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SKUNKWORK AS A LEARNING METHODOLOGY
- FINDINGS FROM VENTURE DEVELOPMENT PROJECTS IN INDUSTRY

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Abstract

This paper presents in some detail findings and experiences gained from a new course entitled "Innovation Engineering" (IE). This course is offered in the Technology Management Programme (TM) at Lund University, Lund, Sweden.

The incentive for developing the new course was the need for a more integrated and practical approach where technical, customer and application problems from reality confront the participants. The driving force behind this change of focus has been the ambition to emphasise real life situations and generate a deeper market understanding as well as extensive insights into innovation and product development than was covered by a previous course. In addition to product planning we also wanted to introduce the role of an intrapreneur and to get an extension of the concept of product development.

A challenging task was to introduce intraperneurship into the curriculum. The theoretical treatment of the subject is covered by traditional lectures supported by literature. But what about providing some hands-on experience of intreprenurship in practice? In order to achieve that, four companies were engaged (all of them global with technology as a core competence). At each of these companies company representatives and the instructors of the course agreed upon a venture project during pre-course meetings. Thus learning arenas for the students were established.

The course was divided into two subprojects, one minor project and one major project. The minor one was an introductory project, which aimed at providing the students with insights into the current status of the company. A goal was also, to give the students the opportunity to identify a potential project on their own. Alternatively the company provided one. The main project was to adopt the role of an intrapreneur in the company setting, undertake the project development task and deliver the results in the form of a business plan.

The students were divided into four project teams comprising nine individuals each. For each and every one of the teams, pre-defined roles of responsibility within specific areas such as project leadership, engineering design, logistics etc., were to be covered by the team members. A supervisor was assigned to handle a specific area for each of the teams.

The evaluation of the course was based on interviews of students and representatives of the companies and on a survey. In their roles as course leaders, the authors also evaluated and reflected upon the process (as action research) and documented insights and experiences. Some examples of the findings from the evaluation of the projects obtained from industry representatives and the students are:

- The students initially felt quite uncomfortable with the "fuzzy" structure of the projects. However, as the course proceeded the students (and the teams) created their own structure and a clear maturation process could be identified.
- The outcomes of the projects have clearly contributed to industry. In one of the projects a patent has been applied for and in another one there is a clear market opportunity provided by the students, which the hosting company is now going for.

Keywords
Education, university-industry collaboration, technology management

1. Introduction

In this paper the findings and experience obtained from a new course entitled "Innovation Engineering" (IE) is accounted for in some detail. This course is offered within the Technology Management Programme (TM) at Lund University, Sweden. The course represents a close cooperation between academia and industry as well as being the final course before the master theses projects are carried out.

TM is a master's degree programme in collaboration between the School of Economics and Management and the Faculty of Engineering and as such the only one of its kind in Sweden. Both business and engineering students can apply to TM after 2 years of study in their entry programmes (e.g. from the Faculty of Engineering – Biotechnology, Mechanical Engineering, Civil Engineering, Computer Science – and from the School of Business and Management). For 2½ years the TM students study strategy, project management, product development, industrial marketing, and leadership. The result is TM classes with a wide range of knowledge and competence areas in the field of technology management. As Nambisan and Wilemon [1:108] state: *"University graduates who can operate effectively across boundaries of engineering, science and business often have career opportunities superior to those not adept at extending themselves beyond their primary professional or technical domain".* This statement reflects the objectives set out for the TM Programme.

A major incentive for the development of the new course was the need for a more hands on experience of complexities in handling technical as well as project and market fuzziness and complexities. This in order to emphasise real life situations and generate market understanding to a higher extent than was covered by the former course entitled "Market Driven Innovation and Product Development". Another incentive was the need for increased entrepreneurial features in the TM Programme. In Nambisan and Wilemon's [1] global survey on management of technology education, it was found that there was a lack of entrepreneurial focus, something the authors expressed as surprising since entrepreneurial activities are crucial in driving development and innovation in technology settings. Consequently, in addition to product planning we also wanted to introduce the role of the intrapreneur in industry and thus extend the concept of product development.

A challenging task was to introduce intraperneurship into the curriculum. Consequently, a third incentive for the actual course set-up was to come closer to implementing theories in practice. No fake projects, no special student version of corporate reality, but an opportunity to work on a project of great interest also to the company. At the same time, the students would be challenged to apply knowledge from different courses and disciplines into this course in a project format with the students as the team with one project leader and a group of functional specialists.

The objective set out for this paper is to present experiences gained with a kind of skunkwork as a methodology to improve student learning in intrapreneurship and product development in close cooperation with industry.

