Netherware: analysis, results and success factors of the designed curriculum unit

Report on EMP-project 2004-2005

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1. Project on the design of the course Informatics Business

1.1 Project goals

This project aims at detecting the strengths and weaknesses of the Master course Informatics Business. In this course students learn the methodology of the development and implementation of product software and internal business processes of a software company. Furthermore, the course aims at teaching students to develop a company as well as develop entrepreneurship. Two courses of this type that the instructor gave at the Vrije Universiteit in Amsterdam resulted in the foundation of 10 companies. The aspect of company development gives the course a surplus value for the Dutch society. Therefore, we are interested in the functioning of the education in entrepreneurship in this course.

The main question in this project is: What elements in the designed curriculum unit stimulate students' learning? What elements hinder students' learning?

Within this project we intend to do the following:

- Describe the designed curriculum unit of this course that teaches entrepreneurship in terms of the educational sciences (see chapter 3);
- Describe the quality of the course implementation: to what extend is the implemented curriculum the same as the designed (intended) curriculum? Is it feasible? Are the aims of the course attained? Always, for all students? Are there mayor flaws in the course implementation that need to be solved? Is the result as intended? To be short: is the designed curriculum unit functioning? (see chapter 4 and 5);
- Describe the functioning of the designed curriculum unit in terms of the educational sciences: which features and cause and effect relations are crucial for generalizing this knowledge? This should make clear to what extend transfer to other educational levels (e.g. post academic), domains, contexts (disciplines, multidisciplinary, international) is possible (see chapter 3-5, particularly section 5.3).

1.2 Methodology

The IB course as it was given at Utrecht University from November 2004 to January 2005 was analyzed to review the effectiveness of the course in teaching students entrepreneurship in product software. We investigated how the different elements of the designed learning environment in this course affect the dependent variables in teaching and learning. The design of the study can be characterised as design research (Collins et al., 2004). For the effectiveness study we used a set of methods to collect information about the course and the way students as well as the instructor acted: analysis of the course design, observations, interviews, questionnaires, analysis of products from students, analysis of learning outcomes, analysis of course materials and analysis of information on the study for students. We explain each of these methods:

Analysis of the course design – A rational description of the course design in terms of the educational sciences: which learning functions are fulfilled? By whom or by what? With what criteria and results?
Observations - In cooperation with the instructor several moments in the course were denoted 'critical moments'. At these moments we performed *observations* during which we tried to gather as much data as possible about students individual and group work next to the performance by the instructor. These moments, which consist of half days, are described in table 1. During these half days we want to see as much as possible of the students' work, both during deliberations between students and during individual work that takes place during the contact hours. We also observe the performance by the instructor during his management by walking around, the meetings with his students, the answering of questions and presentations.

Critical moments	Reason for observation at this moment
1 t/m 3	• students develop an idea of the task • formation of teams
3, 14, 15, 21, 23, 24	• tension rises due to an approaching deadline
7, 26, 27	• tension rises due to an approaching presentation
4 t/m 6, 16	• normal, daily work

Table 1: Day parts at which observations of the course take place.

Interviews - Students as well as the instructor were informally asked clarifying questions to interpret our findings from the observations. Furthermore some interviews where arranged with the instructor and with a delegation of one student from each project team. The conversations with students and their instructor were used to clarify the characteristics of the course: What is the level of complexity of the course? In what elements is this complexity reflected? What effects do the perceived complexity and structure of the course have on the way students go about this course? What elements do the students find motivating in this course?
Questionnaires - Both at the beginning of the course and at the end students were asked to fill in a questionnaire. The first was handed out at the end of the first meeting and was immediately filled in by the students. This resulted in a 100 percent response (N=13 at that time). One student who joined the course later was not asked to fill in this questionnaire. The second questionnaire was send to the students by email. After two reminders the response was 12 (86%). A third questionnaire was send to the alumni of the two courses the instructor gave at the Vrije Universiteit in Amsterdam. In the year 2002-2003 the course was followed by 15 students, in the year 2003-2004 by 27 students. The questionnaire was sent to the alumni by email and resulted in a 64 percent response from which one third from the year 2002-2003 and two thirds from the year 2003-2004.
Analysis of the products from students - We performed an analysis of the products of the students that could give information on the degree of cooperation and the way in which the workload was divided: time registration, progress reports, reports to the Board of Governors. The products of the students and the assessment of these by the Board of Governors at the end of the course were analyzed to determine to what extend students were successful in producing a product that is fit for the market.
Analysis of learning outcomes – The assessment by the Board of Governors as well as the formal assessment by the instructor shed light on the quality of students' work. The presentations of the students to the Board of Governors as well as the assessment by the Board are videotaped. To value the quality of students' work we asked the instructor to give an explanation of the group marks on the formal assessment.
Analysis of the course materials - Also, we performed an analysis of the course materials that are given to the students about the course and / or is posted on the electronic learning environment BscW. The standard course evaluation adds some information to our own questionnaires on the valuation of the students of this course.

The outcomes of these research methods can be found in this report. Another activity in the project was the composition of a literature portfolio.

Literature portfolio – For future reference literature on authentic tasks and education in entrepreneurship will be provided to the instructor on cd-rom. A list of contents of this portfolio can be found in appendix 4.

2. Developing entrepreneurship in product software

2.1 Attention on stimulating entrepreneurship

The IB course aims to develop entrepreneurship in the development of product software. Stimulating entrepreneurship is getting more and more attention as an objective in European education. To create employment in the long run and to develop its economical growth and the power to compete, Europa needs new florishing companies that dare to undertake creative and innovatie entreprises. For this, the furtherance of entrepreneurial spirit is essential. Therefore, the European Commission acknowledges entrepreneurship as a basic competency that needs to be learned through life-long learning. The European Manifest for small companies engages the Europan Union in teaching managment science and entrepreneurship at all school levels as well as develop training programmes for managers. Education can contribute to the development of entrepreneurship by focusing attntion on the career possibilities for entrepreneurs and by developing the most important competencies for entrepreneurship. Entrepreneurial skills and attitudes offer society benefits that reach further than trde and industry alone. Creativity and initiative can be useful for everybody in work and privte life (EC, 2004a).
The dutch employee is full of initiative and independent. This makes us good intrapreneurs. However, in entrepreneurship, developing a company of our own and becoming entrepreneur, we lag behind. The Global Entrepreneurship Monitor of 2003 classifies the Netherlands in the lowest category (AWT, 2004). Therefore, in the Netherlands it is widely acknowledged that entrepreneurship should be developed more in dutch education (e.g. EC, 2004b; Ministry of OC&W, 2004). The Ministry of Economic Affairs stimulates high-tech starters and education in entrepreneurship (MEA, 2004). Well designed courses that stimulate entrepreneurship receive a lot of attention.

2.2 Definition of entrepreneurship

There is no unambiguous definition to be found in literature for the term 'entrepreneurship'. Literature search on entrepreneurship produces a big amount of definitions (see e.g.: Audretsch, 2002; Bull, 1993; Gartner, 1990). Grilo et al. (2004) call entrepreneurship 'a multi-dimensional concept: its definition depends largely on the focus of the research undertaken. The many researchers that came up with a definition most of the times only looked at research in their own discipline (Bull et al, 1993). Ten features are often mentioned according to literature search by Van der Kuip (mentioned in Bosma, et al., 2002): achievement motivation, need for autonomy, creativity, initiative, risk taking, opportunity seeking or recognition, goal setting, self-awareness, internal locus of control and persistence.

The definitions of entrepreneurship are more or less comprising. They describe:
- All the necessary competences to own and manage a company, or
- All the necessary competences to start a company (nascent entrepreneurship).

Examples of definitions of entrepreneurship and the necessary personal qualities for this:
- Definition proposed by the OECD: "Entrepreneurs are agents of change and growth in a market economy and they can act to accelerate the generation, dissemination and application of innovative ideas…. Entrepreneurs not only seek out and identify potentially profitable economic opportunities but are also willing to take risks to see if their hunches are right" (Audretsch, 2002, p. 3).
- Drucker (1985): "entrepreneurship as an act of innovation that involves endowing existing resources with new wealth-producing capacity." (Bull et al., 1993, p. 185)
- Kirzner (1985): "The kind of knowledge required for entrepreneurship is 'knowing where to look for knowledge.' ... The word which captures most closely this kind of 'knowledge' seems to be alertness." (Van Praag, 1999, p. 325)

- Leibenstein (1968): "describes the entrepreneur as one who marshals all resources necessary to produce and market a product that answers a market deficiency." (Bull et al., 1993, p. 185)
- Frank Knight (1885-1972) was the first to make a difference between risk and real uncertainty and mentions the ability to handle this the most important quality of an entrepreneur: "Entrepreneurs are specialized in responsible direction and control, in dealing with real uncertainty [-] The essence of the entrepreneur's position in a corporation is his responsibility for direction and control whenever uncertainty is involved. He exercises judgment effectively, is the decision maker, and he takes the responsibility for his decisions. Decisions include the planning of where, when and what kind of products to create. In addition to these estimating and judicial tasks, the entrepreneur is responsible for guaranteeing the estimated values to the other parties involved with his firm. [-] Successful entrepreneurship requires not only entrepreneurial ability, but also good luck and the belief in one's good fortune. Entrepreneurial ability heavily depends on one's ability to effectively deal with uncertainty." Entrepreneurial ability includes furthermore, 'the power of effective control over other men as well as the intellectual capacity to decide what should be done'." (Van Praag, 1999, p. 322-323)
- Joseph Schumpeter (1883-1950) emphasises innovation and leadership: An entrepreneur "seeks opportunities for profit. He introduces 'new combinations' or innovations to reach this goal. [-] An entrepreneur is a person who carries out new combinations. [-] The entrepreneur's task is to innovate and to lead, i.e. deciding which objectives to pursue rather than deciding on how to pursue them. He is not a risk-bearer or a supplier of capital. [-] Leadership is required in order to 'lead' existing means of production into new channels (out of the accustomed ones). Moreover, the entrepreneur should not feel reluctant to do something new." (Van Praag, 1999, p. 320)
- Alfred Marshall (1842-1924) emphasises the role of the entrepreneur in directing the process of production and distribution, coordinating supply and demand on the market and labour in the company: "To be able to bear in mind many things at a time, to have everything ready when wanted, to act promptly and show resource when anything goes wrong, to accommodate oneself quickly to changes, to be steady and trustworthy, to have always a reserve of force ... [-] Second, successful entrepreneurship requires specialized abilities such as knowledge of the trade, power of forecasting, of seeing where there is an opportunity, and of undertaking risks. Third, to perform his role as an employer the entrepreneur should be a 'natural leader of men'." (Van Praag, 1999, p. 318)
- Jean-Baptiste Say (1767-1832) emphasises the role as director and manager in the company: A successful entrepreneur should have many qualities. [-] Judgment, perseverance, and a knowledge of the world as well as of business ... the art of superintendence and administration'. Furthermore, a successful entrepreneur should have experience within, and knowledge of, the occupation and be in a position to provide the necessary funds: "Not that he should be already rich; for he may work upon borrowed capital; but he must at least be solvent, and have the reputation of intelligence, prudence, probity, and regularity; and must be able by the nature of his connections, to procure the loan of capital he may happen himself not to possess." (Van Praag, 1999, p. 315)
- Richard Cantillon (1680?-1734) "was the first to give economic meaning to the concept of 'entrepreneur.' The entrepreneur is functionally described as arbitrager. " "…he should be alert and forward-looking but he need not be innovative. He adjusts the quantity supplied to existing demand; he does not increase or alter demand nor supply. And the entrepreneur should be well prepared to bear the inherent risk." (Van Praag, 1999, p. 314). An entrepreneur is "someone who exercises business judgment in the face of uncertainty." (Bull et al., 1993, p. 185)

Figure 1: Examples of definitions of entrepreneurship and the necessary personal qualities for this.

Since there is no unambiguous definition of entrepreneurship we have have to describe what is important for the product software business. From his experience in this line of business and research undertaken in his division, the Center for Organization and

Information (http://www.cs.uu.nl/groups/OI/) at the Institute of Information and Computing Sciences, the instructor mentions the following items:

1. Technical understanding
   To be able to discuss technical aspects of the production of product software, both within and without the company. To be able to communicate technical information with customers. To be able to make desicions based on the technical understanding.
2. Commercial understanding
   Credibility towards customers. To be able to tune the solution to the problem of the customer technically, organizational and adjusted to the market. It is not necessary to be a top salesman, but you have to be sensitive to the wants of the market to be able to take the right decisions. You have to be visionary. Furthermore, you have to have some comercial skills for instance in explaining your product idea to the customer without becoming too technical.
3. Company management
   Be proficient in communicating your confidence in the product and the company to others, without nagging. To be able to link people to you. To be able to set up a company: knowing who to hire, communicating certainty to your employees, forming divions and delegating tasks.
4. Financial understanding
5. Drive
   It is not necessary to be a creative wonder. Important is that you have the drive to realize something, that you are decisive and determined and are able to finish what you have started.

These five items are used in the designed curriculum of the course. Furthermore, these items are used in the questionnaires for students at the end of the course.

2.3 Developing entrepreneurship in courses

What is needed to develop entrepreneurship? Bosma et al. (2002) mention awareness next to entrepreneurial competencies, described three objectives for education in entrepreneurship:

1. Raising awareness: everyone should be aware of the importance of and contribution by entrepreneurship to society and economic welfare. Therefore, education should provide students with positive role models. Futhermore, the objectives of education should not only be on developing employees for bigger companies and public services, but also on entrepreneurship in a small enterprise.
2. Stimulating entrepreneurial attitude and qualities: education should develop personal qualities that are important in entrepreneurship, like creativity, risk-taking and taking initiative.
3. Training entrepreneurial skills: to prepare students for entrepreneurship they should learn financial management, how to compile a business plan etcetera. This prepares them to become an entrepreneur.

From a worldwide research on entrepreneurship courses over the periode 1971-1994 Gartner et al. (1994) found that the latter objective gets attention in the 'standard' entrepreneurship course. Furthermore, the 'standard' entrepreneurship course includes speakers, readings and cases. Frequently repeated elements are lectures, judging panels including outside professionals to assess venture plans and entrepreneurship clubs. Less frequent but still common are 'live' cases and videos of entrepreneurs featuring in the cases. In this study the researchers also asked for experimentation successes in the entrepreneurship courses. Interesting outcomes of this question, other than are already applied in the IB-course, are:

- entrepreneurial financial planning software used

- entrepreneur 'living cases' and than dinner afterward
- financing simulation in class, bidding on b-plans, negotiations
- student presentations on their own entrepreneurial experiences
- field trip to patent office to 'search' ideas
- experienced alumni acting as paid 'mentors'
- personality test instruments to develop strength and weakness awareness

Stimulating awareness and entrepreneurial attitude and qualities asks for more attention on entrepreneurship than only within one course. These things need time to develop. According to Eijssen (2003), education should stimulate all kinds of qualities that are also important in entrepreneurship and should do this by giving students more freedom to regulate their own study programme. 'Following education has the connotation of education that is leading you and deriving your security from the study programme, the instructor or what you are told to do.' This is in conflict with teaching entrepreneurship for which you should direct yourself, should learn to master insecurity and come up with own initiatives. This calls for a system of mentoring in which the following aspects are designed:

- learn to discover and explicitly state your own competencies, interests, values and personal qualities
- develop a personal view on possible professions
- reflect on ones own learning expereriences and results and draw conclusions based on this
- take actions based on the reflections.

