribution of investment, equipment |
| Framework | mandatory/voluntary, results, relationship with company |
| Pedagogic considerations | Introduction to profession, motivation, theory–practice link, personal student development |

As an example of guest lectures, we chose the *Meet with industry* case; in this case study, a series of eight guest lectures was studied in its original context and interviews from the interview study concerning guest lectures were analysed. The *Industry link* case study was chosen to exemplify projects; this project course, which includes an industry-related project (i.e., a real-client project), was studied and interviews concerning the projects were analysed. Each *Meet with industry* lecture was given to 80–90 students as part of introductory, bachelor-level courses in computer and electrical engineering. The guest lectures were evaluated via a paper questionnaire handed out in class a week after the last lecture; 74 students completed the questions, 46 from the computer engineering bachelor programme and 28 from the electrical engineering bachelor programme.

The *Industry link* case exemplifies the second main category of collaboration models, that is, projects. The project course also includes life-cycle skills, such as system engineering, requirements engineering, and risk management, and is offered in the fifth semester of a bachelor programme in computer engineering. The course involves 15–30 computer engineering students with five to seven students per team each year.

The course was studied by observation for several years, and all experiences, changes, and evaluations were logged and documented in a study protocol.

Data concerning the *Meet with industry* case were gathered through descriptive observation [6] of the guest lecture series in its original context at the university, through relevant interviews in the interview study, and from questionnaires. Data concerning the *Industry link* project course were gathered from descriptive observation of the course, document study of the analysis and evaluation of the course's development and improvement over time, and relevant interviews from the interview study.

Data reduction is part of data analysis, and it is important to code the material without the sense getting lost. The interviews included in the interview study were transcribed verbatim before analysis. This material was coded according to predefined categories and then analysed and discussed by the researchers before the results were recorded. Before conclusions were drawn, the coded text and parts of the interviews were reviewed. From the results, the various collaboration models were derived and categorized by the researchers.

Observations regarding *Meet with industry* and observations and documents regarding *Industry link* were coded; first, in a first-level coding into key areas according to Table 1, and then in a second-level pattern coding in which the initial codes were broken down into a number of sub-areas, also according to Table 1. After the two rounds of coding, the material was complemented with input from the paper questionnaire and relevant interviews in the interview study. All the coded material was then analysed and discussed by the researchers; conclusions were drawn after reviewing the coded text.

Finally, the researchers conducted a risk analysis of the two student–industry collaboration models, *Industry link* and *Meet with industry*. According to Fairley [7], a risk is "the probability of incurring a loss or enduring a negative impact".

Risk management is often performed in several steps; for example, as described by Hall [8], a typical risk management process includes risk identification, risk analysis, risk planning, and risk monitoring. The presented research examines the first two steps, risk identification and risk analysis. The risks were identified, documented, and categorized into three key areas, i.e., Resources, Framework, and Pedagogic considerations. All the risks were compiled into a table, and each risk was assigned a unique risk identifier, an explanation, and examples of consequences. Then, in the risk analysis step, the probability and effects of each risk were estimated according to the graded scales presented in Table 2, first for *Industry link* and then for *Meet with industry*. The unique risk identifier is presented in the "**PP-1**" format, in which the first P stands for the collaboration model (Project or Guest lecture), the second P stands for the key area (Resources, Framework, or Pedagogic considerations), and 1 is a serial number.

**Table 2. Graded scales**

| Probability<br>The probability of the risk occurring is | | Effect<br>The effect of the risk occurring is | |
|---|---|---|---|
| 1 | Very unlikely | 1 | Insignificant |
| 2 | Unlikely | 2 | Acceptable |
| 3 | Likely | 3 | Serious |
| 4 | Very likely | 4 | Very serious |
| | | 5 | Catastrophic |

In the analysis, the researchers calculated the risk value, $R$, for each risk by multiplying the probability, $P$, by the given figure for effect, $E$, i.e., $R = E \times P$. The highest risk value a risk in this study can have is $R = 4 \times 5 = 20$.

## 2.2 Validity

According to Yin [9], there are four types of validity: construct validity, internal validity, external validity, and reliability. In both interview and observational studies, participant bias could threaten construct validity. In interview studies, interviewees could misunderstand terms or questions or interpret them differently from each other. To reduce this risk, the interviewer could offer explanations during the interviews to try to prevent misunderstanding. All interviews were fully transcribed reducing the risks inherent in having just one person perform the interviews. To ensure construct validity in the risk analysis, the scales and explanations were written and defined paying the utmost attention to being as clear and unambiguous as possible.