The paper is organised as follows: Section 2 elaborates on the concept of skunkwork and how it fits into a university-industry collaboration effort. Section 3 describes the context of the course. Section 4, focus on the course delivery. Section 5 is an account of the course results and in Section 6, a concluding discussion is presented.

2. University-industry collaboration

Working in close connection with industry during a course involves both benefits and risks. Among the benefits are that it provides the students with great motivation and from that, increased learning since real life problems of key importance to the companies are provided [2]. Fulfilment of the tasks is then real triggers to the participating students. It also offers the students workplace experience in a setting where most of them will be employed after graduation. It is motivating and interesting for the teachers as well, since we are presented with new situations and possible research opportunities as a result of discussions and collaborative work with industry representatives.

The term "Skunkwork" has several definitions and people in industry have their own views of the phenomenon. One of the company representatives proclaimed, *"If it was not for skunkworks they would be out of business"*. Wheelwright and Clark [3] present skunkwork as a formed team dedicated to potential break through projects. *"The team is given complete responsibility, with no strings attached, for developing the new product or process"* [3:160]. Brown [4:9] provides another, but similar definition of skunkwork, namely: *"A true skunkwork is an isolated and highly skilled team designed to accelerate the research, but especially the development of innovative product/services"*.

Why introduce skunkwork in an innovation-engineering course? In order to provide industrial hosts with something useful, i.e. that they would like to prioritise and invest time in, while offering students real-life cases that are meaningful for learning and motivation, the concept of skunkwork was appealing for several reasons. First of all, a development project could be set up involving something the companies were interested in but that was not close to their core business, i.e. where company secrets would limit access for students. The projects could, instead, be something the company had thought about but for which they lacked the resources or felt the field was too far away from their daliy business – though it could be tomorrow's business. Secondly, the students could act rather autonomously with a sponsor from the host company providing gateways when needed. This since a skunkwork team works outside the organisation and everyday operations.

3. Context setting of the course

The context setting of the course i.e. in establishing the overall strategy, norms, values, and learning outcomes, included several factors to be considered.

First of all, one of the main tasks was to establish a procedure where the learning responsibility was handed over to the students, and assuring that the students became well aware of this.

Secondly, in order for the students to be able to handle the complexity that the development projects involved and at the same time proactively deal with the common "fee-raider" problem associated with group assignments [5], responsibility areas or roles to be covered by the students were established. The roles defined were as presented in figure 1, project leader, engineering designer, marketing-, production/manufacturing-, logistics/SCM-, supplier-, finance- and quality responsible.

Thirdly, a support organisation was needed in order to provide guidance and knowledge on a student demand basis rather than traditionally lecturing where most information is given on forehand, which in this course, like in reality, was impossible due to the nature of the projects. Two types of supervisors was assigned (se Fig. 1), specialist supervisors that guided the students in their different specialist roles and process supervisors that supported and coached the teams concerning issues of teamwork etc., that might appear during the projects. In order to support the individual team members/specialists each and everyone got a planned mentor time every second week. Two hours were scheduled every other week for discussions between the participants and an appointed senior specialist. These were the course teachers, other academic professors and two very experienced senior executives who were mentors/coaches for the four project leaders.

Finally, close contact from the course leadership with company representatives was perceived as a prerequisite for course success.
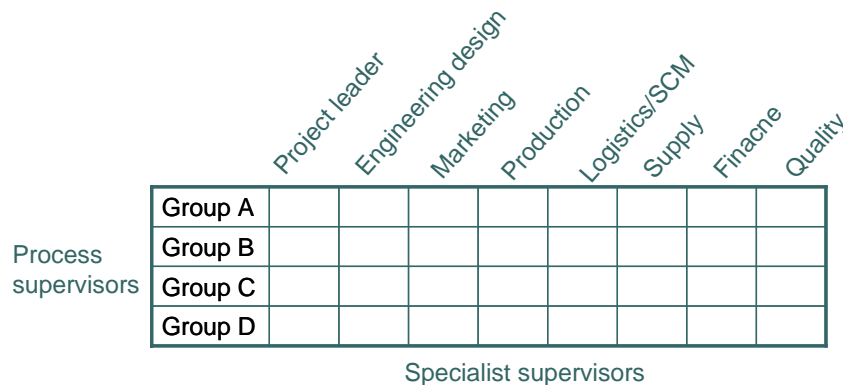

Fig. 1. The organisation matrix of the course, showing responsibility areas for the students, specialist supervisors for each responsibility area and process supervisors for the whole groups.

