TECHNOPRENEURSHIP BATCHELOR, a bachelor program in technology - innovation and entrepreneurship

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Abstract — *This program combines disciplines from technology, economy, entrepreneurship and product development. The program is managed by the engineering department at the Østfold University College, this program being the first of its type in Norway. The program is designed towards students that want to create their own companies and start new business ventures, based on technological skills and knowledge. The program has international partners and 6mnd of the program will take place in U SA. The program is also well designed for persons that want to go into managing positions in start -up companies, and small companies with challenging competition and need for new innovations and development. The Batchelor program will give a broad platform , and the ability to study different speciality's later on in the Master program. Engineers have traditionally been trained to be good in mathematics and technological skills. Their work was to be i n big engineering companies with stable economy . These eng ineers were in fact protected from the real world, and developed habits that was unsuitable for work in small and start -up companies. These bad habits were reflected in the curriculum of traditional engineering education, where entrepreneurship and product development courses did not exist. Big barriers existed also between different disiplines in engineering, and the different departments at the universities did not communicate at all. The Norwegian National Business and Industry Confederation did studies that shoved shortage of people with combined skills in electronics, mechanics and power systems. They also wanted engineers educated to cope with problems in a faster moving wo rld, and able to start up new companies. This made the basis for this new progra m, and a new technological education was to be created that would tear down the walls between university departments. The electronic, mechanic and physics department joined at the Østfold University College to create a new curriculum in mechatronic s, suited for the new bachelor program. A totally new department was created inside the campus, manned with motivated professors. This new department has become a central part of the development system at the university and also the county! One of the biggest chal lenges was to change the habits of the students, habits inherited from their surroundings. Innovative skills and entrepreneurship mentality is maybe easy to teach, but hard to adopt because it relies on the psychological mentality inside each student. This program is aimed at creating a new type of engineer with an innovative and entrepreneurship mentality, not joust to teach about it. To reach this goal teaching is based on teamwork, project development and challenges from real life. Some of the courses is planned to be held in English language. The program has adopted the Young Enterprise concept, and in the second grade students will start and run their own real companies for one year. Hopefully several of the students will graduate after three years with their own new companies.*

Index Terms — *Entrepreneurship bachelor, technopreneurship, mechatronic and innovation, multidisciplinary ventures.*

BACKGROUND

Based on a report from ECON in 1999, Norway will probably loose 800000 working places in industry and related businesses the next 20 years. Norway's population is only 4 million inhabitants, meaning that almost every family in Norway will be affected. Old traditional industrial production jobs will vanish due to high labour costs in Norway, and new ones need to be created. Norway's economy is also highly dependent on oil production, and the income from oil industry will start to decrease around year 2020.This will make the next 20 years very challenging for the Norwegian population. Motivating youths to start their own companies, and to think innovative, is a key in the process of creating new industry and working places in Norway, able to cope with the demands of a new decade. This involves a new profile in the engineering education, where it is necessary to educate innovative young engineers, able to create new companies, instead of educating students for jobs in the existing industry that will soon disappear. Norway needs a new engineering type, the one that is able to create his own job and run his own company. This motivation process must start early, and entrepreneurship programs have been started up at several levels from university down to primary school. In Norway these programs are not more than 10 years old, young regards to England and USA, which started up their programs in the sixties and thirties. The young enterprise

program was first started up at high school level for ten years ago, after a initiative taken by "The Norwegian National Business and Industry Confederation". This program was not adopted by the universities before ten years later, the engineering department at Østfold University College being the first to attend the program in Norway. The Norwegian program was a copy of the English. This program was called "Young Enterprise, The Graduate Program", se: www.young-enterprise.org.uk & www.ue.no The Østfold University College had for over 10 years been involved in entrepreneurship activities, leading up to participating in the young enterprise program. This program gave lather birth to the new Batchelor program in technology – innovation and entrepreneurship, nicknamed the "Technopreneurship Batchelor"