Reactivity [6] is a risk in case studies and refers to whether the objects under investigation may behave differently when examined during the research process. Prolonged involvement may reduce the risks of reactivity and respondent bias, but increase the risk of researcher bias; both observer and data triangulation were used to reduce these risks. Observer triangulation was achieved by having two researchers with different roles cooperate during the study, while data triangulation was achieved by using data from a range of sources, i.e., interviews, observations, questionnaires, and documents.

No conclusions as to causal direction were drawn in this study, which aimed to reduce internal validity threats. When it comes to external validity, the risk is that participants may not be representative of the target population. To reduce this risk, all interviewees were required to have personal experience of student–industry collaboration, and case studies were used to investigate what was happening in these particular cases. The two cases in the study, *Meet with industry* and *Industry link*, exemplify the two main categories of collaboration.

Reliability is affected by how well the described procedures are followed and documented. Researcher bias should not affect the interpretation of the material, so after the interviews and observations are completed, the researcher must provide valid descriptions of them. To reduce the threat to reliability in this study, alternative interpretations and explanations were considered.

Participant bias could pose a threat in this study, if participants try to defend their own actions, focus too much on their own side of the story, or present a distorted view of reality. Another risk is that interviewees may have felt they were being evaluated, since the university itself had commissioned the interviews, even though the interviewer was external and it was initially explained that this was an objective study.

# 3. RESULTS

## 3.1 Resources

Student–industry activities involve three parties and, regardless of the type of activity, require that each party invest time and energy in the endeavor. The intensity of the activities fluctuates over time, and three distinct phases can be identified: the pre-activity, activity, and the post-activity phases.

### 3.1.1 Pre–activity phase

In both the project and guest lecture cases, the pre-activity phase involves the investment of significant time by industry and university; in neither case do students take an active part during this phase. In the pre-activity phase, the activities are conceived, designed, and anchored in the involved organizations. The relationship between university and industry is established or re-established, the scope and timing of the activity determined, and the relative activity of the parties planned.

The responsibility for initiating the pre-activity phase rests with universities, more specifically with teachers and course directors. Interviewees stated that contacting companies that have prior experience of the course from earlier collaborative activities is straightforward and relatively simple. In contrast, it was found that establishing contact with companies new to this type of activity was neither straightforward nor simple. The right type of company had to be identified, the best approach determined, and the appropriate contact person identified and reached. A significant difference between the project and the guest lecture cases was that it was easier to engage a guest lecturer, as engaging a guest lecturer involved only the individual professional, whereas arranging a project activity would involve the company as such or at least part of the company. Arranging an activity required approval from several people in the company.

When contact is established, the activity is planned. The *Meet the Industry* lectures required only simple planning, specifying the content or title of the lecture and determining its date and time. A number of guest lecturers changed the time of the lecture because of other more urgent activities; the teachers then had to spend time rescheduling other course activities.

Planning the *Industry link* project required considerably more time. The assignment would be discussed and redesigned a number of times to satisfy both the company's interests and the pedagogical aim and the scope of the course.

### 3.1.2 Activity phase

*Meet with Industry* engages eight individuals, each meeting all the students once in class. A lecture is limited to two hours, engaging the lecturer and the students; the teacher is present but, apart from welcoming and thanking the lecturer, does not play an active part.
In the activity phase of *Industry link*, which lasts several months, company representatives and student groups meet for information exchange and supervision, and university teachers and student groups meet for supervision and discussions. The involved companies are responsible for providing students with the necessary equipment, both hardware and software. In a number of the observed projects the equipment needed for the project was delivered late to the students, requiring students to reschedule the project. In one case the equipment differed significantly from the specifications forcing students to revise the goal of the project, in yet another case the equipment was never delivered, with the result that the project was never completed. An interviewee from this company expressed dissatisfaction with the student team for not delivering a result at the end of the project. During this phase, company representatives and teachers have little or no contact, since a main point of the course is that the students should take full responsibility for and ownership of the project.