2.4 Developing a product software enterprise

Developing and selling product software has evolved into worldwide substantial economic activity, with companies as Microsoft, SAP, and Oracle as well known examples. The growth rates of product software companies are still high, despite the negative economic climate. Nevertheless, in computer science curricula there is hardly any attention being paid to teaching students the essences of the creation, production and release of a software product. A growing group of researchers is investigating this line of business. The knowledge that comes from this research is worth implementing in relevant study programmes in higher education.

Since the objective of the course (intended curriculum) is to give students an impression of the authentic practice of a product software enterprise, it is good to know this practice. A software product is defined as a packaged configuration of software components with the auxiliary materials (e.g. manuals, training materials and brochures), released in a specific market (Xu, 2005). Unlike tailor-made software (software specifically developed for one customer), and embedded software (software in consumer electronics, office equipment) its market release requires precise synchronization of dependable software engineering activities like design, programming, testing, configuration management, documenting, course creation and translation. Furthermore, the same product requires installation and use in different organizations, with different hardware configurations and software platforms. Moreover, the vendor company remains owner of the software and auxiliary materials, while its use is licensed to the customers. Most product software companies start with a small number of persons (1 to 4) who have an idea about particular software products or services they want to develop and sell in a particular market. In case of independent persons they can establish a company, whereas in case of employees, they can convince their management to establish a separate product line (Brinkkemper, 2003). Software products require considerable up-front investment of development work and budget for facilities before the first release can be marketed to customers (Carmel et al., 1996). This release is usually developed in close collaboration with some customer representatives to make sure that the product is conforming to the market wishes. The first product release is crucial as the early success in the market is a

test for the feasibility of the original idea of the founders. Is the market really waiting for the product as the founders had envisioned? If so, the next step is to get more customers and expand the company with more personnel, usually in sales.
Typical characteristics of the first period are a small work environment in an improvised office, working with low budgets, making long hours, and performing all company roles: engineer, tester, sales and marketing, receptionist, and manager. The company culture is established in the period in which the first employees are hired. New employees come from the network of the founders and important in their selection are capabilities and personal fit to the others. Therefore, these employees come from the same city, from the same university, or frequent the same pubs. Work style, corporate clothing style (informal), meetings, lunches, organizational structure, and the way in which successes are celebrated are ingredients of the culture.

The described authentic practice consists of persons that have in common activities directed at the development and marketing of product software. In common are also knowledge concepts needed for these activities, and the attitudes (culture) connected to their activities. The persons involved in the practice are organized in teams that have a concrete goal, within a limited time span.

3. The designed curriculum of the Informatics Business course

3.1 The course scheme

To tackle two challenges, teaching entrepreneurship as well as the essence of the development of a software product, Brinkkemper started a course on product software at the Vrije University at Amsterdam in 2002. He gave this course, Product Software, twice, both in the academic years 2002-2003 and in 2003-2004. Earlier experiences at the University of Twente (Bruggencate et al., 1995) and some years of business experience were used in the designed curriculum of the IB course. In the academic year 2004-2005 the course was given at the Utrecht University, as one of the courses in the first year of the Master programme 'Business Informatics' (see www.businessinformatics.nl). The course information from the study guide is given in figure 2.

Course information

Credits: 7½ ECTS

Meetings: Wednesday afternoon, Friday

Objectives: After this course the student should:
- know what developing a software product entails
- be able to work with the scientific theories of product software
- be able to start an own software enterprise

Content:
- Requirements management: functional categorization, prioritization for releases (QFD, AHP), tracing en tracking, scope management
- Architecture and design: application genericity and typologies, variability, product architectures, internationalization, platforms, localization and customization
- Development methods: prototyping, realization and maintenance, testing, configuration management, delivery; development teams
- Knowledge management: web-based knowledge infrastructures, quality improvement programmes (CMM, SPI)
- Protection of intellectual property: ©, ™, NDA, Software Patents
- Organization of a product software company: business functions, financing, venture capital, partnering, business plan, product/service trade-off, diversification

Literature: Micheal Cusumano: The Business of Software, Free Press, ISBN: 074321580X.

Course form: Project

Exam form: The course is run as a project, where several deliverables have to be produced.
The course grade is a weighted average of the grades for the deliverables and the presentation. Any activity graded below 6 is to be repeated.

Figure 2: Course information

The IB course focuses on a team-based project. Authenticity and a real problem coupled with a future professional situation and context are key features of a project. The IB course is designed around the fictive product software company Netherware (see figure 3 and www.Netherware.nl). Students start with their own idea for a software product and form teams to develop a small company around this product. With this product team they take part in the mother company Netherware. Furthermore, they take part in one of the staff departments of Netherware in so-called horizontals. Students in the horizontal team 'project office' are responsible for all documentation templates, the delivering of hours accounting sheets and progress sheets and the registration of project plans. Finance does

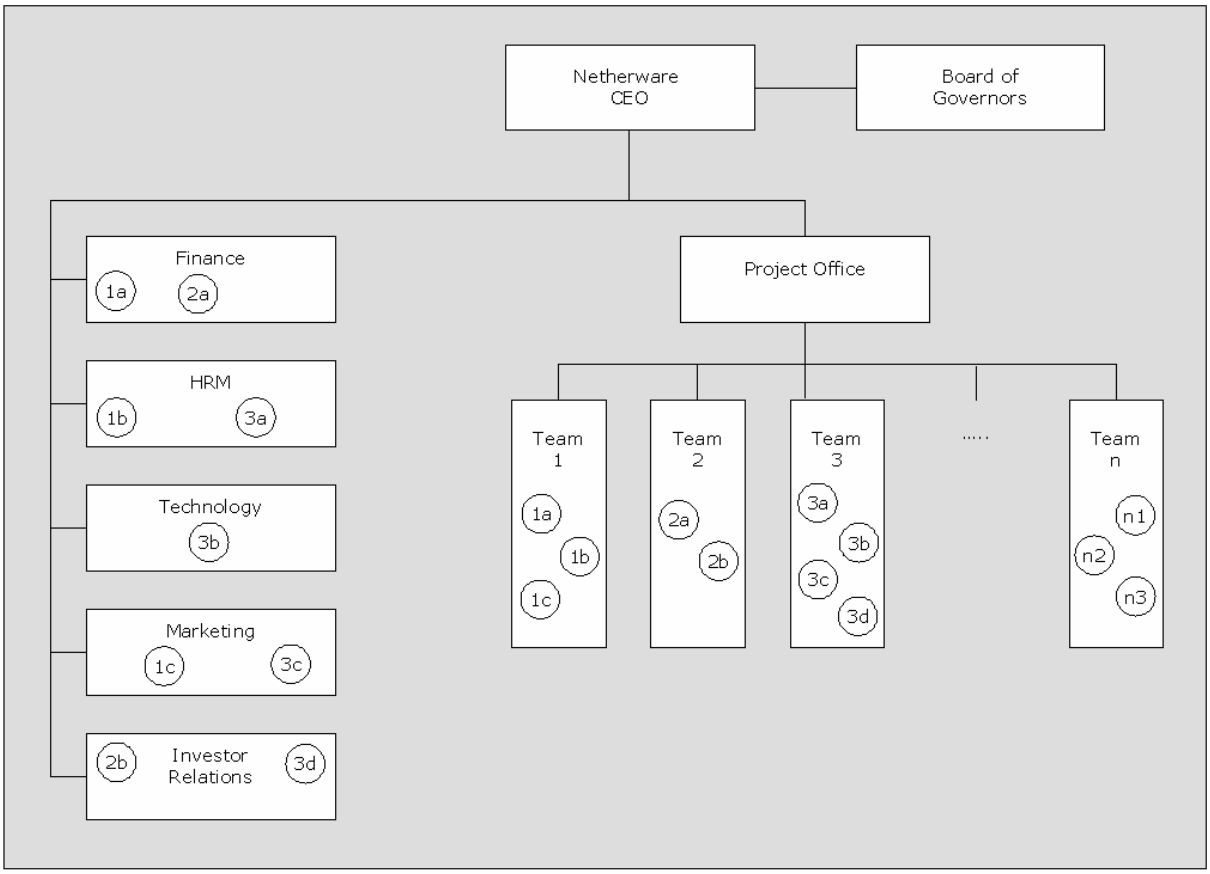

Figure 3: Organizational structure of the fictive product software company Netherware.

the (virtual) bookkeeping, pays salaries, pays invoices for technical infrastructure and maintains the total balance sheet. The human resourse management team handles the employment of new employees and resignations, arranges for salary adaptations, overviews the team collaboration, acts as a social mediator when needed and intervenes for under performance or study problems. Furthermore, the task of the HRM department is to build and maintain the intranet, create an internal communication infrastructure and collect the necessary information for internal communication. Technology reviews all technical platforms chosen by the product teams, advises the product teams on this matter, reviews the technical part of business plans and product plans of all product teams, contacts platform providers for Original Equipment Manufacturer arrangements and passes on information on costs for the necessary technical infrastructure and licence costs for platforms of teams to finance. Another task of the personel of the technology department is to pick up the beamer for the plenary company sessions. Marketing builds the external website, develops a flyer, writes press releases, develops the corporate style, arranges gadgets and corporate presents, arranges for external speakers, looks after the contacts with the Board of Governors and reviews the market plans of the product teams. The team 'investor relations' provides a business plan template, creates a list with venture capital information, tries to involve a venture capital company in the course, performes (financial) market intelligence for products and prepares a continuation advise. The instructor functions as the chief executive officer (CEO) of the company. At the end of the project period the Board of Governors reviews the business plans.

By the development of their own company with their product team and by the activities in the horizontals of the mother company, students must get a thorough orientation on the activities that are needed to develop a product software company and experience the work in such a company. The course aims at stimulating entrepreneurship in students through this experience. The phrase of Confucius alongside this paragraph has been a directive for the instructor in the design of his course. He wants to involve his students in the process of software production to give them the experience and a better understanding of this kind of work and in doing so develop entrepreneurship and knowledge of the commercial development of product software. This is in line with theories on situated cognition which state that learning occurs best, or perhaps only, within the social and physical context in which the authentic problem originally is produced (Brown et al., 1989). According to these theories learning and performance are so closely related to context, that the actual schema of the domain knowledge and processes are different for different contexts. Task performance demonstrated in one context may be only indicative of competence in another context. In the designed curriculum of the course various elements are designed which are in line with this kind of work in practice.

"Tell me and I will forget,
show me and I may remember,
involve me and I will understand"
Confucius

In the next paragraphs of this chapter we will focus on the designed curriculum: what were the intentions of the instructor with this designed curriculum? We base our findings on conversations with the instructor and on an interview with the instructor on the course design. We describe the designed curriculum and characterise the elements within five groups of design features: work atmosphere (§3.2), type of problem and activities (§3.3), role of the problem solver (§3.4), role of the instructor/coach (§3.5), and facilities and infrastructure (§3.6). During our study of this course the five groups of design features were helpful in grouping the authentic elements in the course. Therefore, we use these five groups of design features to describe the intended curriculum as well as our findings about the implemented and attained curriculum. The findings about the intended curriculum are summarized in figure 4 (see page 13). In chapter 4 we will turn to the course as it was given, observed by the researchers.

3.2 Work atmosphere

In small software companies there exists a very specific work atmosphere which is an important design feature of the problem context. Therefore, we start our description with this group of design features.

Organic team forming – The instructor tried to create a work atmosphere similar to the atmosphere that exists in a starting product software company. This already should start in a preliminary phase when students decide to join this course, the instructor decides whether or not to accept them and the students discuss product ideas with him. He lets students decide with whom they want to work together and on what product or service. Students may also decide to work alone. The team development within ones personal network is very common in this line of business and extremely important since the success of the company is based on a good match of persons. Team forming will continue in the first sessions of the course. Because of the importance of the constellation of the teams, the instructor pays a lot of attention to facilitating this process. Therefore, he wants to give students time to talk to each other over a cup of coffee. He also wants to stimulate team forming by asking students who already have an idea to present this before the group and discuss it with them. Probably students want to join in based on a presentation of a product idea.

Own product ideas – Students are stimulated to develop their own ideas instead of working on a product that the instructor has come up with. When they work on a product of their own choice, students are expected to put more effort into it. This is in line with

Authentic elements in the intended curriculum

1. Work atmosphere

1.1. Facilitate organic team forming within the student's own social network.
1.2. Stimulate students to come up with their own product ideas over which they keep autonomy.
1.3. Real product: product development is not limited to the duration of the course.
1.4. Create a corporate image and a sense of togetherness: company logo and T-shirts, getting to know each other.
1.5. Time pressure: keep strict to deadlines, sudden deadline for a press release.
1.6. Tempo: work according to schedule, working overtime close before deadlines, select most important task.
1.7. Function as a team: solve problems together, provide feedback to others.
1.8. Students work for appraisal in the market as well as for a grade.

2. Sort of problems and activities

2.1. Develop a real software product or service for (potential) customers in a small company (5 students at max).

Structure:

2.2. *Work on product and business:* Making deliverables (project plan, product definition, product architecture, product design or prototype, business plan, hour registration, annual report), attend presentations about what developing a software product entails, work with scientific theories of product software.
2.3. *Work on horizontals:* Performing tasks in their horizontal, give plenary presentation on the horizontals work, attend presentations from other horizontals.

Complexity:

2.4. Open-ended problem: there is not just one product that is the solution to a problem.
2.5. Students have to take in consideration several aspects of the production process and the development of a company at the same time: technical possibilities, market requirements and financial possibilities.
2.6. Give help think about products from other teams, in different stages of development.
2.7. Students work under time constraints

3. Role of the problem solver

3.1. Starting entrepreneur in a small software company.
3.2. Involvement through autonomy of decisions on what the product will be and how it is developed and through ownership of the product.

Complex:

3.3. Perform various roles in product team: company manager, product developer as well as salesman for a certain software product or service.
3.4. Perform various roles in Netherware: co-worker in a software production team as well as in a division of the company.