3.1 Initiating contact with companies

In order to have a successful outcome of the course, one of the prerequisites was to find interested companies with the right profile. The profile was based on a technological product or process orientation, accessibility and interest in participation. An evaluation of potential companies was made during the spring semester. Four companies were contacted and all of them agreed on engagement; each of the companies acts on the global market with technology as the core competence. In an attempt to establish a really solid foundation for the students' work, we carried out a couple of meetings with the managing director and/or the actual project owner at each of the companies. The company representatives and the leaders of the course agreed upon a venture project during these pre-course meetings – thus setting the learning arena for the students.

4. Course delivery

The students prepared for the new course by taking a product development and innovation course during the spring semester of 2006. The actual course was given during the autumn semester of 2006. During the previous year and a half, they had taken courses on subjects such a teambuilding and leadership, project administration, project leadership and strategy. More specific technical subjects were also studied in areas such as engineering design, management and corporate finance. In addition, they had worked in teams of five on projects in two other courses during the previous year.

4.1 Setting of the course – the first project

One of the main tasks of this first phase was to instil an intrapreneurial mind-set in the students. In the first lecture, five key values were presented based on entrepreneurial skills [6]:

- Consider both the whole and the parts in parallel and continually.
- Seek passionately for opportunities.
- Work and act in a disciplined manner out of the best opportunities.
- Focus on execution.
- Engage and involve a network of resources.

The students were asked to reflect on these and act according to them as much as possible during the course.

At the end of the first lecture the students were assigned the first task of forming new teams. This time the set-up was different from previous teamwork experiences. The project teams were designed by merging the earlier teams into larger four ones made up of 7 to 9 persons. Although first perceived as a small challenge, it turned out to be a bigger change then expected. They were also assigned the task of appointing specific members in the group to be in charge of one of the functional specialities i.e. taking a role of project leader, quality responsible etc (see figure 1). They were also told that they could reorganise according to the problems they encountered and the demands imposed by the actual situation.

In the following lecture, the intrapreneurial concept was further elaborated upon and the introductory project was handed out to the teams in the form of a project mission statement. This first minor project aimed at providing the students with insight into the current status of the company and if possible, to give the students the opportunity to identify a potential development project for their skunkwork. If such a task could not be identified, the one prepared in advance by the company and the course leaders were presented to the team. All of this was to be accomplished with an intrapreneurial mind-set. They were assigned company contacts and then set off to work. One of the companies provided a list of 17 people whom the students could contact and within two days they had interviewed them all. Other companies maintained a single contact person for the initial part of the projects.

At this time all of the students were fully aware that this introductory project should be followed by an additional assignment, the skunwork, which should be reported in the form of a business plan to the hosting company. The students were informed that their mission was to solve problems related to the product portfolio of the company and that they were supposed to perform the actual project as a skunkwork, under the leadership of a project leader appointed by the course leaders.

The students reported the first phase at the end of the third week of the autumn semester - the intrapreneurship check. Their way of reporting was similar to that of any other university course, i.e.

much focused on what they interpreted as the expectations of the teachers rather than what was expected from their hosting company. They were, in other words, still in their role of being students than having stepped into the role of becoming industrial skunkworkers or intrapreneurs.

4.2 Introducing the main project

After four weeks of the 20 weeks, constituting the course, the teams started their main project. They were all given an assignment by their project host as none of the teams succeeded to find a skunkwork on their own during the first phase. They were provided with the following deadlines: A preliminary presentation was due on 15th December 2006 and a business plan, based on the product/solution they were expected to produce, on 10th January 2007. They were now set to execute their skunkwork as intrapreneurs in the company setting.

Inspiration seminars with guests from both academia and industry provided the students with theoretical and practical guidance and insights from which they could further develop their skills and solutions. These seminars were held during the whole course.

5. Course and project results

The business plan from each team was delivered on time; some of them even weeks in advance. The results from the projects after evaluations showed that they were all of high quality, both technically and economically, and showed important insights and learning from a student perspective, a company perspective, as well as from a solutions perspective. The technical concepts presented were verified by the companies to be of great interest and provided new insights for several of the company representatives. Some of them were regarded as strategically important and in one case, the results revealed both mishaps and unforeseen opportunities. From an academic perspective the solutions were qualitatively high and involved aspects considered from several engineering fields such as thermodynamics, laser physics, biotechnology and information technology. It is clear that the students contacted and used several departments at the Faculty of Engineering to gain knowledge and verification of their results. From a student learning perspective it is evident from both oral presentations and individual reports that the students' understanding and skills in the area of product development and intrapreneurship showed a significant increase. The examination results are generally high.