REGIONAL CONDITIONS AND QUALIFICATIONS FOR ENTREPRENEURSHIP ACTIVITY

Østfold University College with 3000 students is situated in the County of Østfold, a county dominated by primary industry and agriculture. The county of Østfold has traditionally been a rich and prosperous county, but change has come. In average 1600 working places is lost each year out of approximately 90000 jobs in trade and industry. The County has 240000 inhabitants. Østfold County is located in the southeast of Norway, with border towards Sweden, and therefore closest to the European market in Norway. The localization, industrial network, best climate in Norway and one of the biggest harbours gives the county an ideal position for making business. The need for new jobs, have forced the county to start op several entrepreneurship programs. The engineering department at the Østfold University College has for several years been engaged in product development and entrepreneurship programs. Every year, students have to exhibit their graduate projects for the public. 90% of these projects are done for the industry and the exhibition acts as an idea-bank and innovation kick-off for the visitors. This innovative environment at the university did not create so many new companies as wanted, and a business incubator was established inside the campus to stimulate students to start up companies. The business incubator "Østfold Innovation Ltd." is using 80% of its resources towards young entrepreneurs and is at present running tree different entrepreneurship programs in partnership with the Østfold University College. The University has its own student union for entrepreneurs, named START, and has for some years been offering a not compulsory one year program in entrepreneurship. The University is also responsible for running the national network for entrepreneurship among Colleges and Universities. The University has participated in a lot of entrepreneurship activities, and is regarded as one of the most active in Norway, se examples in underlying list:

Entrepreneurship activities undertaken by the Østfold University College:

- **RUSH development program**: National governmental development program designed for creating industrial development and ventures by using the competence and resources at the regional colleges to help industry.
- **Business incubator:** Østfold University College has established and owns partly a business incubator located at the campus. The incubator uses 80% of its resources towards young entrepreneurs.
- **Product development:** For over 10 year, product development and innovation had been a part of the syllabus at both the engineering and business department.
- **Enterprise and business development:** A not compulsory one year program in entrepreneurship based on economic curriculum and made open for all students. Development of business plans and financing is a vital part of the syllabus.
- **Student union for entrepreneurs:** After model from two other universities, a student union for entrepreneurs was established and financed. The union was called START.
- **Innovation Net:** Østfold University College is in charge of the National network for entrepreneurship training for professors at Universities and Colleges. This program was developed by Professor Karsten Jacobsen.
- **Regional entrepreneurship program for young people:** Program run by the university, aimed at teachers and pupils in the compulsory school system. Several joint programs between university and lower grade education were developed.
- **Young Enterprise graduate program:** This is a one-year program where students develop products and business ideas, establish shareholding companies and run them for one year.
- **Innovation Camp:** Idea and invention contest for pupils in the compulsory schools run by the University and the business incubator, Østfold innovation Ltd.
- **Generator:** Innovative product development, business-plan development and contest for students, aimed at participating in Venture Cup ant other business plan contests.
- **FORNY program:** Entrepreneurship program aimed at getting students to start new business ventures, and to motivate professors to take part in the process. This program focuses on creating new startup companies.
- **INTERREG III program:** Scandinavian program aimed at reducing barriers between countries and motivate the regional school and universities to work together and promote entrepreneurship activity.