4. Role of the instructor/coach

4.1. Chief Executive Officer (CEO) of the Netherware company.
4.2. Instructor: is content expert, gives instruction, gives feedback on documents, assesses, gives grades.
4.3. Stimulate students' initiative, not taking over initiative, being supportive.
4.4. Management by walking around: giving students feedback and the opportunity to ask questions, recognizing students' talents.

5. Facilities and infrastructure

5.1. Work environment with facilities for easy exchange of knowledge and ideas.
5.2. Document management system for the storage of documents and software related files.
5.3. Not an ideal company with all the necessary facilities and infrastructure.

Figure 4: Authentic elements in the intended curriculum.

theories on intrinsic motivation. When working on their own products, students have a sense of ownership, which gives them the feeling that they can direct their own work. Students maintain autonomy over there products. They decide on what and how they are going to develop their product. This is known to be a motivating factor.

Real product – The development of the product idea is not limited to the time of the course. Some students enter the course with a product idea that is already in a certain stage of development and some have prior experience in working for customers. Once the course has ended, students can get further support for the development of their company and their product from the instructor or during other courses of the Institute of Information and Computing Sciences, because the students are working on real products and company development is a genuine possibility.

Corporate image and sense of togetherness – Another important factor in this line of business is a corporate image and a sense of togetherness which determines the work atmosphere. The instructor wants to create this by introducing a company logo and company T-shirts. A sense of togetherness can only exist if colleagues know each other. Therefore, he arranges for a classroom in which students are working close together so informal contacts are possible. Company lunches and diners are also planned to stimulate this. Moreover, the instructor wants to stimulate a group feeling by making students share their personal interests and by inviting quiet students to give their opinion.

Time pressure – As in normal contact with clients, students must keep deadlines. Therefore, the instructor will not accept any delay on so-called deliverables and tasks that are part of their work in the horizontal team. Furthermore, the instructor wants to surprise them by creating a sudden deadline for a press release from the department of Marketing.

Tempo – Normally one will be working according to schedules, except for periods close before deadlines in which working overtime is considered normal. Employees will devote most of their time to the task that is considered to be most important in a certain period. To familiarize students with this way of working and to make choice of task necessary, several deadlines are created.

Function as a team – Within their product team students should solve problems together, for instance in keeping a deadline when a team member is ill. They should also function as a team within Netherware as a whole. The horizontals (see fig. 1) should function as team builders because students are working with other students than the colleagues from their product team. The instructor requires students to provide feedback on products of other teams from their position in one of the horizontals and during presentations for the group.

Students work for appraisal in the market as well as for a grade – A Board of Governors, consisting of experienced venture capitalists and others who know the market well, evaluates the business plans and product presentations. They give their opinion on the feasibility of the small companies on the market by dividing one million virtual euros over the product ideas. Students will be stimulated to give a good presentation and deliver a good business plan. The instructor expects students to work also (and some only) for the credits of the course. He will not treat students who only work for a grade, differently. However, if they do not succeed in making a prototype they will not be allowed to present their product for the Board of Governors.

3.3 Sort of problems and activities

This course combines the experience of the development and market launch of a software product or service with learning about product development, good conduct of business, and entrepreneur-ship in this line of business.

Develop a real software product or service – In the intended curriculum students will be working on the development of real product software in the fictive company Netherware. They are developing software products for real-life problems and for which they think that there is a potential market. To find out if there is a market for their product, students carry out a market research.

Work on product and business – To satisfy the needs of the market and produce a viable product, students should consider not only the technical specifications of the product but also the market requirements. This makes the task rather complex. The process is structured because students have to write one document after the other in which they specify their choices on each of the subjects. Students use prior knowledge from previous courses or experience outside their studies in the development of the product and their company. Students should also help other students whose products are in a different phase of development during discussions in the group.
Work on horizontals – To give students insight in finance, project management, investor relations, HRM, internal communications, marketing and the costs and requirements of technical support, all students have a position in one of the horizontals of Netherware. Students get tasks in horizontals that represent the tasks in departments in a normal software company. Furthermore, students have to read literature on the primary process of development of a product software company, depending on the horizontal they are working in. They present the contents of this literature during company meetings and discuss what implication this reading material will have on their own work. From their position in a horizontal they review the products from other teams.
Open-ended problem – Starting entrepreneurs in this line of business usually apply the knowledge and skills they already have instead of looking for what would be best for this product in the market. Therefore, the instructor does not want to press students to choose for a particular platform. Students should make their own choices based on their knowledge and skills. In case they are confronted with problems they cannot solve, they can search for solutions in specific literature or in their social network.
Students take in consideration several aspects of the production process and the development of a company – For this reason students have to work on so-called deliverables for the development of their own company as well as for the horizontals. It is assumed that the course, which lasts for 10 weeks, covers a period of product development of five months. Every two weeks they have to deliver their 'monthly' hour registration for the work they have done in their product team as well as for the work they have done for the horizontals of Netherware.
Students help think about products of other teams – Students talk to each other about their products while working in the same room. In plenary sessions they discuss each others products. The products are in different stages of development.
Students work under time constraints – Students are bound to several deadlines for deliverables. Working under time constraints can increase the complexity of a task.

3.4 Role of the problem solver

Starting entrepreneur in a small software company – Students are given the possibility to develop a software product and develop a small company around this product. The mother company, Netherware, is considered a breeding ground for starting entrepreneurs. They work on the product in a product team in which they take the position of company manager, product developer, salesman or a combination of these. More than trying to make them take up a role for the time of the course, the objective of the course is to naturally transform the students into young entrepreneurs.
Involvement through autonomy and ownership – The student is autonomous in deciding what the product will be like and how it is developed. Furthermore, the student is and remains the owner of the product.
Perform various roles in their own product team as well as in Netherware – During the course students work on their product ideas in teams and are challenged to develop a small company with this product team. Furthermore, they form part of one of the horizontals of the company. By stimulating students to take up various roles in the fictive company, the course aims to give students a thorough orientation on the activities required for development of a product software company and experience work in such a company. Through this experience the course aims to stimulate entrepreneurship in students. Because students perform different duties, they learn different things.

Therefore, there are no homogeneous course objectives. By taking a position (role) in the company, they learn to fulfil the tasks that belong to that position. Besides, they learn to delegate other tasks to those who fulfil the position in the horizontal to which this task belongs. In performing these tasks they should find out what their talents are.

3.5 Role of the instructor/coach

CEO – The instructor acts as chief executive officer (CEO). Ultimately, he is the one who decides what should be done within Netherware, not within the small companies of students. In a company a manager would want to control to a certain extent what employees are working on. The instructor therefore holds some informal meetings with the product teams at regular intervals. He also receives hour registration and deliverables to control the productivity of the Netherware company and to monitor deadlines.
Instructor – The instructor will also take up the usual instructor role, next to his role as CEO. He draws up the course objectives. He is the content expert and as such, he will give presentations on relevant subjects. During the course, he will assess the students, give them feedback on their documents and give them their grades.
Stimulate, not taking over initiative – The instructor does not want to take away the initiative from the students. He wants to be supportive by giving advice instead of instructions about decisions students have to make about the product and the deliverables. He also intends to give information, help students to contacts outside Netherware and remind students of knowledge they have learned in earlier courses. The instructor does not want to be the one who controls the efforts of the students. Therefore, he commits this duty to the HRM department.
Management by walking around – From his experience, he knows that it is important to monitor his employees and give feedback, therefore he manages by 'walking around'. This also makes him accessible to students for questions. He wants to know his students by name and learn more about them by talking with them during coffee and lunch brakes. For this reason he wants to be present during most of the contact hours of this course, although he might be working on other things.

3.6 Facilities and infrastructure

Work environment with facilities for easy exchange of knowledge and ideas – The work environment should have facilities for easy exchange of knowledge and ideas. Therefore, a classroom near a rest room with coffee machine is wanted. Furthermore, the classroom should have movable tables, desk top computers, and the facility to give plenary presentations. In that way everything can be done in the same room and students can follow each others work.
Document management system for the storage of documents and software related files – This should give everyone easy access to each others documents and software related files. During the course, documents of each team will be posted here. The system will also be used to make information on the course and literature available.

4. Implemented and attained curriculum

4.1 Course participants

We studied the course as it was given in the period between 17 November 2004 and 28 January 2005. In this period 13 students participate from the start of the course. During the second week a new student joins in. These students, all male students of informatics, attend the scheduled contact hours and finish the course (are given a mark). The age of the students varies between 21 and 27. Apart form this group three more students enroll in the course and receive coaching by the instructor. However, since this study focuses on the designed curriculum we did not include these students in our study.
In a questionnaire at the beginning of the course we asked students about their reasons for joining the course (see appendix 1a for the results of this questionnaire). The main reasons they give are the appealing course description and the opportunity to explore new ideas for software products or services. Four students mention a product idea or a product or company under development as a reason for joining the course. Furthermore, two students mention that a friend with a product idea asked them to join in. This makes clear that although some of the students join the course with a specific idea, more than half of the students (7) had not decided what to work on during the course. Apparantly the course appeals to both groups of students.
The students think highly of their own qualities at the beginning of the course. Table 2 shows that students see themselves as good or excellent performers on product development, innovation, entrepreneurship, marketing, project work, project management, knowledge management, the organization of a company and the development of a business plan. Six students say they lack one or two of these qualities.

Personal qualities:	**- -**	**-**	**0**	**+**	**+ +**	**mean**	**Standard deviation**
Product development	0	2	2	5	4	3,85	1,07
Innovation	0	0	4	6	3	3,92	0,76
Entrepreneurship	0	2	4	6	1	3,46	0,88
Marketing	0	0	5	5	3	3,85	0,80
Project work	0	0	3	8	2	3,92	0,64
Project management	0	0	3	8	2	3,92	0,64
Knowledge management	0	1	4	5	3	3,77	0,93
Organization of a company	0	0	3	7	3	4,00	0,71
Development of a business plan	0	2	2	9	0	3,54	0,78

Table 2: Students beliefs about their personal qualities at the start of the IB course (N=13)

Most students expect to learn knowledge and skills that will allow them to develop software products or services as well as knowledge and skills for entrepreneurship that they will need. Furthermore, many students expect to learn how to start their own software company. Three students expect to be introduced into a network of contacts which could be important for their future work. Only three students think getting a clear idea about working in or leading a company is something they can expect from this course. These expectations tend more towards receiving information and gathering knowledge about starting one's own company, than working as an employee in a big company.

In this chapter we will see how these students go about the course. We discuss the course as it was given, as observed by the researchers (implemented curriculum), and as it was perceived by the students (attained curriculum). We use the same five groups of features for the design of authentic cases as were used earlier (see figure 4): work atmosphere (§4.2), type of problem (§4.3), role of the problem solver (§4.4), role of the

instructor/coach (§4.5), and facilities and infrastructure (§4.6). For each of the groups of design features we describe to what extend the implemented curriculum is the same as the intended curriculum. Furthermore, we describe the functioning of the designed curriculum unit.

4.2 Work atmosphere

Organic team forming – In the first sessions observations show that students choose for themselves with whom they are going to work together. Two teams were already working on a product before the start of the course: a team of six and a 'team' of one. The instructor considers the team of six to be too large, because it makes the collaboration more complex and the task is not big enough to provide work for all of them. The team jointly decides how to split up. The other teams seem to consist of groups of students that already know each other. The students seem to choose each other first and then decide on the product by building on the product idea of one of them. It seems that this process has taken place before the presentations of the product ideas. One student that remains alone tries to interest a friend that doesn't take this course to join him, but does not succeed. A student that joins in after a week talks with all of the teams to decide which team he prefers. He says his choice is based on the product idea and the fact that one of the students who work alone needs a partner. Possibly his choice is also based on which person he wants to work with. During the first two sessions there is time to talk, and students do not seem to feel pressed by time or by the instructor to decide with whom to work. Because they are together in one room students can easily hear each other's ideas and explore the possibility of working together.

Own product ideas – Some students enter the course with their own ideas for products. Others team up with them. Students base their final decision for a product on a small market search they perform on the internet to find out whether this product has already been developed. If this is the case they choose a different market, after suggestions by the instructor. Based on the needs of this new market they make changes to the original product idea. The decision on what will be developed is made by the entire team. None of the teams choose one of the product ideas suggested by the instructor. The time available for talking about ideas in the first two sessions helps students to make their choice. Students also use the time between the two sessions to discuss ideas and search the internet for competitors. The instructor does not pressure students to choose a certain product. He also makes clear that they are and remain the owners of the product.

Real product – Two of the product teams enter the course with a product that is already in development. This is no problem in the course. Students develop a company around their product. The teams can work on products in different stages of development. Some students go on with their company after the course. Students are stimulated to contact clients to find out the necessary product requirements and make the product suitable for the market.

Students think this course cuts through the normal pattern of their studies. They like the fact that they are producing something and that they have to combine knowledge that they have learned in different courses. Furthermore, they feel that this is a task that has effects beyond their studies.

Corporate image and sense of togetherness – Students form a group as a whole and within their product teams. Students treat each other in a friendly and non-competitive way. The corporate image is visible in that everybody works according to schedule, everybody is interested in what the other teams are doing and students perform small jobs for each other. The instructor is almost always present during the contact hours.

This gives him the chance to affect the atmosphere. He reacts positively when students help each other out with answers on their questions and with tips. He reacts aversely to harsh feedback from one student to another and reacts disapprovingly to students in a group who are blaming each other for something that didn't go as planned. Furthermore, the instructor acts as a role model by showing a keen interest in all the students and not just their work. He also organizes for students to lunch together on full work days and is present at lunch himself. This turns into a sort of ritual as the students wait for each other to go to lunch even when the instructor is not present and even when they need to wait till long after lunchtime.

The corporate image and a sense of togetherness is further stimulated by the Netherware logo that is designed during the course and is put on the door of the classroom as well as on company T-shirts that the marketing team has to arrange. More than by these aspects, a sense of togetherness seems to develop by the fact that they are working close to each other and by the time students have to see what other teams are doing. Therefore, the work tempo is a motivating factor in this respect. There are ample possibilities to get to know each other. During the first two sessions of the course, time has been planned to talk to each other. During the whole course there is time to talk over coffee since there is a coffee machine close by and the instructor stimulates students to make use of this facility. The instructors attention and his enthusiasm in arranging things for his students seems to make them feel a group as well.