### 3.1.3 Post–activity phase

From the student viewpoint, *Meet with Industry* consists of the eight guest lectures presented in class and does not involve further activities. Guest lecturers generally wish to receive some form of feedback on or evaluation of the lecture; the teachers generally wish to continue the relationship with the guest lecturers, and lecturers and teachers continue their dialog after the end of the activity phase.

*Industry link* culminates in a final delivery to the company and a project presentation in class. The student–company relationships established during *Industry link* projects can lead to thesis projects in collaboration with the companies and, at a later stage, to employment for some students. Teachers were eager to continue the relationships with companies after the activity phase, which is perhaps not surprising seeing that repeat collaboration with the same company entailed considerably less time and work during the pre-activity phase.

## 3.2 Framework

The university establishes the frameworks and settings for guest lectures and project courses. The university and teachers involved must make decisions regarding student participation, grades, equipment, and so on, and these decisions constitute the fundamental conditions for such educational forms.
Student participation can be either mandatory or voluntary, and both have their pros and cons. When guest lectures are voluntary, there is a major risk that the students will fail to attend, resulting in few students at the guest lecture. The consequence for the individual student will be deficient knowledge in the area covered by the guest lecturer. With few students attending, the guest lecturer could lack inspiration, experience a sense of failure, and be reluctant to return to the university. The university could risk losing the guest lecturer in the future and experience difficulties recruiting new guest lecturers because of the reputation of the university's students.
Making the guest lectures mandatory ensures that the students will be present, giving them the opportunity to obtain the mediated knowledge. The students themselves decide whether to be active or passive listeners, and students who display no interest and sometimes even fall asleep generally disappear in the crowd, calling for no university response.

Making the guest lectures mandatory was the chosen strategy in *Meet with Industry*, in which the lectures were part of two 7.5 ECTS-credit introductory bachelor-level courses in computer engineering and electrical engineering. The students had to participate in all mandatory course components, including the guest lectures; the grading of the course was pass or fail. To confirm that they were present, students had to sign an attendance list; absent students had to complete a mandatory assignment connected to the guest lecture. Attendance at the guest lectures was very good, and the questionnaire indicated that 65 of 74 students thought that *Meet with Industry* should be offered to new students next year some however found the lectures boring or irrelevant and did not support the idea to invite the lectures back.
Project courses can be voluntary or mandatory. If a course is voluntary, it is taken mainly by motivated and interested students, but if a course is mandatory, all students must take it, even those uninterested in the course. *Industry link* is a 7.5 ECTS-credit project course that is mandatory for bachelor students in computer engineering; the grading of the course is pass or fail. The students, who work in groups of five to seven, are assigned to various industry projects and work in close connection with the companies that have assigned the project.

The equipment, premises, software, and hardware requirements for guest lectures are not normally onerous. Project courses normally demand more resources, such as software and hardware. In *Industry link*, all equipment and software is provided and paid for by the companies giving the assignments. More but smaller premises are needed and for a longer time than for the guest lectures, premises for both education and where students can work on their assignments. In *Industry link*, the involved company provides premises for the students, but the students work mostly at the university and at special student workplaces provided by the university. To work efficiently, each project team needs a room of its own.

## 3.3 Pedagogic considerations

Student–industry activities involve various pedagogical concerns, depending on the activity implementation and educational setting. However, three major concerns were derived from the interview study: 1) introducing students to their future professional roles, 2) linking theory with practice, and 3) motivating students. These three concerns served as a basis for reviewing the case studies.

### 3.3.1 Introducing students to their future roles

Both *Meet with Industry* and *Industry link* introduce students to their future professional roles. The main difference is that *Meet with Industry* offers a view from outside, whereas *Industry link* offers a view from inside. The *Meet with Industry* lecturers visit the university as guests, meeting the students on their home turf. The encounter is impersonal; students may choose not to engage in a discussion, so, from the student viewpoint, the situation poses no risks. Use of a familiar setting reduces "noise", from the student viewpoint, and may allow the guest lecturer to offer a broader view of the topic and of his or her professional profile. The downside is that the students cannot see the professional in action: they will hear actions and occurrences described, but they will see neither of them. Another potential is that guest lecturers may focus on a small part of a larger problem, may be biased and may present students with a personal view, all of which may not be immediately transparent to the student, but give the student a distorted view of the profession and result in lectures, that students find boring or irrelevant. The questionnaire indicated that only 16 of 74 students thought that the lecture series described their future professional roles; however, it should be noted 23 found the lectures relevant to their studies. Interesting to notice is also that 22 students found the lectures boring or irrelevant.