5.1 Reflections from students

In discussions with the students after the course was finalised, several aspects concerning both administrative and formal aspects of the course came up as well as, and more importantly for this paper, the reflected learning the students explained they had obtained. One of the first, spontaneous learning aspects was their ability to handle the dynamic conditions that characterised these projects. They expressed that this was the first course where the boundaries were rather blurred and where the responsibility for the project work was assigned to the student teams. In prior courses, clear goals had been set out and there had been quite a clear path to follow in order to complete the course. They explained the process during which they together had created a common enemy, the course co-ordinators, based on what they expressed was bad course management and administration, and vague guidelines concerning both the project and the individual work. However, they all expressed and agreed that there was a point in this chaos where something happened and they started to focus on their projects instead, where the insight came that "we own this process". Another thing they expressed as a learning outcome was the stakeholder management situation. Reporting to several stakeholders such as company representatives, course co-ordinators and expert supervisors placed them in a situation where they had to figure out what type of information should be supplied, its format, how often etc. Each of these was a problem they had to deal with. In the discussions they reported that they are better prepared for stakeholder management based on the real life experienced obtained in the course.

When we asked how they had experienced studying as a skunkwork it was followed by silence (at least for a while). Then they were confused as to if they really had been working within the framework of a skunwork. This reaction was found to be based on their definition of a skunkwork, which claims that it must be driven by someone with very good insights and experiences in the company, which they as students by definition not possesses. In the future, this insight will be covered in a prerequisite course in which several definitions and examples of skunkworks will be discussed.

5.2 Reflections from involved companies

During the course and in the follow up discussions with the company representatives the overwhelming impression was that the progress and results of the projects were interesting and useful for the organisations. Experience can be understood as an end product of a process. In this case, the special character, we called it skunkwork, had an obvious impact. We can see learning or experience coming from the interplay between the students, organised as they worked in a team, and the corporate staff. The perspectives were sometimes conflicting. The students learnt the models and procedures in a formal way in situations characterised by order and control. What they met was sometimes very different. They learnt from that, but so did the managers in the companies and the staff members as well. The different roles taken by the students forced company representatives to act in new ways. The interplay in the companies was very different. One company was extremely open and a broad network of contacts was more or less established already during the first week. In other companies all contacts went through the project host for the first month and a half.

The level of contact was also different. In three companies the CEO and a manager were the contacts, in one company a division manager and in one basically the CEO was the main contact. As a consequence the level of learning and experience was very different. All companies were very pleased with the results. All want to become partners during the next course as well. But the level of organisational experience and learning differed. The company with the broadest early contacts expressed the broadest scope in their learning.

The four product development ventures, which were reported as business plans, ended very differently. Two were real product concepts with innovative potential (one patent is applied for); one was a potentially radical redesign of the primary product, and the fourth and last was the exploration of new competitive issues in the market.

The "NIH" effect (not invented here) can be seen is the action of some company representatives. That has also been understood in the companies as well as the need for assuring joint actions and attitudes on issues such as:

- Motivation and ethos
- Open and covert agendas
- The reporting and control system has to be a joint responsibility between the project leader and the host
- Accessibility and openness
- Role correspondence

6. Concluding discussion

Taken together, the four projects have been successful for the students as well as for the companies, but the course management has also learnt a lot from the experience. We have good partners and many lessons to work on. It is our conclusion that in establishing a curriculum that focuses on intrapreneurship skills in an industrial setting, the skunkwork concept might be an appealing methodology.

The overall results from the Innovation Engineering course are positive. The students have both spontaneously and in evaluation discussions declared their appreciation of the course and that they had gained real life experiences in how to deal with "fuzzy" development situations. The companies involved affirmed that the projects had provided them with new insights and experiences. They would also like to participate again in the next course.

The course have also drawn attention from other parts of Lund University and is now being used as a role model for other courses that combine practical experiences with theoretical and technological depth in industrial settings.

So, did the students improve their intrapreneurial skills? Well, based on their own comments, it is clear that they have gained the experience that there are several obstacles to conquer in taking on the role of being an intrapreneur in a company. Some of the students felt that this would not deter them and that by knowing about it they could probably succeed with development efforts in future working

situations. Other students were more restrained in their comments and would think twice before getting too involved in executing new radical ideas in the future. From a teacher's perspective, all the teams and especially some individuals showed clear intrapreneurial skills as they searched for opportunities, acted on them, focused on execution and at the same time were not hindered by obstacles caused by either the task as such or by the stakeholders involved.

As the course is focused more on competence than knowledge development, it could be argued that it suffers from theoretical insufficiency. However, unlike most of their prior courses, this course aims at bringing together the individual and collective knowledge gained from the students' specialisations on areas of responsibility in the project and from their primary programme studies.

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