Time pressure – From day one the instructor points out the importance of keeping deadlines in this line of business. Extra deadlines are set by the dates of meetings with potential customers. Because the deadlines for deliverables for the course are not clear to the students they say they can not plan ahead. Once in a while the instructor reminds the students of the next deadline. They switch tasks if necessary according to the task that has the first deadline. Most often they are surprised by the deadline and the work pace enhances. Students keep the deadlines for deliverables, but not the deadlines for tasks of the horizontals. For instance, the annual report of Netherware for which every horizontal has to deliver facts, is finished after the course finishes.

Tempo – The instructor explains to students that during the course they are working in a company and working nine-to-five is considered normal, with peaks in work hours just before deadlines. Students almost all arrive around the starting hour of the meeting and leave around closing time. The instructor does not react when students show up late. Throughout the course students work steadily but not very hard. Students check their email and drink coffee together before devoting themselves to their work. Regularly, they watch over each other's shoulder to see what the other teams are doing and react on questions that were not posed to them. During their work students check their email regularly, some have a chat programme open all the time, some read the news on the internet every now and then, and they answer their mobile phone. Just (hours) before deadlines the work is speeded up. They don't seem to make the intended amount of hours for this course, although this differs depending on students' position in the team, the size of the team and the stage of development of the product.

Students don't think the work tempo is high. However, they think there is too little time to produce their own product. Students think the presentations and breaks slow down their work on the deliverables. From their conversations it becomes clear that they use the time outside the contact hours to work on one thing for longer periods of time, for instance by trying out a possible solution to a problem in the functional architecture or by engaging themselves in the design of their company logo. However, working on the product in the evenings is not always possible when they have commitments for other courses. Another factor that upsets their agenda is the fact that deadlines are not clear to students, although the instructor has told them several times. On Wednesday they

realise for the first time that there is a deadline on Friday. This makes them feel time pressure.

Function as a team – Students help each other with information and methods, even across product teams. They are interested in each others work. Because everybody treats each other kindly, no one is pressed hard to defend his choice, look further for information, perform better and make the most of the product. Within the teams students seem to have a fixed position. This is in line with the instructor's wish to encourage students to leave jobs to their team members. When deadlines for deliverables are getting closer one student keeps on working on the design of the company logo. This is not in line with the instructors intention to make students work on the most important task and fill in for each other if necessary.

Students work for appraisal in the market as well as of for a grade – The work atmosphere is not entirely free of competition. Students know that the Board of Governors is going to decide which business plan they consider the most viable. Students think it is stimulating to see products from other teams because of the tasks they have to fulfil in the horizontal team. They feel challenged to perform, because they want to do better than another team:

> "You choose in which team you want to participate, you work in small groups with some degree of mutual competition. You want to produce the most beautiful or the best product or at least the best presentation [-]. It is nice to be the best of the whole bunch in the end. That is stimulating in itself."

Passing the course and getting credits is also a motivation for the students to perform well. Furthermore, they are challenged to perform better than other product teams because they want to be the ones that are given the best rating by the Board of Governors at the end of the course.

4.3 Sort of problem and activities

Develop a real software product or service – We observed that students develop products for real problems in the market for product software. Almost all student teams contact (potential) customers for the product. The team that didn't do this is corrected by the Board of Governors. During the development of their ideas teams perform a small market research to see whether this product has not already been developed and to find out what the needs of the market are. When they find out that the product has all ready been developed for one market, they choose another market. This affects the product requirements, the product architecture as well as the marketing.

In an interview with students halfway through the course, it appeared that students value the possibilities that they are given in the course to develop an idea into a real product, without taking to much risk.

> "To make your dreams come true. It is nice to be motivated to develop your own products, to think about something that could be of use in the market, with what you could earn money. Just to think about it and learn to develop it step by step."
> "It is a nice way to start a small company without really taking a risk. In a real company you need investors, you make a loss and it is possible that you need to wash cars for a year for the money that you have lost. Here you can just try."
> "I think … considering the expenses … that you are not often in your life in the possibility to spend so much of your spare time to develop something like we are doing now. Now you have two months, two full days a week and the time that you spend on it next to the contact hours to produce your own product. Usually, since you have to pay your rent and such, you have to commit yourself to the big work, than you must deliver a real product."

Furthermore, they value the fact that what they are doing is real or at least can become real. The course scheme cuts through the normal pattern of small assignments.

> "I think it is good to have the possibility to extend it. Maybe into a company. That is a real possibility. Much nicer than thinking out something that you throw away at the end of the trimester, like 'it was alright, but that's it'. This is much more stimulating."
> "You are expanding something, that's nice. Something for a longer period of time. I think this is the best course in which we have to do something like that. Most often you are given smaller tasks and when you have finished those nobody ever looks at them again. You get your grade and that's it. You move on to the next, and when you have finished that you have an exam and once again you move on to the next trimester."

Work on product and business – Students work on documents that describe their product and their business. They devote most of the available time during the course to this. In their product teams students have to consider a lot at the same time before making a decision in the development process, such as technical requierements, market requirements, time constraints and how to make the product extendable. This makes the task complex. There are several presentations by the instructor and guest speakers that give students information on how to handle the different aspects of product and company development. Students all seem to have the required book for this course on the strategy and organization of software businesses. Next to that, students use materials from earlier courses in writing the required documents. Students are very positive about the fact that they can bring into practice what they have learned before and think about requirements and possibilities in the market at the same time.

> "An important extra value of this course is the fact that you learn to see the bigger picture. Normally, you just follow some courses, which is alright. But they are about separate subjects, wheras now you get to see the complete picture and you learn to combine, so you learn how to think things through more. I have made a use case,but this affects my business plan and my product definition. So. you learn to combine things."

Work on horizontals – In the second meeting students get information on the tasks in the horizontals in a presentation by the instructor. During the break after the presentation, students have time to decide which horizontal they like best. In a plenary meeting after the break students are divided over the horizontals. Most of the students can get their first choice. Some are allotted by the drawing of lots. Of all the duties that have to be performed for the horizontals, marketing gets the most attention. Students seem to be less interested in the task for the horizontal than the task for their product team, although one of the students dedicates almost all of his time in this course on designing company logos. Some students have to be reminded to perform duties for their horizontal. The instructor doesn't seem to take the duties of the horizontals seriously either. To give an example: he sends a new student that enters the course after a week through to the HRM department for an interview but adds a "But don't worry, you can join anyway".

Open-ended problem – Several solutions are possible because there is not just one solution that meets the needs of the problem and the market, therefore the problem is open-ended. Students choose a solution to the problem and don't seem to think through other possibilities. Students describe their choices in the business plan.

Students take several aspects of the production process and the development of a company into consideration – During the course students have to produce several documents for which they have to make decisions on the product architecture, price of the product, potential market, etcetera.

Students think about products of other teams – Students think about products of other teams, in different stages of development. They see each other's products during plenary presentations and because they are working close to each other and watch over each other's shoulder regularly. They are asked by the instructor to react to the teams' presentations from the point of view of their position in a horizontal. However, during presentations everybody reacts to every subject. During informal discussions or presentations students are not pressed hard by their peers to defend their choices.

Students work under time constraints – Students are bound to several deadlines for deliverables.
Students work together in teams – Students can choose whether they want to work together or alone, therefore this subject is not mentioned in figure 4 on the intended curriculum. However, we think this is an important feature in the complexity of the task and for this reason we add this subject here. Students that work in a team (all but one) have to deal with the complexity of working together and dividing tasks. Half of the time they do not divide their work very clearly. We observed that several times students started off without consulting others only to find after a while that they had been working on the same thing. Looking back, students thought this to be very instructive.

4.4 Role of the problem solver

Beginning entrepreneur in a small software company – In this course students are addressed as young entrepreneurs of a small product software company. Students take up the actual development of software products for a real market.
Involvement through autonomy and ownership – The students are autonomous in the choice of product, the development of their company and the division of tasks in the team. During the course, students don't have to wait for the instructor's next task or his approval to take a next step. Furthermore, students can decide for themselves where to search for information. Students are also given autonomy in dividing the tasks and making decisions. While the decisions are made mutually, in each product team the tasks are divided according to interest and skill. Furthermore, the student is and remains the owner of the product. The instructor emphasizes this from the first meeting. Some students display ownership by including a paragraph on confidentiality in their business plan. Students value the freedom they are given to develop their own ideas.

> "The stimulus is for the bigger part caused by the freedom you get to develop your own ideas. You receive some tools to work with and you can frame the development process any way you want. For me personally this makes me feel it is something I do, I am behind it, I developed the idea and this is what we are going to develop."

Performing various roles in their own product team as well as in Netherware – The student is a member of a product team that forms a small software company and functions in a division of the Netherware company. The time and presentations planned in the first two sessions help the forming of teams and departments. However, the roles in the horizontals are not fulfilled very seriously.

4.5 Role of the instructor/coach

CEO – The instructor has a lot of experience in the field and therefore can take up his role as CEO naturally. When students come to him with questions he doesn't solve the problem for them but helps by giving them suggestions on how to handle the question. Furthermore, he does not repeat information on concepts they have had before in other courses. He does not control when students are entering or leaving during contact hours.
Instructor – Next to the role as CEO of Netherware, the instructor also performs the formal duties of an instructor. He gives students access to the course, gives information on the course and decides on the course materials. He gives presentations on theories of the development of product software. Although the presentations cut through their work, students appreciate the information they get from thiese presentations. Unmistakably, the role of the CEO changes during these presentations into that of a instructor. He tries to engage students by asking them questions like "Where would you place your own company in this schedule?" This is a question of a instructor who knows the answer and wants his students to learn, rather than an open-ended question of a CEO who wants to consider a strategic question together with his employees. In a company the CEO may

have the most experience in the field and may have the power to take decisions, but he is not necessarily the one who knows the most about all the aspects of product development. The instructor asks students to be quiet during his presentations or to stop reading the newspaper which gives the impression he is using his authority as a instructor to make them listen. Students do not question the meetings although most often they perceive the presentations to be an intrusion during their work on the product. The fact that they listen carefully, seems to be more out of the respect for the instructor, than out of interest in the subject. The information on small starting companies like their own, that grew out to be big selling companies seems to raise their interest. However, at other moments during the presentations they are playing with their mobile phones and finding it hard to keep their attention.
Furthermore, the instructor gives feedback on documents students have handed in and gives students their grades on the end of the course. After the course he presses students to finish the annual report.
Stimulate, not taking over initiative – Both in the course information and in his actions he makes clear that students are and remain the owners of the products and companies. He does not take over the initiative. On questions he believes they have followed courses before he does not answer but advises them to look in their course materials. The instructor supports the students with interesting information he places on the shared workspace or hands out during contact hours. Furthermore, the instructor helps students with contacts he has in trade and industry as well as at the university. The instructor is not the only source of information, but if students do have a question for the instructor he is also willing to react outside contact hours. Students appreciate highly the tangible help they get form the instructor.

> "In the course sometimes you are taken by the hand, or rather, you are shown what to do to get, for example, a good perception on your product. At the Chamber of Commerce they only give you some booklets to read on how a company functions and that's it. Of course you can ask for counselling to get advise but then you start off with high expenses."

Management by walking around – The instructor is very accessible to the students. He pays for a round of coffee. He asks students to call him by his first name and knows their first names as well. Students can call and expect replies to emails outside the course hours. He knows their personal interests and asks students about their activities outside the course.

4.6 Facilities and infrastructure

Work environment with facilities for easy exchange of knowledge and ideas – The Netherware company has one classroom at its disposal during the scheduled contact hours which is one and a half day. Most of the time the classroom is closed when the students arrive before time. The students of 'technical support' fetch the key and bring in the beamer. Outside the contact hours students work at home. This classroom has moving tables, tables with desk top computers and a whiteboard and is therefore suitable for deliberation, meetings, presentations and work on the computer.

Figure 5: Classroom where the course takes place.

There are not enough computers for all the students. Some of them bring their own laptops and use these. Others work on one computer as a couple and discuss work. During the course technical support arranges for two more computers to be installed in the room. The students can use these computers for their work on the deliverables. However, there is no web-server computer available for web-products. Therefore, a computer of one of the students at home is used for this purpose.

Document management system for the storage of documents and software related files – The shared workspace system BSCW is used to store documents from the product teams and horizontals as well as software related files. The instructor also uses BSCW to provide students with recent articles and PowerPoint slides from presentations.

4.7 Learning results

Students do not seem to develop an in-depth understanding of concepts from computer science during the course. Students choose a solution to the problem and don't seem to think through other possibilities in an attempt to find the best solution. Furthermore, students do not seem to strive for an in-depth understanding of choices others have made. Therefore, during presentations and discussions students are not pressed hard to defend their choices. The discussions during the presentations should bring about a deeper understanding of the problem but since they are not pressed hard by their peers the discussions do not function in this way. Although the instructor urges them to put more effort in it, they are not pressed to go further. A need-to-know seems to be lacking. This need-to-know seems to grow during the reactions of the Board of Governors on the business plans and the product presentations on the last day of the course. The Board of Governors does not make it easy for the teams. During the endmeeting with the Board of Governors understanding is reached as to what it takes to develop product software or services in the field. The comments of the Board of Governors on the quality of their product, further clarifies the importance of each part of the business plan. Possibly students will strive for in-depth understanding if they know more about the assessment by the Board at an earlier stage.

5. Results on perceived and attained curriculum

5.1 Is the design functioning?

The Informatics Business course aims at teaching students the methodology of the development and implementation of product software and making clear the internal company processes of a software company. Apart from academical competencies, the course aims to teach students how to start a company and to develop entrepreneurship. The course focuses on the crucial starting phase of product development.
In chapter 3 we described the designed curriculum of the course (intended curriculum) and the intentions of the instructor with the design features of the course. In chapter 4 we described the implemented curriculum as the researchers observed it and the attained curriculum as it was perceived by the students. From our observations and the information from interviews and conversations with both instructor and students we can draw some conclusions on the functioning of the designed curriculum unit, the second question of this project. It becomes clear that many design features implemented by the instructor, had positive effect on students' learning. Sometimes the design features had an unexpected detrimental effect on students' learning. Some design features were not implemented as designed but nonetheless affected students' learning positively.
We group the most striking conclusions under the same headings used in earlier sections: work atmosphere, sort of problems and activities, role of the problem solver, role of the instructor/coach, facilities and infrastructure.