MOTIVATION: OUT OF MONEY AND OUT OF FRIENDS

Back in the sixties (1960), Norway had not yet discovered the oil resources in the North Sea, and its primary resources was from industry, fishing and agriculture. The county of Østfold with its 240000 inhabitants, border to Sweden and big harbours, was a prosperous county. Paper, chemical, shipyard and mechanical industry dominated. Norway's most wealthy and powerful industry companies resided inside the county. Unemployment was almost non existent, and the big industry companies also took part in the social welfare of the inhabitants. The Østfold College of engineering was established in 1965 to cope with the demands for engineers from the industry. Up to this point the "brainpower" in the industry came from abroad and other places in Norway. The population in Østfold was to be educated, and shortly after the College of economics and language was also opened. Inhabitants in the county was well fed and happy, did not want to move, and did not really need education. It was important to establish higher education inside the county to motivate young people to take higher education. For many decades, inhabitants in the County of Østfold had one of the lowest educational levels in Norway. No need for education, people was earning money anyway. Everything was going well, the prosperous industry provided welfare. One of the regions in Norway that did not go so well and really needed help was North Norway. Huge governmental resources were used on keeping industry in this ice-cold and hostile territory. And the regions in North Norway are dependent on huge economical help from the government today. The prosperous industry in the County of Østfold was in fact financing welfare also in North Norway by its huge tax paying. By 1985 the industry in the County of Østfold started to collapse. Its huge shipyards and paper mill industry was the first to be closed down. Unemployment was rising. The work force was immobile and without education. Initiative and entrepreneurial skills was seldom to find. Inhabitants were used to be given jobs, not to create and run them. Help from the government was asked for, the same type of help that was given to North Norway, and financed by the workers in Østfold county for decades. The help did not come…..Regions in North Norway did not want to share with others, and they had secured political majority in the Norwegian government for this. Today the Troms County in North Norway gets approximately 10 times more money from the government in development programs than the county of Østfold gets. Østfold having more inhabitants….At the same time number of students applying for engineering education was going down, and the engineering department was loosing money since the economy was connected to the number of students that was taking courses. Other departments in the university wanted to close the faculty of engineering down since the numbers of students was falling, and also because the education itself was one of the most expensive to run. By 1994, both the industry and its engineering education were bleeding. The former wealthy industry county was on its knees, asking for governmental help, help that was not to come. It took some time before inhabitants in the Østfold County realized that the help would not come from the government, and that they had to rely on their own skills. Slowly things started to happen. Because of need, Østfold County was the first in Norway to adopt the young enterprise program. Since the start, high school pupils from Østfold County, has dominated among the National price winners. The engineering faculty was one of the first in Norway to start education in product development, and the economics department was early on with education in enterprise and business development. Students from the Østfold University College has for the two last years dominated in national business plan contests like Venture Cup, and the county is today regarded as one of the leading ones in creating new business ventures. The traditional process industry is not coming back, but people are creating new industry not seen before, without help from the government… Entrepreneurship is starting to be a part of the mentality in the Østfold County, not because of politics and governmental programs, but out of need. If no one wants to help you, you must help yourselves. The first thing to realize is that entrepreneurship is connected to the mentality of the inhabitants in a region, and that the educational system has a powerful influence on that mentality. The coincidence in Østfold County that both the industry and the engineering and technical education went into trouble at the same time helped turning the mentality in the industry and in the school system at the same time, this being one of the major factors to the success of entrepreneurial activities in the county. "Out of money and out of friends" is a very good motivation to start changing things, but the educational system has still a long way to go.

Periods of development in the County of Østfold:

- **1960: Industrial wealth and power!**
- **1970: Trade unions succeeds in creating social and economical wealth for the working classes, good times!**
- **1980: Wages are rising and Norwegian labour is starting to be too expensive in international competition…**
- **1985: Shipyards and paper mill industry are closing down, rate of interest to be paid on loans are rising….**
- **1990: Norwegian banks are going bankruptcy and Norwegian industry is being moved out of the country….**
- **1995: Unemployment and depression is rising….**
- **2000: Entrepreneurial activity is increasing in business, industry and schools!**
- **2003: Østfold University college starts the first bachelor program in technopreneurship in Norway!**
- **2004: Government approves plans to boost entrepreneurship activity in business, industry and schools!**

BIRTH OF THE BATCHELOR PROGRAM IN TECHNOLOGICAL INNOVATION & ENTREPRENEURSHIP

The educational system reflects the mentality, social structures and management policy of different trades which they are educating students to work in. The engineering education is a very good example of this, since the professors for long time in Norway have been recruited from the industry. Engineers have traditionally been trained to be good in mathematics and technological skills. Their work was to be in big engineering companies/departments with resources to train the new employees in what technological skills that was needed. These engineers were in fact protected from the real world, and developed habits that was unsuitable for work in small and start-up companies. These bad habits were reflected in the curriculum of traditional engineering education, where entrepreneurship and product development courses did not exist. Big barriers existed also between different departments in engineering education, and the different departments at the universities did not communicate at all. At the Østfold College of engineering professors from the chemistry department was unable to understand what professors from the mechanical department was talking about, and these again was unable to understand the professors from the electronics and civil engineering department, and visa versa… In fact the mechanical and chemistry department had their own lunch room, so communication was often done by letter, not wanting to walk some few meters to talk to each others. Big barriers were built between the different technological departments, and instead of helping each other, they would rather destroy the other one. Competition went before cooperation. The only thing that everybody at the faculty of engineering was able to fully agree about, was that no one could talk with anyone at the faculty of economics. Students taking courses at one department was not allowed to attend lectures held by other department's ore faculties! By 1990 the faculty of engineering consisted of 7 segregated technological departments.