*Industry link* gives a different perspective, as it allows industry representatives to engage directly with the students. The representatives act as supervisors during the project, a role very similar to their everyday professional role. Students and industry representatives interact with each other on a number of occasions, and the students have "test runs" of their future professional roles. The downside is that the complexity and uncertainty of the situation, combined with the responsibility placed on the students, means that students risk not meeting company expectations. In certain instances, these conditions are so overwhelming that the students cannot grasp the situation and are left with a fragmented understanding. In a number of cases students found that the company had failed to take their project seriously, not shown sufficient interest in the students' work and had been slow or negligent in answering project related questions.

### 3.3.2 Linking theory with practice

The *Meet with Industry* lectures typically focus on a specific subject or perspective concerning engineering practice; lecture titles include "Innovation strategies in software development", "Test procedures", and "Being an engineer". Beyond the title and a broad outline, the teacher has limited advance knowledge of the exact scope and level of the lectures. Seeing that the guest lecturers create their lectures with little personal knowledge of the students and may recycle lectures given to other audiences, it is difficult for teachers to plan learning activities linked directly to the lectures. As a result, the link between theory and practice varies from lecture to lecture: some lectures illustrate topics taught in the course, while others are more general, primarily exemplifying methods and solutions for typical engineering problems. 32 students found the lectures interesting, 22 found them uninteresting, and 17 found them too difficult.

*Industry link* project assignments are formulated by the company and the teachers in collaboration, giving the teachers some control over the scope of the project. Teachers also function as supervisors during the activity phase of the project, which allows them to influence the project direction as it develops over time.

An explicit learning goal of *Industry link* is to integrate theory and practice. The course is constructed as two overlapping parts: the first part comprises lectures in which the theoretical basis of the course is built; the second part comprises the actual industry project. As the project develops, the number of theoretical learning activities decreases. From the teachers' viewpoint, students should view the theoretical parts of the course as providing tools for solving practical project activities, rather than as isolated tasks. Lectures and literature are generally used as starting points for activities pertinent to student team projects. This means that course topics and parallel project processes are synchronised to imbue the theoretical aspects with a sense of immediacy and to create an obvious link between theory and practice.

### 3.3.3 Motivating students

Students taking part in *Meet with Industry* demand that a guest lecturer be inspiring, present a relevant topic, and find the right degree of complexity. Answers to the questionnaire indicated that the key concerns of students were that the lecture subjects should be interesting and be relevant to their educational programmes. Students also stressed that the level of the lectures should be adjusted to that of the audience, being neither too difficult nor too basic. This is not easily done but, while no more than 32 students found the lectures "interesting", 65 still recommended that the lecture series should be offered to future students – some qualified this answer by adding comments as, "better lecturers" or "more relevant lectures"; this suggests that most students found the lectures worthwhile. Because the guest lectures are not directly integrated with other course activities, no direct effect can be seen; insofar as *Meet with Industry* motivates students, it does this by establishing a context for the study programme, rather than directly influencing student behaviour.

In *Industry link*, the industry contact very clearly functions as a factor motivating the student teams. Teachers find that students engage willingly in project activities and invest considerable time and effort producing viable solutions to the problems. This high level of activity is probably inspired by the perceived importance and urgency of the project task.

## 3.4 Risk analysis

The risk analysis resulted in the identification of 11 risks for *Industry link* and nine for *Meet with industry*. In *Meet with industry*, there are no risks involving equipment, as there are in *Industry link*, since student use of equipment is not relevant in the context of guest lectures. Otherwise the risks in the two categories are identical or very similar; it is mainly the estimated probability, effects, and consequences that distinguish the two collaboration models. *Industry link* entails more risks and risks of higher overall risk value. The highest risk value for *Industry link* is $R$ = 12 while for *Meet with industry* it is $R$ = 8. In the following, only risks with a risk value of 8 or higher are discussed; an overview of these is presented in Table 3 for *Industry link* and in Table 4 for *Meet with industry*