Work atmosphere
To set the work atmosphere the first contact between the instructor and his students and the first mutual meetings are extremely important. During these meetings the way of working together, the 'social contract', is formed. The instructor has an important role as he is the one who shows what the norm should be by setting the example and by emphasising certain aspects of the work ethos. Several features of the work atmosphere in a developing small software company were recreated in this course. In big product software companies employees do not decide for themselves what team they want to join nor do they decide which product they work on. Smaller companies come into being because of good realtions between the team members. They start off when they have a stimulating idea for a product and most often with only one to three developers (Carmel, 1996). The IB course is intended for this kind of company start ups, the small companies and the organic team forming is therefore an important authentic element in the course. By creating an atmosphere without pressure and by giving students the time and opportunity to form their teams, the instructor supports this. Furthermore, the instructor is successful in creating a team and a corporate image. Through these authentic elements students experience how a small software company is formed.
Although the omnipresent CEO is not an authentic element, this gives the instructor the opportunity to maintain a good work climate, which is important in team forming. Furthermore, his presence makes it possible for students to pose questions and thus creates a good learning climate.
The easy-going atmosphere gives the students little structure. This seems to be a good breeding ground for creativity which is needed in this line of business. It also stimulates students' autonomy which positively affects their taking their own decisions. However, productivity is not stimulated by this atmosphere. Students experience hardly any pressure and are not challenged to do their utmost.
The fact that students are working on a real product with market potential creates a clear context for the task and a clear reason for their activities. Students engage in a natural scenario. This forms a meaningful environment in which they perform their task naturally. When students work on real problems they naturally get engaged in meaningful activities. There are also students who do not intend to go on with their company after the course. They seem to put less effort in their work on the deliverables.
In practice delivery dates will determine the work pace. Several deadlines are planned to bring a sense of a real work rhythm in the course. During the course the tempo is only

altered close before deadlines. When the instructor sometimes urges students to work harder by pointing out the deadlines, students do not seem to feel pressed. Nonetheless, students seem to get a sense of the authenticity of the work processes through these deadlines, because these deadlines structure their work. A sudden deadline is not created, therefore this possibility of making students cope with a sudden request, creating time pressure and a need to divide the work, is not utilized. Nonetheless, a sense of sudden deadlines is created, though unintentionally, because students are not aware of the deadlines for deliverables. Students feel time pressure and have to devide tasks because of this. However, since they perceive this as a flaw in the information on the course they don't see it as an example of actual work.
The work tempo in the course gave students the idea of actual work tempo, but was in fact much slower. According to the alumni in real life, the time pressure is much higher. Hence, the work tempo was effective in realizing the work atmosphere, but did not give so much pressure that it was ineffective for the problem solving process. This reduction of pressure is functional in that it reduces the complexity of the students' task. With more pressure cognitive overload might appear. Aligning the time pressure to the student's level is a way to align the complexity of the task. The students' problem solving tempo is not the same as that of experts. Cognitive overload should be prevented and the problem solving process should be aligned with students skills in problem solving.
Students go about their tasks in a quite unstructured way. They do not discuss who is going to do what. The instructor does not interfere with the work processes within teams. As becomes clear in the questionnaires, students have learned from this mistake. They say that one of the important things they have learned from the course is the necessity to plan well. Within the teams students give feedback on each other's work, but they do not talk their work through intensively.
The room in which everybody is working side by side stimulates the exchange of information and gives students the possibility to see more problems than the ones they are working on themselves. Students regularly help each other, even across teams.
Students want to present the best product or have the best presentation for the Board of Governors and this stimulates them to perform. Seeing the products of the other teams stimulates this positive competition as well.

Sort of problems and activities
Real product – In general, students find the production of a real product much more inspiring than working on a task for a grade. They put most effort in the task they like best or think is most important, especially after their studies. The IB course is designed with the intention to give students experience in the development of and work in a small software company. Several features and activities students have to perform are designed to resemble the authentic practice of the creation of a small software company. Students work on solutions for real problems in the market. From research it is known that for students to be motivated to start with a problem, they have to perceive it as a problem they are able to solve. A problem that is too simple or too difficult will not be challenging (Ten Berge, 2004). In the IB course students choose their own product and product platform. They base their choices on their prior knowledge and can thus align the task to their own level.
During the course, students work on the real problem by developing a business plan in which they have to consider the effect of choices in their use cases on their product definition and business plan. Students have to make contact with real customers and act as real product developers. By performing a market research the product is put in the real market and becomes more than a course task.
Because of the tasks they have to perform, students are placed in a relevant and meaningful context. This seems to stimulate entrepreneurship. For instance, the teams that take the contact with the customers seriously, grow in their position as entrepreneurs. The problem environment seems to be meaningful to students. Students fit easily in their function of entrepreneurs in a small software company. However, students don't seem to take their position in the horizontals very seriously. Students must be stimulated into taking up these tasks. The instructor too doesn't seem to take

the tasks of the horizontals very seriously. By saying a student can join in the course no matter what the HRM department says he doesn't take the role of the HRM department seriously. The horizontals seem not to be in line with the character of a small product software company and therefore the tasks for the horizontals seem not to derive naturally from the problem environment. As two of the alumni mention in the questionnaire, the course seems to have a double focus by on the one hand trying to make obvious the processes of a developing small software company of one to three persons and on the other hand giving students tasks in departments that only a big company would have. The two tasks seem not to fit because they are part of different practices. This is shown in figure 6 presenting in a matrix the objectives and the problem environments that in this course seem to be intertwined. In this figure we see that designing a problem environment from each objective leads to two environments with slightly different design features.

Objective **Design elements of the problem environment**	**Stimulate entrepreneurship**	**Experience and learn company processes**
Type and size of the unit	• Small companies • Netherware as holding or as subletter of offices including advisory centre for starting companies	• R&D unit or product development team of the big company Netherware
Role of the team	• Make decisions independently • Keep the books of own company	• Dependent on company decisions / directing by the company management • Report to company management
Contact with other teams	According to own needs, e.g.: • Through meetings organized by e.g. Chamber of Commerce, advisor in office building or a mutual professionalizing comittee • Informally when there is a need for information	Directed by top management: • Through mutual duty to report to management
Possible role of the instructor	• Advisor at Chamber of Commerce • Advisor in advisory centre in office building for starting companies	• CEO

Figure 6: Two objectives leading to different problem environments.

Complexity – A problem that can be solved in more than one way, is open-ended. For open-ended problems several perspectives have to be taken in consideration. The software problems students work on are clearly open-ended. Students are confronted with a complex task as they have to make decisions taking into account many aspects of the development process of both the product and their company while working on the deliverables. On order to do this, students have to actively engage in the problem solving task and integrate knowledge from prior courses to solve the problem.
Working under time constraints can increase the complexity of a task. However, the students do not speed up their work until a few hours before deadlines. The students

consider time constraints to be helpful in making decisions and finishing documents. The fact that deadlines are not very clear to them makes it hard for them to plan their work.
Furthermore, the task is complex because students are confronted with different stages of development and different questions about products and companies from other teams. This gives them the possibility to practice their problem solving skills.

Structure – Problems and activities that students engage in, can be reduced in complexity by giving a structure when the problem consists of many sub problems. In this course this is done by having students focus on the problem from one perspective at the time. They can focus on separate subjects of the business plan which makes the task less complex. The documents students have to make for the business plan structure the development process and they feel supported by the presentations by the instructor on each subject.
When the complexity is caused by having to deal with several tasks, students in this course are also helped by giving them structure. Separate deadlines for each task help students make choices on what is the most important task to work on at a certain moment in time.

Role of the problem solver
The tasks students have to take up, both within their product team and in the Netherware company, give them the possibility to practise with various roles. In a small company tasks are divided on the basis of interest and who does what best. The emphasis in this course lies on giving students insight in the processes around product development, not on the development of skill in the development process itself. Therefore, students can also choose their tasks on the bais of interest. Because of this, it is possible for a student to use the time of the course for designing the Netherware logo as well as the logo of the company he is part of, instead of working on the technical aspects of the product development. This illustrates that students are not all learning the same thing.
During the course students make decisions on the development of the product as a team. On the final day of the course, the members of the Board of Governors advise teams to proceed by choosing a director who takes the final decision instead of taking decisions with the whole team. Students learn to value each task and leave tasks to whoever will do it best.
There is not one 'best way' to develop a product. What solutions students choose during the development process is entirely up to them. By making clear that they are autonomous in their choices and maintain ownership over their products and companies, the instructor stimulates involvement by the students. By doing this, he makes the students 'problem owners'.
In this course the day of presentations for the Board of Governors was very important. In general, the way students are assessed and on what criteria is directive in what students do during a course. In this course the grades are not given by the Board of Governors. Nonetheless, students perceive their presentations for the Board of Governors as the most important assessment because this is where they hear if their product is viable on the market. Considering the problem task 'becoming an entrepreneur' this session is of the utmost importance. The sound advice on the viability of their product by the Board of Governors at the end of the course, the fictive capital that is divided by the Board among the most viable products and their comments on the business plans shows students the possibilities of their product. This is even more so because the capital investors from the Board show real interest in investing in some of the products. This makes students see that their product could grow out to be their source of income, that they are in fact already entrepreneurs. The reaction of the Board of Governors changes what they thought to be a mere experiment, maybe grown out of a personal interest, into a possibility to make a business. This gives meaning to the process they have been engaged in during the course.

Role of the instructor/coach

Because of his practical experience the instructor can fulfil his role as CEO of Netherware naturally. His interested and enthousiastic attitude as well as his 'management by walking around' stimulates students and makes it easy for them to ask consult him.

Using the full complexity of a role makes the role more credible. The instructor could take up his role naturally because of his experience in the field. This gave him the opportunity to add many aspects to his role: knowledge of the subject, skills, words used in the field, ways of working together, the kind of decisions he takes or doesn't take, his way of stimulating his 'co-workers'. The use of specialized words by the instructor is an important authentic aspect that helps students in learning content knowledge in this line of business. The instructor also tries to stimulate this by giving presentations and commissioning students to make documents for their business plan and by inviting an experienced Board of Governors to assess the business plans and products.

The instructor knows both the field and the study programme well. He can form a meaningful context for the problem task, that students are fulfilling which makes transfer to the authentic problem environment more feasible. The instructor has many contacts with experts in the field. Students can make use of his network for information and facilities. As a CEO he gives advice instead of instruction. He has a lot of theoretical knowledge on the subject and knows the study programme well enough to be able to redirect students' information from earlier courses: students have to activate their prior knowledge and reactivate the knowledge structure they have build in earlier courses. Students accept this easily and keep the initiative. His role fulfilment makes him credible to students and a good discussion partner during the elaboration of their product idea and company.

Students who can not attend certain contact hours due to other appointments have to notify the HRM department and make agreements to make up for lost time with their team. For that reason the instructor is not the only one who controls students' work hours. Students are made responsible for their own commitment and act accordingly.

Under the influence of deadlines the quality of the learning process may come under pressure. When students devote their time to the development of the product, they are only working on a small aspect of what it takes to develop a product software company. To make them learn about the other aspects that are important for successful company development, the instructor gives some presentations on certain subjects, like development methods and architecture and design. Students consider the information given at the presentations to be necessary at that time, as becomes clear in the end questionnaire. They do experience a need-to-know. However, the presentations cut through the work of the students and they perceive that as delay. Furthermore, during these presentations the work atmosphere of a software company is lost and the students are back in school. This can have a detrimental effect on the students' autonomy.

The placing of the tables in the formation of a classroom adds to the atmosphere of teaching a class instead of presenting on a meeting of the company. In a company one would expect a circular or U-shaped formation for company meetings. During most of the course however, the tables remain in a classroom formation although the instructor urges his students to make the room their own and to use the facilities any way they want.

The instructor role also becomes apparent because he is the one who most of the time decides the schedule for the contact hours. Furthermore, when the students are working on product development and the instructor asks them a question which has to do with their position in a horizontal, they immediately turn to this question and drop the more difficult problem of product development they were working on.

From the above we conclude that the roles of the CEO and the instructor seem to conflict each other every now and then. Students accept both roles. But the instructor role seems to have a detrimental effect on the authenticity and on students engagement. At these moments students' actions do not derive from a meaningful context.

Facilities and infrastructure
To give students the opportunity to work on the problem as it would be done in the field, it seemed to be important for students to have access to facilities that have the functional fidelity for that kind of problem solving. This means that certain elements of the facilities and infrastructure should have the same effect on the behaviour of the problem solver as in the authentic environment. The computer facilities students work with are comparable to the computers they would work with in the field, although a server computer was missing in the work room. However, this reflects work in practice where in the beginning you have to work with the facilities that are available.
The availability of a coffee machine close by, and one work room for all students with all the necessary facilities, has a positive effect on team forming and exchange of ideas. The shared workspace functions in the exchange of documents and gives every student easy access to the teams documents and other information delivered in the course. The facilities and infrastructure seem to be conditional for several learning activities.

5.2 Recommendations for improvement of the course design

Problem 1: Students do not feel (strong enough) the need to expand their knowledge
To develop a good product, students need to know facts, terms, notions, definitions, relations and theories. We had expected that by working on a product the need for certain knowledge and working methods arises, as well as for the use of them. Because of this, students will look for fundamental knowledge that they need for the development of their product and company. From our observations it becomes clear that the motivation of the students to search for knowledge is limited. They do not seem to strive for the best; enough is enough. A possible explanation for this is that they do not feel the need for thoroughness. Not before the day of the presentations to the Board of Governors they notice that they should have been more accurate in their choices and in the support for these choices. Therefore, it is advisable to make sure students feel the need to underpin their choices theoretically earlier in the course period. Stimulate students to find out what is necesarry to present a good business plan to the Board of Governors. Gradually build up the pressure. It is important to keep an inspiring, stimulating and challenging them from the beginning. Later on the pressure should rise to reach more depth in the students work. For this it must be clear on what items the focus will be of the Board of Governors. This can be done for example by providing a video with parts of the presentations to the Board of Governors from the academic year 2004-2005. The video must not be dictating, but must be presented as one of the ways to inform the students about the presentations of the BoG. Another possibility is to invite (one of) the Board members earlier in the course to reflect on the product ideas in progress.

> *Recommendation: Organize for students to get an insight in the thoroughness of the comments by the Board of Governors earlier in the course.*

Problem 2: Although the instructor wants students to experience the environment and atmosphere of a company, students' feeling of taking part in an academic course prevailes
To stimulate the atmosphere of entrepreneurship we must look critically at some elements in the course that have an academic atmosphere. For instance, a company room could be created that is available to the students during the full course period. Students can work longer without interruption, can leave their items in the room and work whenever they want. Somebody should have the key to this room or it should be possible to get the key from the attendant.

> *Reccomendation: Stimulate the company atmosphere by reducing academic elements: create a company room.*

Another way to intensify the character of a company is by reducing the academic atmosphere during presentations. Reflect on how these presentations take place in a company and create this setting in the class room. For example, put the tables in a U-shape as they would be during meetings. Call a meeting together when students ask for it, on the subject students need to know more about at that time. Discuss how the subject presented can better the product of each of the product teams rather than taking one product team as an example to explain the meaning of the subject.