The 7 different departments at the faculty of engineering at the Østfold University College by 1990:

- **Chemistry**
- **Mechanics**
- **Electronics**
- **Electro power systems**
- **Civil engineering**
- **Automation (moved to faculty of information technology in 1995)**
- **Biotechnology (moved to faculty of health care in 1995)**

The competition between the different departments was so hard, and the social environment so bad, that the department of Automation and department of biotechnology moved out of the engineering faculty when they got a chance in 1994, reducing the total number of students at the faculty of engineering, and thereby reducing the faculties economy severe. When students started to choose other faculties than engineering in 1995, the economic situation started to be critical. Someone was hoping that things was going to be better again, but the low interest among the applying students for engineering education was not going to turn, it was permanent. This trend was not only localised to Norway, it was seen all over Europe… The most unpopular curriculum to study is Chemistry. In fact the low interest for mathematics and physics among students at the high schools is threatening to destroy technological and natural sciences in Norway and Europe. In 1998 was economy so bad at the faculty of engineering that changes was desperately needed. The old traditional barriers were broken down between the different departments, and cooperation was started based on the development of a new bachelor program in industrial design. This program is the most popular program at the faculty of engineering today. The participation in all of the different regional development programs, the courses in "product development" and "enterprise and business development" created the consciousness for making a bachelor program in entrepreneurship. The establishment of the business incubator "Østfold Innovation Ltd" (2001) inside campus gave the faculty of engineering an excellent "laboratory" for entrepreneurship activity. The Young Enterprise graduate program, was run at the engineering faculty in 2002, and gives an excellent training in starting up/closing down companies, earning money and dealing with shareholders. This program was excellent as a "live" course in business development, and had to be a central part in the new bachelor program. Students had already started the student union for entrepreneurs, the START group, so the student community was not unfamiliar with entrepreneur mentality. Through different development programs like INTERREG III, RUSH and Innovation Net, collaboration between the faculty of engineering and economics had resulted in greater understanding between these two faculties. The traditional old barriers between different disciplines in engineering and between engineering and economy were being tired down, and new knowledge and understanding had emerged. This resulted in a new multidisciplinary mentality where engineering, economy and entrepreneurship was mixed together. At the same time the "Norwegian National Business and Industry Confederation" did studies that shoved shortage of people with combined skills in electronics, mechanics and power systems. They also wanted engineers with entrepreneurial skills and educated to cope with problems in a faster moving world. The

new generation of engineers should also be educated to start up new companies, and trained for taking higher risks. The "Norwegian National Business and Industry Confederation" wanted more new companies to replace the old ones that was going to die. This made the basis for the new bachelor program, and a new technological education was to be created that would tear down the walls between university departments. The electronic, mechanic and physics department joined at the Østfold University College to create a new curriculum in mechatronics, suited for the new bachelor program. A totally new department was created inside the campus, manned with motivated professors. This new department was to function like a start-up company, and has become a central part of the development system at the university and also the county! One of the biggest challenges was to change the habits of the students, habits inherited from the school system and the society around them. This society was used to be given secure jobs in a stable and wealthy industry.