**Table 3: Highest risks in *Industry link***

| ***Industry link*** | | | | | |
|---|---|---|---|---|---|
| **Risk** | **P** | **E** | **R** | **Explanation** | **Examples of consequences** |
| **PP-2**:<br>The burden is too heavy/ the situation too complex for students | 3 | 4 | 12 | Students lack adequate qualifications to handle the situation *or* lack information / supervision | Students are frustrated; may give up, lose interest, or never achieve goal |
| | | | | | |
| **PF-4:**<br>The outcome of the activity fails to meet the company's expectations | 3 | 4 | 12 | The company has not understood the students' abilities *or* students and company have failed in communicatio n | The company finds the activity futile<br>The company may want to discontinue collaboration with the university<br>This may be detrimental to the university's reputation |
| | | | | | |
| **PF-1:**<br>Company representativ es fail to take sufficient interest in students or their work | 2 | 4 | 8 | The company does not understand the nature of the commitment *or* the company has failed to plan the activity, not allocating sufficient resources | The project is unsatisfactory for the students<br>Students may gain a negative impression of the profession<br>Students may end up disenchanted with the study programme |
| | | | | | |
| **PR-3:**<br>Necessary equipment is unavailable to students | 2 | 4 | 8 | The company does not understand the nature of the commitment *or* the company has failed to plan the activity, not allocating sufficient resources | Student frustration<br>Students may be unable to complete the project |

Four risks identified in the *Industry link* risk analysis earn a risk value of 8 or more. These risks represent all three key areas: Resources (1), Framework (2) and Pedagogic considerations (1).

In comparison, these four risks, if relevant at all, generate risk values of only 1–4 in the *Meet with industry* analysis. For example, if a guest lecturer (*Meet with industry*) displays little interest in his audience, students may merely lose interest in the lecture, but if a company representative supervising a student project (*Industry link*) appears uninterested in the students and their work (**PF-1**), the consequences will be serious.

The risk that students may fail to deliver results that meet company expectations (**PF-4**) earns a risk value of $R$ = 12, since the probability of the risk occurring is deemed high and the effect, should the risk occur, is very serious. This risk is not applicable in the case of *Meet with industry*. The risk that students may find the burden too heavy or the situation too complex (**PP-2**) is a pedagogical issue with very serious consequences.

There is a strong correlation between the three risks **PP-2**: *That the students find the burden too heavy or the situation too complex*, **PF-1**: *That company representatives fail to take sufficient interest in students or their work*, and **PR-3**: *Necessary equipment is unavailable to students, meaning that students may fail to deliver results that meet company expectations*, on one hand, and risk **PF-4**: *The outcome of the activity fails to meet company expectations*, on the other hand. **PP-2, PF-1,** and **PR-3** all reinforce the probability of **PF-4.**

Table 4 presents the risks with the highest risk values in the *Meet with industry* risk analysis. Risks **GP-1** and **GP-3**, both with risk values of 8, belong to the key area Pedagogic considerations and both concern the contents of the guest lecture, and whether or not the lecture enhances student understanding of subject matter or their future professional field. The probability of these risks occurring during *Industry link* activities is deemed much lower, resulting in a risk value of 4.

**Table 4: Highest risks in *Meet with industry***

| ***Meet with industry*** | | | | | |
|---|---|---|---|---|---|
| **Risk** | **P** | **E** | **R** | **Explanation** | **Examples of consequences** |
| **GP-1:**<br>Lecturer focuses on limited part of situation / problem | 4 | 2 | 8 | A guest lecturer may convey a personal interpretation of the situation and may be biased. | Students get a simplified or skewed understanding of professional role<br>Students get mistaken expectations of the study programme and their own futures<br>May create a sense of false security or false anxiety in students |
| | | | | | |
| **GP-3:** | 4 | 2 | 8 | Low degree of | The guest lectures fail |

| | | | | | |
|---|---|---|---|---|---|
| Weak or no link between lecture and study program | | | | teacher control with little influence on content | to motivate students in their studies<br>Activity is meaningless |

## 4. DISCUSSION: RISKS, CONSEQUENCES AND PRECAUTIONS

The risk analysis of *Industry link* highlights risks from all three key areas, but the consequences of the risks draw attention to two main issues: 1) student reaction to an unsatisfactory situation, and 2) the impact an unsatisfactory project outcome may have on the university's reputation.