> *Reccomendation: Stimulate the company atmosphere by reducing academic elements: give presentations in a business atmosphere.*

A third possibility to intensify the atmosphere of a company would be to make sure that all activities that students undertake during the course period are concentrated on entrepreneurship. Students should preferably not follow other courses or only those courses that are not given in a academic setting, like internships or a research assignment. This objective can also be reached by giving the course in full time. When the course is offered in full time, the time that comes available could be used to work up to higher standards on acquiring customers, networking and marketing.

> *Reccomendation: Stimulate the company atmosphere by reducing academic elements: make sure that other courses that students follow at the same time do not intervene in the company atmosphere by being very academic.*

When one of the three elements of this second recommendation can not be fulfilled the other two become more important.

Problem 3: Students do not understand the usefulness of tasks for the horizontals
Prevent for two practices getting mixed up: a big company with departments (horizontals) that have to report to the CEO next to small companies in which several functions and tasks have to be fulfilled by one person. This causes for incompatible realities that ask for different kinds of guiding.

> *Recommendation 3: Design one clear practice from which the tasks for students derive naturally.*

Problem 4: Only a couple of students have experiences that make them reflect on their personal qualities as an entrepreneur
What students experience in this course is different for each student. This is not necessarily wrong. However, the objective is to stimulate entrepreneurship in all students. In the current designed curriculum unit some students have an experience that make them see their personal qualities in entrepreneurship which may or may not stimulate them. It could be organized for all students to reflect on their qualities on entrepreneurship.

> *Recommendation 4: Create a possibility for each student to reflect on their personal qualities on entrepreneurship.*

5.3 Relevance of the conclusions on education in entrepreneurship in other domains

Which of the experiences from this course are useful in other courses that try to stimulate entrepreneurship in students in higher education? Of course, we need to be careful to draw general conclusions from the study of one course. However, we can formulate the design features that add to the success of stimulating entrepreneurship in

this course. Furthermore, we add some recommendations that derive from literature (as presented in chapter 2).

1. The creation of a meaningful context for company and product development from which the activities of the students derive naturally and students can experience what being an entrepreneur means.

In our study we found five groups of design features to be important to reach a meaningful problem solving environment in the course. On each of the following five groups of design features a certain level of authenticity is required to engage students in meaningful actions: work atmosphere, sort of problems and activities, role of the problem solver (student), role of the instructor / coach and facilities and infrastructure. It all starts with a real problem which is open-ended to stimulate students to look for content knowledge to solve it. With a real problem the link with authentic practice is immediately clear. The task of producing a real product which could be or will be put in the market has a different effect on students' work than a simulation in which a product is created in the form of a game. A simulation tends to create side-effects, like sabotaging other teams to prevent them from winning.

To create this meaningful context there are some crucial moments in the course. To establish a certain atmosphere and way of working together the contact between the instructor and the students is important from before the start of the course. It becomes clear that students have to choose for a product themselves and that the product remains their personal property. The instructor clarifies that students keep the initiative and that much is possible. The first two meetings intensify the work atmosphere. Furthermore, these two meetings are important in a practicial sense, to form teams and clarify the tasks. The final meeting, in wich the Board of Governors assesses the business plans and products of the students is also crucial. Students are informed about the viability of their product and company. They are treated seriously by the Board of Governors. It becomes clear to them that they are already entrepreneurs and they grow in this function when the members of the Board are really interested in investing in their products.

2. The possibility to try to create a product or service without taking risks.

Students should work on a real product, but should be able to make mistakes without it leading to financial disasters. This prevents them from being too cautious and stimulates their creativity. They can go unbeaten tracks. The fact that they are working for a potential customer prevents them from pulling this to far and working on unrealistic ventures.

3. Give students the possibility to develop their own product or solution to an open-ended problem.

Turning an idea into an actual product or service makes students see what possibilities they have. What may seem to be a simple idea, could grow out to be a source of income. Giving students the possibility to work on their own product and go unbeaten tracks requires some flexibility of educational organization since the instructors previously do not know what the student will develop.

4. Give students insight in their personal qualities on entrepreneurship and reward those qualities.

Creating an attitude for entrepreneurship is not done in one course period. It takes a longer period of time and should therefore be stimulated in more than one course. Furthermore, it should be stimulated by giving opportunities to students to show personal qualities that are important in entrepreneurship and by valuing and rewarding that sort of behaviour: take the initiative, go of the beaten tracks, be creative. This may involve for instance giving more possibilities to students to do assignments on a subject they choose for themselves.

Knowing your personal qualities and their importance for entrepreneurship makes you see the possibilities you have in becoming an entrepreneur. Being valued for the qualities

that are important in entrepreneurship makes students grow in their role as an entrepreneur.

5. Instructor with practical experience as well as content knowledge.

The practical experience of the instructor is an important factor in this course. Because the instructor has many contacts in trade and industry he can help students to a network. Because he stimulates students to contact sponsors, the work practice is brought into the course. This elevates the degree of authenticity. Because the instructor refers to his network regularly, it is made clear to the students that building up a network is important. The instructors experience in presiding over a company department and leading personel makes him able to create a work atmosphere that resembles practice. Because of his knowledge of the field, he is a role model for the students. His way of thinking over possibilities and taking decisions is an example to students. In their use of words and the considerations students make regarding the alignment to the customer it is clear that students take over this example gradually.

6. Stimulating instructor with an open attitude and enthusiasm for entrepreneurship who is not taking over students' initiative.

Some other things that are stimulating for students have more to do with the instructor's personality. He does not tell them what to do but stimulates them by leaving the initiative in their hands and helps them by referring to the necessary information. This creates an atmosphere in which creativity, which is another important factor in entrepreneurship, can flourish.

The instructor is approachable. Although he is busy with his own activities during contact hours, he obviously likes it when students come to him with questions and most often students get an answer right away. Once in a while he challenges students by posing questions. Outside the contact hours students can also contact him easily and expect an answer to their questions without him taking over the initiative. He keeps on treating them as independent, active adults, thus leaving them autonomous. His enthousiasm for the course and the products from students is an extra stimulus for the students.

7. Bring the real practice into the course.

An important moment for this is the assessment phase. When people from the field evaluate students' work and this is clear to students beforehand, students are very motivated. They value the comments of respected practioners highly.

If students are working on a real product, they should be stimulated to contact real customers. This puts students in the role of entrepreneurs. This experience gives students inside in their personal qualities as an entrepreneur.

Another way of bringing real practice into the course is by arranging for young entrepreneurs to give presentations. Most likely, students compare themselves intuitively with these young entrepreneurs. These persons make clear that starting a company is feasible for students. They dared to take the risk with the knowledge they had at that time. These persons make clear that this is also possible for the students in the IB course if they are willing to take the risk, which is an important element of entrepreneurship. The enthousiasm of the entrepreneurs inspires the students and gets them excited.

8. Working on documents for the business plan one at a time.

The documents for the business plan students have to hand in at certain times structure their work. By working on the documents students learn which things are important to consider in the development of a company around a product. These documents have to be completed under time pressure. Because of this students are pressured to make choices and not to spend to much time on weighing the pros and cons.

Appendix 1: Questionnaires

Appendix 1a: Results on the student questionnaire at the beginning of the course (N=13)

At the end of the first meeting of the IB course students were asked to fill in a questionnaire. The questionnaire is in English. In the following tables the results of these questions are presented.

Question 2: Age

Age	**21**	**22**	**23**	**24**	**25**	**26**	**27**
Number of students	2	3	3	2	2	0	1

Question 3: Sexe

Male	**Female**
13	0

Question 4: Mark how far each of the following statements reflect your personal qualities

	- -	**-**	**0**	**+**	**+ +**	**mean**	**Standard deviation**
Product development	0	2	2	5	4	3,85	1,07
Innovation	0	0	4	6	3	3,92	0,76
Entrepreneurship	0	2	4	6	1	3,46	0,88
Marketing	0	0	5	5	3	3,85	0,81
Project work	0	0	3	8	2	3,92	0,64
Project management	0	0	3	8	2	3,92	0,64
Knowledge management	0	1	4	5	3	3,77	0,93
Organization of a company	0	0	3	7	3	4,00	0,71
Development of a business plan	0	2	2	9	0	3,54	0,78

Question 5: The main reason for joining this course Informatics Businee is/are (more applicable answers allowed)

	Times ticked	**Number of students**
The description of this course appealed to me	6	6
I would like to explore new ideas for software products or services	5	5
I have an interesting idea for a software product or service which could be successful	3	4
I have already a software product which I would like to develop further	1	
I already own a (small) company which I would like to develop further	1	
A friend with (an idea for) a software product he/she wants to develop asked me to join in	2	2
There was no better alternative course which I could join	1	1

Question 6: The expectations I have about this course Informatics Business which I value most are (more applicable answers allowed)

	Times ticked
Gathering the knowledge and skills that will allow me to develop software products or services	10
Gathering the knowledge and skills concerning entrepreneurship that I will need	9
Getting a clear idea about working in or leading a company	3
Starting my own software enterprise	8
Introduction into a network of contacts which could be important for my future work	3
Do not known what to expect	0
Other	0

Appendix 1b: Results on the students questionnaire at the end of the course (N=12)

Shortly after the finish of the IB course students were send a questionnaire by email. This questionnaire is in Dutch. The questionnaire contains the following items:

1. Information before the start of the course: did students know enough about what was expected of them as a participant in Netherware?
2. Valuation of the course: their opinion on the usefulness of the contact time and the content of the course, the strongest aspects of the course and their suggestions for improval.
3. Valuation of the design of the course: usefulness of the work in horizontal teams, does the information about the work of other horizontal teams suffice and their opinion on the functionality and timing of some course parts.
4. Valuation of the instructor: quality of the coaching.
5. Valuation of the facilities: adequacy of the offered facilities
6. Learning effect: did the course align with their previous knowledge, did they learn a lot, what is the most important thing they have learned about working in a company and about their own qualities and skills.
7. Effect on entrepreneurship: has their enthusiasm for entrepreneurship increased, did they learn what it takes to start your own ICT company, are they able to start their own ICT company, which qualities have increased.
8. Authenticity: did students think the work situation in the course gave a realistic impression of a software production company.

Of all 14 students that finished the course 12 filled in the end questionnaire.

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1. Informatie voorafgaand aan de cursus

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 2. Ik wist voldoende wat er van mij als deelnemer in Netherware werd verwacht.	1	2	1	5	3	3,58	1,31

2. Waardering voor de cursus

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 3. Ik vond de contacttijd nuttig besteed.	0	1	2	4	5	4,08	1,00
Vraag 4. De inhoud van deze cursus spreekt mij aan.	0	0	0	3	9	4,75	0,45

Vraag 19. Wat vond je het sterkste onderdeel/aspect van deze cursus?

- De geboden vrijheid die het mogelijk maakte en tevens stimuleerde om er echt voor te gaan.
- Gastcolleges door bedrijven, het op papier zetten van je ideeën en daar nog eens over nadenken. Het feedback krijgen van anderen (docent, student, raad van commissarissen).
- De verschillende architecturen die wij eigen zijn gemaakt.
- Dat je dankzij de enthousiaste begeleiding zin hebt gekregen om te ondernemen.

- De uitwerking naar een eindpresentatie. Hierbij kreeg je soms echt weer die zenuwen van vroeger bij je eerste presentatie. Tevens de presentatie van echte jonge ondernemers.
- Enthousiast worden gemaakt voor ondernemen en de praktijk (gastcolleges etc) die er bij gehaald wordt.
- Dat werd getoond dat er vrij weinig voor nodig is om ideeën om te zetten in realiteit. Dat er, om dit tot een succes te maken, erg veel nog bij komt kijken is logisch, maar daar zijn dan ook verschillende *tools* voor aangereikt.
- (1) De ontspannen sfeer waarbinnen gewerkt werd. (2) De presentaties van mensen uit bedrijfsleven: geen saaie theoretische presentaties, maar praktische en tastbare verhalen.
- Het daadwerkelijk in de praktijk brengen van de geleerde kennis en hier een eigen "echt" product mee te maken.
- De totaliteit, zowel theorie als praktijk voorbeelden, een product mogen ontwikkelen door er eerst over na te denken (theorie) en het later uit te voeren (praktijk).
- Heel praktijkgericht en maakt studenten enthousiast voor ondernemen.
- Mogelijkheid om eigen product op te zetten.

Vraag 20. Hoe zou de cursusopzet volgens jou verbeterd kunnen worden?

- Overzichtelijke planning van wat wanneer komt. welke deadlines & wanneer.
- Wat meer tijd zou fijn zijn mits daar ook meer studiepunten tegen over staan, dus of het vak in één periode voor dubbele punten zodat je geen ander vak hoeft te volgen of het vak in twee periodes. Misschien zou het nuttig zijn om bepaalde documenten al in een eerder stadium door externe partijen te laten evalueren.
- Meer tijd aan de daadwerkelijke ontwikkeling van het product. Iets meer gerelativeerd.
- Er kan worden gezorgd voor een aanpak die je dwingt om meer thuis te werken. Nu was het zo dat je leefde van contactdag naar contactdag omdat je afspraken moest maken met je collega's. Daarnaast moet er van te voren iets meer duidelijkheid komen over de inhoud van het vak, als je van te voren een idee hebt kan je sneller beginnen met het ontwikkelen van je product.
- De juiste gastsprekers eerder laten komen en op basis daarvan een onderdeel in het business plan laten uitwerken. Dit scheelt tijd in visie ontwikkeling en herschapen van het idee. Geeft meer inzicht in marketen, financiën en het schrijven van een degelijk business plan. IPV een flut dingetje waar we nu mee afkwamen en dat volledig door het “slijk” werd gehaald door verschillende raadsleden op 't einde.
- Iets eerder eigen presentaties geven en studenten meer de tijd geven iets neer te zetten.
- Door de individuele bedrijfjes meer te pushen op tijd te beginnen met programmeren en niet te blijven hangen in de vrij abstracte businessplannen en andere documenten. Werk bv met de 13 stappen in het stappen plan voor het maken van een product (beta, alfa releases ed) Maak hier deliverables voor. Nu hebben we eigenlijk al het programmeer werk in de laatste twee weken gedaan.
- Het vak meer promoten onder informatici, zodat je productlijnen kan opstarten die bestaan uit zowel informatiekunde als informatica studenten. Ik denk dat de producten een hogere kwaliteit krijgen...
- Door dit vak in 1 periode een dubbele hoeveelheid tijd toe te kennen, zodat je meer met je eigen product aan de gang kunt. De presentaties over een business plan had eerder gemogen.
- Duidelijkere tijdsindeling voor creatie proces. Het geheel voelde hierdoor wel een beetje schools aan.
- Dit moet volgend jaar een fulltime vak worden. 20 uur per week is niet genoeg voor de (nodige) colleges en ontwikkeling van eigen product. Zeker niet als daar ook nog de horizontals bijkomen.
- Meer tijd geven voor de ontwikkeling van het product. Elke week moest er weer een rapport worden ingeleverd waardoor we eigenlijk niet aan de ontwikkeling zijn toe

gekomen. Deelnemers op een of andere manier nog eerder laten weten dat ze een eigen product moeten ontwikkelen.