NEW KIND OF APPLICANTS

A combined new project group was established consisting of professors from different engineering disciplines and faculty of economics, representatives from the industry and the "Norwegian National Business and Industry Confederation". This project group was under the leadership of professor Per T. Kirkebak, having a PhD in Entrepreneurship. One of the first questions to deal with was recruitment for this new bachelor program, and which student groups at the high schools to target. Traditional engineering education demanded high skills in physic's and mathematics' for entering. The number of students coming out of high school with advanced curriculum in physic's and mathematics' had been falling since 1995, and all types of engineering educations in Norway and Europe was suffering from it. It was a high risk that a new kind of bachelor program would suffer from this, if it was to have its basis on engineering education. The number of applicants for traditional engineering education was low, and the other engineering programs would have to suffer if a new program showed up. The young enterprise program was well established in the high schools in the county of Østfold, and students taking this program were naturally a prime target for the new technopreneurship bachelor. But the majority of these students did not have advanced curriculum in physics and mathematics'. This huge group of students was out of question for recruitment if standard engineering curriculum was chosen. The project group decided not to demand advanced curriculum in physic's and mathematics', but to go for the level which was used at the faculty of economy. This would raise the number of applicants for the new Technopreneurship bachelor. The students would get a standard bachelor degree in Technopreneurship, not the specialised engineering title. The key to this problem relied on the amount of physics and mathematics that was to be given during the 3 year long bachelor education, and if this was to be given, the courses in entrepreneurship and economy had to suffer. The "Norwegian National Business and Industry Confederation" did not want this to happen, they wanted more economy and entrepreneurship curriculum and less mathematics and physics curriculum. This was very surprising for the professors at the faculty of engineering, but they bowed head after some debate. It was suggested that a fourth year was to be offered for those at the Technopreneurship program who wanted to ad an engineering title to the bachelor title. This was the biggest problem tat the project group had to deal with.

No demand to have advanced curriculum in mathematics and physics from high school applicants due to:

- **Few applicants with advanced curriculum:** The number of students coming out of high school with advanced curriculum in physic's and mathematics' had been falling since 1995, and all types of engineering educations in Norway and Europe was suffering from it.
- **Target Young Enterprise participants:** The young enterprise program is well established at the high schools in the county of Østfold, and students taking this program are a prime target for the new bachelor. But the majority of these students do not have advanced curriculum in physics and mathematics'.
- **Industry turned down mathematics:** The "Norwegian National Business and Industry Confederation" did not want to reduce the mount of entrepreneurship and economy curriculum in favour of more mathematics, physics and advanced engineering curriculum. They wanted innovative persons to run development activity, not technicians.
- **4th pick up year:** If technopreneurship bachelors wanted to ad the engineering title to their bachelor degree, this could be done be giving a forth year with mathematics and advanced engineering curriculum.
- **Freedom to choose engineering degree:** Since the technopreneurship bachelor is a multidisciplinary engineering program, combining courses from electronics and mechanics, at 4th year would give the student the possibility to choose one of them, being either a bachelor of engineering in mechanics ore electronics.
- **Applicants from business and industry:** New applicants from business and industry, with their own business ideas, were a secondary target. These would be older students with valuable experience, not anticipated to have advanced curriculum from high school at all.

TECHNOPRENEURSHIP CURRICULUM

The project group had really no big debates about the multidisciplinary curriculum for the new bachelor program in technological innovation and entrepreneurship, later called Technopreneurship bachelor. The only surprising occurrence was that the "Norwegian National Business and Industry Confederation" wanted to focus on entrepreneurship and economy curriculum in favour of traditional engineering curriculum. They wanted a new engineering type that was able to understand the different engineering disciplines and focus on innovation and product development. Table 1 shows the different main disciplines in the new program and their percentage of the whole program.

Technopreneurship disciplines	%
Engineering & mathematics	47
Entrepreneurship & product development	31
Economics & project managements	22

TABLE 1
PERCENTAGE OF MAIN DISCIPLINES IN THE TECHNOPRENEURSHIP CURRICULUM

53% of the traditional engineering curriculum was replaced with entrepreneurship and economy curriculum, and the methods of teaching was to be project based, training the students to work in groups and take personal initiative. Since teambuilding is central to this kind of education, 4 one week periods of development projects was included in the first year of education. This was 2 development projects at campus, and two outside campus. The two inside campus challenged the students to finish a given task on time and one budget. In the first one the task was to build a 6m long and 2m high bridge that could carry one person with minimum of resources used. The second one was to build a computerised robot, where the different robots had to compete in the final contest. These projects were challenging and boosted motivation for theoretical disciplines. The two outside campus was one week in the mountains in the Hessdalen valley, and the other one at the Andøya rocket range in North Norway. The purpose of the two last ones was to open the minds of the students for frontline research in astronomy where no answers exist at this date. Picture 1 and 2 shows pictures from the Andøya rocket range and the bridge building.