Should they occur, three of the four risks would lead to unsatisfactory situations in which students may grow frustrated, lose interest, and possibly become disenchanted with their study programme and even with their future professional role. An earlier study [10] concentrates on what motivates universities, industry, and students to enter into student–industry collaboration. The desire to establish a context in which student confidence and personal growth were encouraged and in which students would find inspiration was cited by university teachers as a main motive for entering into student–industry activities. In this light, the risks and consequences of *Industry link* are well worth attention, as they may negatively influence the main objectives of collaborative efforts. To reduce the risks, it is obviously desirable that students who take part in *Industry link* –type activities be able to handle complex and demanding situations and not be easily discouraged. This implies that students should not only possess sufficient knowledge and skills for the assignment, but also sufficient personal maturity that they can handle unforeseen situations, revise their goals, and clearly express their need for communication with company representatives. Carefully composed student teams will meet some of these requirements, but student–industry projects of the type found in *Industry link* may not be suitable for all students, so participants should be subject to careful selection. A university may also define an explicit strategy for supervising such projects, a strategy in which students are clearly guided and have access to continuous tutoring by university supervisors throughout the project process. This requires that adequate resources be allocated during the activity phase.

Should the outcome of the student project fail to meet company expectations (risk FP-4), the company may well feel that it has invested time and resources in a futile activity, and choose to refrain from participating in further student projects. This will force the university to invest resources in establishing new relationships with different companies and may negatively affect the university's reputation.

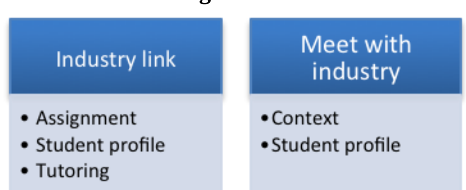
To reduce the probability of risks being realized, the structure and design of the project assignment is a key issue. The assignment's level of complexity should be attuned to student abilities and should also be adjusted to the project timeframe and the number of students. The university and the company need to design the assignment in dialogue with each other. The company should also be made aware of what can realistically be expected of the students; the students' skills and competences as well as their motives for collaboration, motivation, and personal goals should be made clear. This requires that adequate resources be allocated during the planning phase.

*Meet with industry* activities differ fundamentally from *Industry link* activities in two respects: First, the *Meet with industry* activities do not rely on active student participation; in fact, students invest little work or effort in the activities and accordingly have little to lose. Second, the company does not expect students to contribute in any way that will influence the company and therefore has no expectations that could be disappointed. Not surprisingly, fewer serious risks threaten *Meet with industry* activities, which are limited and demand little of the students apart from the expectation that they be present and reasonably attentive.

The consequences of the two serious risks identified in *Meet with industry* activities concern how students view their future working field and their study programme. A guest lecture is short, has a limited scope, and may be biased; while it offers the mature and informed student an excellent arena for critical discussion, it may lead the less mature and less-informed student to a skewed understanding of his or her future professional role, potentially creating a sense of either false anxiety or false security. The less-informed student may also fail to see the relevance of the lecture and be unable to create a link to the study programme, rendering the lecture meaningless and a waste of time. While student projects, as included in *Industry link*, to a certain degree present a transparent process that can be somewhat adapted by university representatives along the way, guest lectures, as in *Meet with industry*, are opaque. The moment the guest lecturer starts his or her address, the university representatives have no way to influence the situation. This emphasizes the context and timing of the guest lecture. Universities may want to carefully design the learning activities immediately before and after the guest lecture, so that students are well prepared for the subject of the lecture and afterwards are offered the possibility of discussing issues raised during the lecture. The undemanding nature of a guest lecture may seem to lend itself to introducing students to a study programme, this is the case in *Meet with industry*, in which the lecture series forms part of an introductory course for first-year students. However, while only two serious risks were identified in this study, the consequences of these risks indicate that guest lectures may be better suited to mature and critically thinking students, who are presumably found in larger numbers in the later years of the programme.

Table 5 highlights the strategic areas of the two types of activities that demand careful attention if the activities are to succeed.

**Table 5. Strategic areas**




We suggest that, before choosing a specific model of student–industry collaboration, a risk analysis should be conducted focusing on the three key areas, i.e., Resources, Framework, and Pedagogic considerations perhaps not primarily to identify specific risks, but to identify the *typical risk areas* for the activities to be offered. In this study, we have chosen two very well-known, but markedly different, types of activities to exemplify how collaboration models can be described and subjected to risk analysis, leading to the identification of strategic areas specific to the particular collaboration model.

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