3. Waardering voor het ontwerp van de cursus

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 5. Ik vind het werken in horizontale teams nuttig.	1	2	7	1	1	2,92	1,00
Vraag 6. Ik had tijdens de cursus voldoende zicht op de werkzaamheden van de andere horizontale teams.	3	4	2	3	0	2,42	1,17

Vraag 17a. Geef van elk van onderstaande cursusonderdelen aan of je deze functioneel vond.	**Ja**	**Nee**	**Missing value**	**Gemid-delde**	**Standaard deviatie**
Presentaties door Microsoft, Eitri, Exact, SPF	12	0	0	2,00	0,00
Presentaties door docenten	10	1	1	1,91	0,30
Presentaties horizontale teams over het boek van Cusumano	9	2	1	1,82	0,41
Presentaties productteams	10	1	1	1,91	0,30
Presentatie voor Raad van Commisarissen	11	0	1	2,00	0,00

Vraag 17b. Geef van elk van onderstaande cursusonderdelen aan of je deze gepland vond op het juiste moment in de cursus.	**Te vroeg**	**Op het juiste moment**	**Te laat**	**Missing value**	**Gemid-delde**	**Standaard deviatie**
Presentations by Microsoft, Eitri, Exact, SPF	0	8	3	1	2,27	0,47
Presentations by instructors	0	10	0	2	2,00	0,00
Presentations by horizontal teams about the course book	0	5	6	1	2,55	0,52
Presentations by product teams	0	11	0	1	2,00	0,00
Presentation to the Board of Governors	0	11	0	1	2,00	0,00

Vraag 17c. Toelichting.

- De presentaties van MS, EXACt, etc. zijn niet op de zelfde datum geweest. het is onzin om hier iets zinnigs over te zeggen. MS kwam namelijk veel te laat. Exact kwam op tijd etc.
- Soms kwamen de presentaties, met name door de docent, op een verkeerd moment, er bleef weinig tijd over om met je collega's te werken aan je product tijdens de contacturen
- Vond een aantal presentaties te laat gehouden.
- Alleen van de laatste kan ik zeggen dat die op tijd was. Het was op een logisch moment; aan het einde van de periode. Van de overige dingen kan ik geen algemeen

antwoord geven. Sommigen wel, anderen misschien op een ander moment (bv. marketing veel eerder omdat dat veel belangrijker is dan HR)
- Ik denk dat het leuk is dat onderdelen uit de "analyse" fase eerder in de cursus worden behandeld. Bijvoorbeeld de product architecture kwam pas na enkele weken aan de orde. Door deze activiteiten meer in de eerdere weken te stoppen, komt de nadruk iets meer op het ontwikkelen van het product zelf te liggen. En daar heb je best wat tijd voor nodig...
- Veel presentaties bevatten elementen die je op dat moment direct kon gebruiken, alhoewel er ook informatie naar voren kwam dat niet van toepassing was.
- Niet elke gast college was even nuttig, vaak zaten we net diep in de stof/code en dan moesten we plenair activiteiten volgen, dat wilde het creatie proces wel eens tegenzitten. Sommige gastcolleges hadden misschien eerder kunnen worden gepland, zeker de laatste weken wilde ik liever werken aan het product
- de presentaties van de horizontals voor cusumano vielen aan het eind van de cursus, net op het moment dat iedereen druk is voor de eindpresentaties. Niet erg praktisch.
- Alle bovenstaande presentaties zijn (op de laatste na) op verschillende momenten aan bod gekomen. Sommige presentaties waren zeker niet nuttig anderen juist wel. Ik kan hier niet goed aangeven wat wel of niet goed is omdat alles bij elkaar wordt gezet.

4. Waardering voor de docent

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 8. De kwaliteit van de begeleiding was goed.	0	0	1	5	6	4,42	0,67

5. Waardering voor de faciliteiten

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 9. De geboden faciliteiten (werkruimte, computers, e.d.) waren voldoende.	0	0	3	7	2	3,92	0,67

6. Leereffect

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 7. De cursus sloot goed aan bij mijn voorkennis.	0	0	1	6	5	4,33	0,65
Vraag 10. Ik heb in deze cursus veel geleerd.	0	0	1	3	8	4,58	0,67

Vraag 15. Wat is het belangrijkste dat je in deze cursus te weten bent gekomen over het werken in een bedrijf?
- Teamwork, interne verantwoording.
- Denk dat ik hier niks over te weten ben gekomen omdat Netherware toch geen echt bedrijf is en omdat ik mijn product in mijn eentje deed en daarom bijvoorbeeld geen sprake was van vergaderingen.
- Niks, werken in een bedrijf kan je overal leren. Deze cursus gaat over het opzetten of mede opzetten van een bedrijf.
- Dat het hard werken is, dit heb ik met name ontdekt door de verhalen van gastsprekers. Daarnaast het feit dat je structureerd moet werken anders wordt het een bende. Het overleggen met je collega's anders wordt er dubbel werk verricht

- 100 uur per week maken, en met volle overtuiging erin storten.
- Je bent erg afhankelijk van elkaar. Doet de ene zijn taken niet dan ligt de rest ook stil.
- Dat veel dingen niet zo uitgebreid (hoeven?) gaan als je bij verschillende vakken wordt geleerd. Dat je niet alles in een keer goed hoeftte doen, maar dat er vaak nog wel ruimte is om later bij te schaven. Soms is het belangrijker iets te hebben, wat je later aanpast, dan helemaal niets. (bv een demo).
- Persoonlijk lag voor mij de nadruk binnen het vak op het opzetten van een eigen bedrijf; niet op het werken binnen een bedrijf zoals Netherware.
- nvt.
- Goed plannen, goede afspraken weten te maken met partners en derden, devotie.
- Je komt er alleen met hard werken, en veel lef om beslissingen te durven nemen.
- Eigen bedrijf is vooral heel veel tijd besteden in het begin.

Vraag 16. Wat is het belangrijkste dat je in deze cursus te weten bent gekomen over je eigen kwaliteiten en vaardigheden?

- Dat het goed mogelijk is om mijn eigen aanwezige kwaliteiten en vaardigheden meer te doen, in de zin van ondernemen.
- Dat ik toch wel beschik over bepaalde ondernemers vaardigheden maar dat ik over alles toch wel grondig nadenk.
- Dat ik zeer goed in staat ben om mijn eigen mening uit te dragen, door te zetten en dat ik goed ben in marketing.
- Dat ik nog wel wat te leren heb als ik een echte ondernemer wil worden, met name wat betreft de commerciele en financliele kanten van het ondernemen.
- Dat je zonder programmeer ervaring bijzonder weinig kan.
- Wel doorzettingsvermogen en verantwoordelijkheid op me nemen.
- Dat ik in principe genoeg vaardigheden heb om productsoftware te maken, maar dat die kwaliteit pas ten top naar buiten komt als ik iets maak waar ik zelf voor ga.
- Dat mijn kwaliteiten en vaardigheden, zoals de bedoeling is van informatiekunde, tussen de gebruiker en de ontwikkelaar inliggen. Ik vervul dus meer een rol als tussenpersoon.
- Mijn persoonlijke kwaliteiten liggen meer in het managen van personen, werkzaamheden en zaken. Daarbij ben ik te weten gekomen dat een eigen bedrijf goed bij mij zou kunnen passen.
- Ik kom vaak te laat, maar dat wist ik al. Ik ben goed in overleggen en kan goed kritische kantekeningen maken.
- Dat ik de 'drive' heb om te ondernemen maar dat ik ook nog een heleboel heb om te leren daarover.
- Communicatieve vaardigheden en creativiteit.

7. Effect op ondernemerschap

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 11. Door deze cursus is mijn enthousiasme voor ondernemen toegenomen.	0	1	0	3	8	4,50	0,91
Vraag 12. In deze cursus heb ik geleerd wat het inhoudt / wat je nodig hebt om een eigen ICT-bedrijf te starten.	0	1	1	5	5	4,17	0,94
Vraag 13. Door deze cursus kan ik een eigen ICT-bedrijf starten.	0	1	1	8	2	3,92	0,80

Vraag 18. Welk van onderstaande kwaliteiten zijn in deze cursus toegenomen?	Aantal keren aangekruist
Technisch inzicht	6
Uitvoeren van marktonderzoek	6
Financieel inzicht	4
Capaciteiten om te managen	9
Visie op het vormen van een ICT-bedrijf	12
Overdracht van kennis en productvisie op anderen (klanten, collega's)	10
Doorzettingsvermogen	6
Omgaan met onzekerheid	8
Enthousiasme voor ontwikkeling van een software-product	12
Creativiteit	7
Besluitvaardigheid	10

8. Authenticiteit

	- -	-	0	+	+ +	Gemiddelde	Standaard deviatie
Vraag 14a. De werksituatie in de cursus geeft volgens mij een realistisch beeld van hoe het er in een software-productiebedrijf aan toe gaat.	0	3	3	5	1	3,33	0,99

Vraag 14b. Geef een toelichting. Wat in de cursus was in jouw ogen kenmerkend voor hoe het er in het bedrijfsleven aan toegaat?

- Belang interne terugkoppeling/rapportages.
- Rapporteren van uren en het maken van de voortgangsrapportages. Raad van commissarissen die je ideeën bekritiseerd.
- Door de vele workshops en gastcollege's ruik je aan het echte bedrijfsleven, zonder zelf risico te nemen. Kenmerkend is dat alles goed moet worden onderbouwd en dat overal goed over nagedacht moet worden, zowel over de risico's als de kansen.
- Het samenwerken met je collega's, het moeten halen van deadlines, de gestructureerde aanpak, het op de hoogte houden van je activiteiten aan de docent.
- Contacten leggen met anderen, netwerken!
- Deadlines. maakt niet uit wat de kwaliteit is, als het maar af is.
- Kan ik moeilijk zeggen; werken van 9-5? Hoeft niet. Werken met collega's wel. Wellicht werk je in het bedrijfsleven iets doelgerichter, het was nu redelijk 'free-stylen'.
- Er wordt op een gestructureerde manier tegen het ontwikkelen van product software aangekeken. Er wordt duidelijk onderscheid gemaakt tussen de verschillende activiteiten die zijn betrokken bij het ontwikkelen van een product, niet alleen technische aspecten.
- Het werken in teams. de deadlines, die ook onderhevig zijn aan voorvallende situaties.
- Weet dat je met alles rekening moet kunnen houden en vergeet ook alle voorbeelden want zo zal het niet gaan.
- Zoveel hebben we nog niet van het echte bedrijfsleven gezien dus dit is moeilijk te bevestigen. Wel denk ik dat dat de cursus heel intensief op het bedrijfsleven gefocust was.
- Uitwisselen van informatie met andere afdelingen(horizontals). Schrijven van business plannen etc.

Appendix 1c: Results on the alumni questionnaire

To get a better insight in the success of the course, alumni of the course as it was given in Amsterdam twice were send a questionnaire. In this appendix we report the findings from this questionnaire. The following information can be found under the headings:

1. Who are the alumni: sexe, when did they follow the course, what field of study did they take, in what phase of their studies did they follow the course, how far advanced in their studies are they now.
2. Current activities of the alumni: do they work in a company, is that the same company as the one they were working on during the course, in what function, do they develop product software, how much time do they spend on this work.
3. Own companies: how many students have their own company, is it an ICT-company, is it the same campany as they were working on during the course?
4. Alumni working in software production: how many students work in an ICT-company, is it the same campany as they were working on during the course?
5. Contribution of the study to a career: which activities during the study help their current career.
6. Valuation of the course Product Software: reasons for participating in the course, what they have learned in the course, what do they (expect to) use in their work, what (other) apects of the course were useful, qualities that have increased because of the course, wether or not the course should be obligatory, if the course stood up to their expectations, if it was a good preparation for working in a ICT company or for starting their own ICT company, strong/weak aspects of the course and things students have missed in the course.
7. Degree of reality: does the course reflect work in practice?

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1. Wie zijn de alumni

Aan de cursus Product Software namen in het studiejaar 2002-2003 15 studenten deel, allen man. In het studiejaar 2003-2004 waren dat 27 studenten, waaronder 2 vrouwen. Op de vragenlijst hebben 27 alumni gereageerd, waaronder één vrouw. In één van de vragenlijsten waren de data niet goed opgeslagen waardoor deze onbruikbaar was, waardoor er van 26 vragenlijsten data beschikbaar zijn.

Van de respondenten hebben er 9 de cursus Product Software in het studiejaar 2002-2003 gevolgd en 18 in het studiejaar 2003-2004. De meeste respondenten waren afkomstig uit de afstudeerrichting Multimedia en Cultuur binnen de opleiding Informatiekunde (zie tabel 4).

Bijna de helft van de studenten volgde de cursus Product Software terwijl ze in het vierde jaar van hun studie waren (zie tabel 5). Ook waren er een groot aantal studenten die de cursus in hun derde studiejaar volgden; in het studiejaar 2003-2004 betrof dit een kwart van de studenten.

Afstudeerrichtingen	
Informatiekunde / Multimedia en Cultuur	7
Informatica	6
AI	5
Bedrijfskundige Informatica	3
Kunstmatige Intelligentie	2
Alleen bachelor gevolgd / zit nog in bachelor	2
Computer Science / SWE	1
Natuurkunde	1

Tabel 4: Afstudeerrichtingen van de respondenten op de alumnivragenlijst.

Studiefase ten tijde van deelname aan cursus	
1e jaar	1
2e jaar	3
3e jaar	7
4e jaar	12
5e jaar	3
Niet ingevuld	1
Totaal	27

Tabel 5: Studiefase van de respondenten op de alumni-vragenlijst ten tijde van deelname aan de cursus Product Software.

2. Huidige activiteiten van de alumni

De meeste respondenten studeren op dit moment nog (zie tabel 6). Van de respondenten zijn er drie tijdelijk met de studie gestopt. Zij werken momenteel alle drie in een eigen bedrijf, waarvan 2 in de ICT-branche.

Huidige studiefase	
Ik studeer nog	18
Ik ben tijdelijk gestopt met mijn studie	3
Ik ben gestopt met de studie	-
Ik ben afgestudeerd	5
Niet ingevuld	1
Totaal	27

Tabel 6: Huidige studiefase van de respondenten op de alumnivragenlijst.