PICTURE 1
DEVELOPMENT PROJECT IN MECHANICS, BUILDING OF A 6M X 2M BRIDGE ON BUDGET AND ON TIME

PICTURE 2
LAUNCHING OF ROCKET AT THE ANDØYA ROCKET RANGE IN NORTH NORWAY

The engineering disciplines in the curriculum are divided between, electronics and power systems, mechanics, computer aided design and product design. The design part is joust a small part only to open the minds of the students for the problems and challenges related to the design process. The different engineering topics are chosen to fit in with the traditional engineering education. Table two shows the different engineering disciplines.

Engineering disciplines	%
Mathematics	22
Physics	6
Electronics & power systems	28
Mechanics & construction	28
CAD, Computer aided design	10
Product design	6
Total	100%

TABLE 2
PERCENTAGE OF DIFFERENT ENGINEERING DISCIPLINES IN THE TECHNOPRENEURSHIP CURRICULUM

The bachelor program in technopreneurship follows the normal 3 year program for engineering education, and several of the subjects is teached in common classes for engineering and technopreneurship students. The idea of mixing technopreneurship students and engineering students is based on the wish to give the technopreneurship students a broad personal network, and give them experience in working together with ordinary engineers of different disciplines. This will hopefully give them the ability to understand and lead development processes involving persons with different technical professions. The subjects of the full 3 year long technopreneurship program are shown in table 3.

FIRST YEAR		SECOND YEAR		THIRD YEAR	
Subjects	**%**	**Subjects**	**%**	**Subjects**	**%**
Entrepreneurship	25	Product development & design	25	Project control & economy	15
Mechatronics	42	Construction & machinery	25	Financing & analyses	15
CAD, Computer aided design	16	Business development	15	Marketing	15
Mathematics	16	Young Enterprise Graduate Prog.	20	Automation & digital controll	25
		Mathematics	15	Business development project	30
Total	100	Total	100	Total	100

TABLE 3
PERCENTAGE OF AND THE DIFFERENT SUBJECTS IN THE 3 YEAR LONG TECHNOPRENEURSHIP PROGRAM

The technopreneurship program is also giving attention to the need of creating personal networks for each student outside the campus. This process is carried through by establishing a “Venture Café” where students can meet influential persons form industry and business, politics and governmental and local management. This is a meting once a month at Friday 1200, where speeches are given from influential person around special topics. Dinner ore a light meal is served after the speech, giving opportunity to discuss topics and make new acquaintances. Students are also encouraged to take part in influential organisations and apply for membership in political parties. The students will also develop business ideas and write business plans for participating in national and international business plan contests like “Venture Cup”. The Østfold College has for the two last years been in front of the national Venture Cup contest regards to number of plans and of winners. Se picture 3.

PICTURE 3
STUDENTS FROM THE ØSTFOLD COLLEGE IS AWARDED IN NATIONAL BUSINESS PLAN CONTESTS

CONCLUSION

The Norwegian Government launched in may 2004 its national strategy for entrepreneurship in the educational system, named:

"**Take the chance and do something with it ! "**

This was exactly what was done in the process of creating this new bachelor program. When the government released this new plan, a plan that supported the birth of this new kind of bachelor in technological innovation and entrepreneurship, 26 students had almost finished their first year in this program. This class consisted of very different people, in age, background and mentality. These differences were often the cause of misunderstandings and problems in project work. Married people with children had other priorities than young ones without responsibilities. Many of the students had a hard time with mathematics and subjects using mathematics, despite of the reduced demands in mathematics and reduced level. Most of the students did very well inn entrepreneurship subjects like business plan writing and business development. Most of the students were very innovative and easy to motivate. Only 4 students left the program, and 22 students are now attending the second year of the program. This was a very good result after the first year, since many of the other classes at the engineering faculty had fewer students. The result of the number of applicants from the first year was so good that the management at the university did not do any special marketing for the second year. This was a mistake which reduced the number of applicants by 50%! The lesson learned from this was that a new kind of bachelor program without a profiled name like Design and Informatics needs special attention and good marketing. It is not sure that students want to apply for this education, despite of the wishes from the government and the industry. But if you are knocked down, the only thing to do is to rise up!

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