3. Eigen bedrijven

Bij de vraag of de alumni momenteel in een bedrijf werken antwoordde 10 respondenten dat ze in een eigen bedrijf werken, waarvan 9 in de ICT-branche (zie tabel 7). Bij deze vraag was aangegeven dat alleen sprake was van een 'bedrijf' als deze is ingeschreven bij de Kamer van Koophandel. Door deze toevoeging blijven startende ondernemingen die nog niet een inschrijving hebben gerealiseerd buiten beeld. Vijf van de bedrijven betreffen bedrijven die zijn ontwikkeld tijdens de cursus.
Van de respondenten die een eigen bedrijf in de ICT-branche hebben, bestaan er vier uit eenmansbedrijven, vier bedrijven van tussen de 2 en 5 werknemers en één uit meer dan 10 werknemers. Het eigen bedrijf buiten de ICT-branche van één respondent bestaat uit 2 to 5 werknemers.

Ja, in een eigen bedrijf *in* de ICT-branche.	9
Ja, in een eigen bedrijf *buiten* de ICT-branche.	1
Ja, bij een werkgever *in* de ICT-branche.	4
Ja, bij een werkgever *buiten* de ICT-branche.	4
Nee, ik werk niet in een bedrijf.	8
Niet ingevuld	1
Totaal	27

Tabel 7: Aantal respondenten werkzaam in een bedrijf (ingeschreven bij KvK).

4. Alumni die werken in de software productie

De alumni van de cursus Product Software die in een eigen bedrijf werken of werkzaam zijn bij een bedrijf in de ICT-branche hebben verschillende functies. Vijf van hen noemen één functie, maar de meesten verenigen meerdere functies in één persoon (10 respondenten).

Ontwikkelaar productsoftware	10
Manager	6
Verkoper	6
Consultant	5
Onderzoeker	4
Ontwikkelaar software	1
Web developer	1
Inhoudelijk specialist	1
Marketing onderzoek	1
Eigenaar	1
Niet van toepassing / niet ingevuld	12
Totaal	27

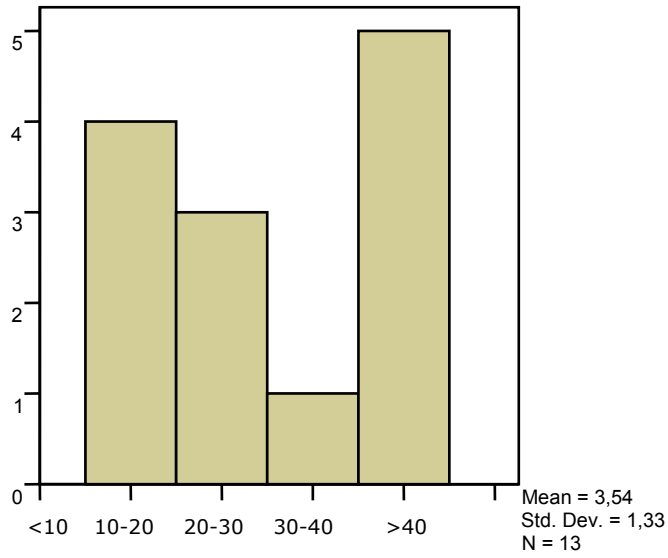
Tabel 8: Functies van respondenten die in ICT-branche werken.

Zes van de respondenten die in een eigen bedrijf werken of werkzaam zijn bij een bedrijf in de ICT-branche werkt momenteel nog aan het software product dat ze tijdens de cursus Product Software hebben ontwikkeld. Eén daarvan gaf aan daarnaast ook aan een nieuw product te werken. Zes andere respondenten die in een eigen bedrijf werken of werkzaam zijn bij een bedrijf in de ICT-branche werken inmiddels aan een ander product.

Werken aan *hetzelfde* product als waar in de cursus Product aan werd gewerkt	6
Werken aan een *ander* product dan waar in de cursus Product Software aan werd gewerkt	6
Werken niet aan ontwerp, ontwikkeling of verkoop van een software product	3
Niet van toepassing / niet ingevuld	12
Totaal	27

Tabel 9: Aantal respondenten dat aan ontwerp, ontwikkeling of verkoop van een softwareproduct werkt.

De helft van de respondenten die in de ICT werkzaam zijn of een eigen bedrijf in een andere branche bezitten besteden meer dan 30 uur aan dit werk. Daarvan zijn er drie afgestudeerd, één tijdelijk gestopt met de studie en twee nog aan het studeren. Zes alumni van de cursus Product Software die nog studeren en één die tijdelijk gestopt is besteden gemiddeld per week tussen de 10 en 30 uur aan werk in de ICT-branche.



Figuur 7: Gemiddelde tijd besteed door respondenten aan werk in ICT-branche of eigen bedrijf.

5. Bijdrage van de studie aan een loopbaan

Op de vraag welke activiteiten volgens alumni een bijdrage leveren aan hun loopbaan wordt vooral het daadwerkelijk werken in de praktijk, eventueel in de vorm van een stage, genoemd. Een bestuursfunctie wordt vooral belangrijk gevonden door de alumni die nog studeren.

Werkervaring in het ICT-bedrijfsleven (waarvoor geen studiepunten werden verkregen)	18
Stage (waarvoor studiepunten werden verkregen)	12
Bestuursfunctie	11
Andere werkervaring	7
Practica die over specifieke aspecten van de ICT gaan (Security, Agents, Plannings systemen, …) / programmeervakken	2
Studentassistentschap (begeleiding, doceren, onderzoek)	2
Afstudeerscriptie binnen de VU	1
Veel actief zijn in verschillende disciplines en activiteiten (netwerken)	1

Tabel 10: Activiteiten tijdens de studie die volgens alumni bijdragen aan hun loopbaan.

6. Oordeel over de cursus Product Software

De beschrijving van de cursus in de studiegids is enthousiasmerend geweest voor studenten. Van de alumni geven er 21 aan dat deze ertoe bijgedragen heeft om voor deze cursus te kiezen. Dat deze cursus studenten de gelegenheid geeft aan nieuwe ideeën te werken en bestaande ideeën uit te bouwen was ook vanaf het begin al duidelijk. Veel alumni zijn om die reden met de cursus gestart. Opvallend is dat studenten zich ook in de cursus laten trekken door medestudenten: vijf studenten zijn op deze wijze aan de cursus begonnen. Van de respondenten (27) zeggen er 20 dat de cursus aan hun verwachtingen heeft voldaan.

De beschrijving van de cursus sprak me aan	21
Ik had een interessant idee voor een software product of een –dienst waar ik mee wilde beginnen	7
Ik wilde nieuwe ideeën voor software producten of -diensten uitproberen	6
Ik wilde in de cursus een software product dat ik al aan het ontwikkelen was, verder ontwikkelen	5
Een medestudent met een idee voor een software product of -dienst vroeg me met hem/haar te gaan samenwerken binnen de cursus	5
Ik was al eigenaar van een (klein) software bedrijf en wilde dit bedrijf in de cursus verder ontwikkelen	4
Verplicht vak	4
Er was geen andere interessante cursus die ik op dat moment kon volgen	2
Iedereen deed het en het leek me spannend/interessant om te ontdekken	1

Tabel 11: Redenen (meerdere antwoorden mogelijk) om deel te nemen aan de cursus Product Software.

De alumni zijn erg positief over de opzet van de cursus: productteams en horizontale afdelingen, intensieve samenwerking, vrijheid van het project, in grote lijnen leren denken over het in de markt zetten van een product, beoordeeld worden door 'hoge' mensen uit het bedrijfsleven.
Hoewel de opzet van het werken in horizontale teams gewaardeerd wordt, wordt de uitvoering ervan door enkelen als zwak aspect genoemd: saai, niet genoeg informatie over de mogelijkheden, niet genoeg ervaring binnen het team waardoor de simulatie van een bedrijf niet goed uit de verf kwam. Sommige alumni noemen ook het aspect 'meeliften', wat kennelijk in een enkel team aan de orde was. Verder wordt het gebrek aan tijd genoemd als een punt van verbetering.

De alumni noemen verschillende zaken die ze geleerd zeggen te hebben in de cursus Product Software. De leerdoelen van de cursus zijn erop gericht studenten de werking van een softwarebedrijf te leren, de zaken die er nodig zijn om zo'n bedrijf op te zetten en hoe je van een idee naar een product komt. Deze onderwerpen ervoeren alumni als belangrijke elementen in de cursus. Opvallend is verder dat studenten zeggen veel geleerd te hebben van samenwerken in een team en het belang van goede keuze maken met wie je een bedrijf opstart. Een alumnus noemt dit de 'people-ware kant' van het bedrijf.
Vier alumni noemen als belangrijke leeropbrengst van de cursus het vertrouwen krijgen in dat een idee een product kan worden en tot een bedrijf kan uitgroeien. De succesverhalen van bestaande bedrijven hebben daar zeker toe bijgedragen. Ook wordt het inzicht krijgen in eigen kwaliteiten door een alumnus genoemd. Daarmee bereikt de cursus doelstellingen die lastig in leerdoelen te vangen zijn, maar die wel heel belangrijk zijn voor het ontwikkelen van ondernemerschap.

Een belangrijk leerpunt dat studenten in hun werken gebruiken of denken te gaan gebruiken is het systematisch werken. Ook in de cursus Business Informatics noemden studenten het een belangrijke ervaring dat plannen en systematisch te werk gaan nodig zijn om tot een goed resultaat te komen. Die planmatige en georganiseerde aanpak was niet altijd aanwezig in de werkwijze van de studenten. Kennelijk hebben ze geleerd van hun fouten.
Belangrijk nut van de cursus zat hem voor de alumni verder in het leren samenwerken waarbij het een uitdaging is om overeenstemming te bereiken en samen te werken met mensen met verschillende achtergrond en kennis. De toets van het eigen product aan anderen wordt eveneens regelmatig (8 keer) genoemd als een belangrijk nut van de cursus. Studenten kunnen hun eigen aanpak toetsen door de beoordeling van een jury van mensen uit het bedrijfsleven, de gastsprekers, de bedrijfsexcursie, de feedback van medestudenten en het bij elkaar kunnen kijken. Opvallende andere zaken die door de alumni worden genoemd zijn 'plezier bij het werk hebben' en 'zelf de doelstelling

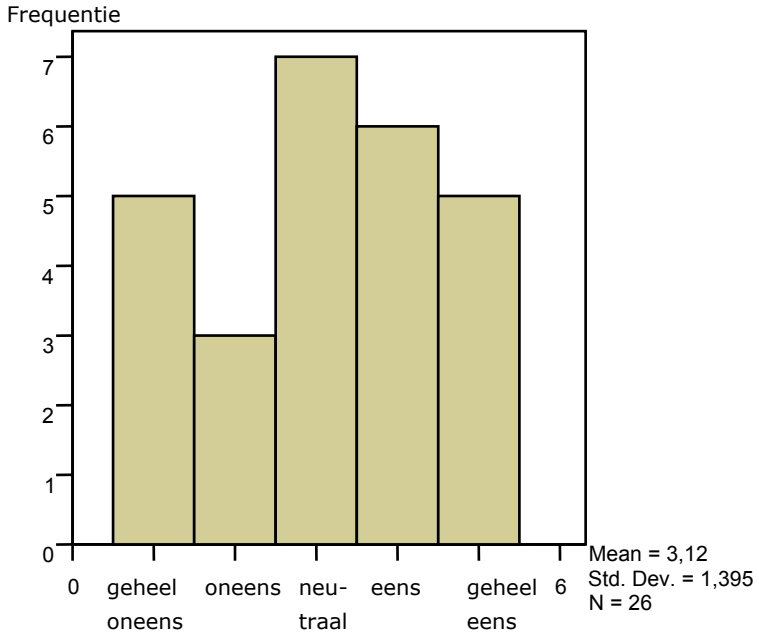
bepalen'. Het eerste is een van de elementen die van belang zijn bij ondernemerschap: enthousiasme. Kennelijk heeft de alumnus die dit noemt dit herkent. De docent gebruikt onder andere het 'zelf doelstelling laten bepalen' als een manier om dat enthousiasme te kweken.

In de vragenlijst aan alumni is gevraagd naar toename van ondernemerskwaliteiten als gevolg van de cursus. De genoemde kwaliteiten zijn afkomstig uit een door de docent gehanteerde definitie van ondernemerschap. Opvallend is dat alle kwaliteiten door alumni herkend worden, aangezien ze allemaal zijn aangekruist (zie tabel 12). Het vaakst worden genoemd 'visie op het vormen van een ICT-bedrijf' en 'enthousiasme voor het ontwikkelen van een softwareproduct'. Veertien respondenten zijn het er dan ook over eens dat de cursus een goede voorbereiding is voor het werken in een ICT-bedrijf (tegen 10 neutraal en 2 oneens). Met de uitspraak dat de cursus een goede voorbereiding is voor het starten van een ICT-bedrijf zijn 21 respondenten het eens (tegen 2 neutraal en 2 oneens).

Ondernemerskwaliteiten die zijn toegenomen door de cursus	**Aantal malen aangekruist**
Visie op het vormen van een ICT-bedrijf	22
Enthousiasme voor ontwikkeling van een softwareproduct.	16
Overdracht van kennis en productvisie op anderen (klanten, collega's).	11
Financieel inzicht	11
Uitvoeren van marktonderzoek	10
Capaciteiten om te managen	10
Creativiteit.	10
Omgaan met onzekerheid.	9
Besluitvaardigheid.	9
Doorzettingsvermogen.	8
Technisch inzicht	6
Niet ingevuld	1

Tabel 12: Ondernemerschapskwaliteiten die zijn toegenomen door de cursus Product Software.

De alumni antwoorden niet eenduidig op de vraag of de cursus Product Software een verplicht onderdeel moet vormen van een studie die opleidt voor de ICT-branche (zie figuur 8).



Figuur 8: Cursus moet verplicht onderdeel vormen voor een studie die opleidt voor de ICT-branche.

7. Realistisch gehalte van de cursus

De respondenten zijn verdeeld over de vraag of de werksituatie in de cursus een realistisch beeld gaf van hoe het er in een ICT-bedrijf aan toe gaat (7 geheel oneens/oneens, 10 neutraal, 9 eens/geheel eens). Dat geldt zowel voor de alumni die nu in een ICT-bedrijf werken als voor hen die dat niet doen.

Appendix 2: List of contents of the literature portfolio

(For those involved in the project a cd-rom is enclosed in this report.)

Entrepreneurship

Audretsch, D.B. (2002), *Entrepreneurship: A survey of the literature*. Prepared for the European Commission, Enterprise Directorate General. Institute for Development Strategies, Indiana University & Centre for Economic Policy Research (CEPR), London, July 2002.

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