LUND UNIVERSITY

Mixing Engineering, Business and Design Students in an International Cross-Disciplinary Course on Innovation

Johnsson, Charlotta; Nilsson, Carl-Henric

Published in:
Applied Innovation Review

2015

Document Version:
Peer reviewed version (aka post-print)

Link to publication

Citation for published version (APA):
Johnsson, C., & Nilsson, C.-H. (2015). Mixing Engineering, Business and Design Students in an International Cross-Disciplinary Course on Innovation. *Applied Innovation Review*, *1*(1), 66-75. http://scet.berkeley.edu/applied-innovation-review/

Total number of authors:
2

Creative Commons License:
Unspecified

General rights
Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.
• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: https://creativecommons.org/licenses/

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Mixing Engineering, Business and Design Students in an International Cross-Disciplinary Course on Innovation

Charlotta Johnsson
Faculty of Engineering,
Lund University, Lund, Sweden
charlotta.johnsson@control.lth.se

Carl-Henric Nilsson
School of Economics and Management
Lund University, Lund, Sweden
carl-henric.nilsson@fek.lu.se

International Market Driven Engineering (iMDE) is an international course on innovation where Swedish and Chinese engineering students are mixed with business and design students. The course is run on a yearly basis, is six weeks long and takes place in China. Both the development and the execution of the course are created as a joint project between the Swedish and Chinese instructors. The course contains lectures, coaching sessions, company visits and an innovation-project performed in teams. The course aim is to expose students to the innovation process and international collaborations, and to open their eyes to entrepreneurship. Pertex analysis reveals that the students highly value the international collaboration in the innovation-project. The number of startup companies formed by the students has also increased with the introduction of the iMDE-course.

Keywords: cross-disciplinary, international, innovation, market-driven engineering

I. INTRODUCTION

The world is becoming more international. Cutting edge marketing knowledge and engineering are becoming valuable assets on the job market in this global world. There is a lack of people with skills in both fields with the ability to connect market needs and innovations with product development, especially in an international context. International Market Driving Engineering (iMDE) is aimed at providing this knowledge and these skills. This text is taken from the course homepage[1] and is the first presentation of the course that the students are exposed to. In essence, the course aim is to expose students to innovation processes and international collaborations, and to open their eyes to entrepreneurship[2].

Figure 1: The logo used for the iMDE course, a cross-disciplinary (Technology and Management) course on innovation.

The course International Market-Driven Engineering is a joint course collaboration between Technology Management at Lund University Sweden (LU) and three schools at Zhejiang University China (ZJU). The course is developed within the framework of LU-ZJU JCIE (Joint Centre for Innovation and Entrepreneurship) and co-funding was received from STINT (the Swedish Foundation for International Cooperation in Research and Higher Education). The course aims at making it possible to intertwine the disciplines of Technology and Management in Sweden and in China in four ways: Students, Teachers, Subjects and Cultures. Design is also included in the course and is considered part of the Technology discipline.

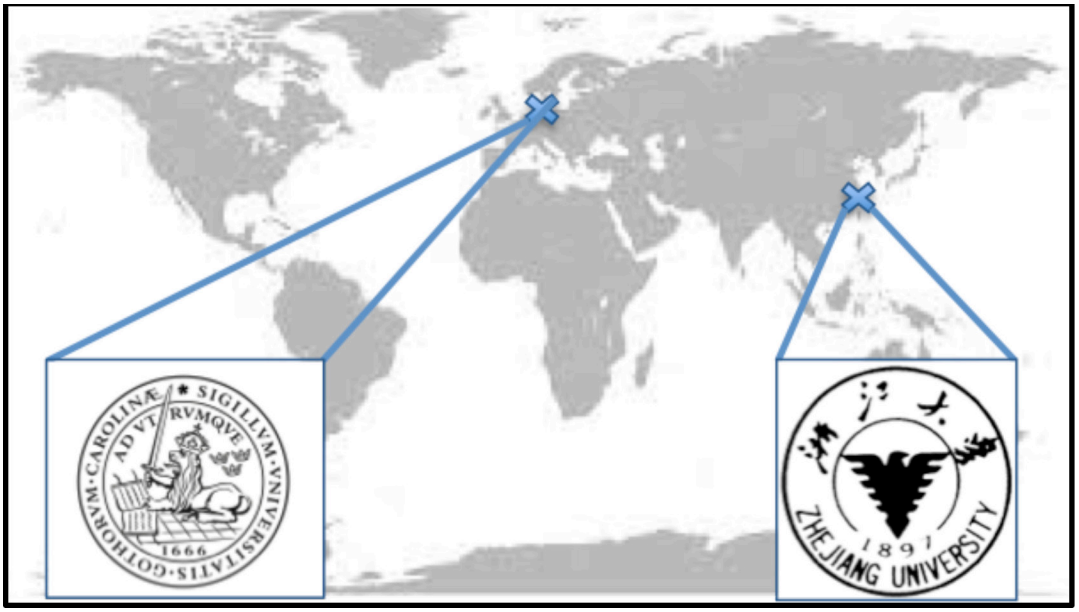

Figure 2: The course is a joint venture between Lund University, Lund, Sweden (upper-center marking in the figure) and Zhejiang University, Hangzhou, China (middle-right marking in the figure).

Swedish and Chinese instructors jointly developed the course in 2011/2012. They designed the course to be six weeks long, take place in China and use English as the course language. It was held for the first time in fall 2012 and attracts about 80 students (40 Swedish and 40 Chinese). The course has also been held in fall of 2013 and 2014.

During the course, the students work in eight teams. They work in mixed teams of about eight to ten students fully mixed between faculty, country and gender. The task of each group is to invent, design and prototype a product associated with a specific theme. The themes were 'helping every day life' in 2012; inclusion in 2013; and Cars and Clean Air in 2014. Each group develops a business plan, a marketing movie and a group-development movie.

After the first run of the course, a Pertex analysis[3] was performed in addition to the standard course evaluation. For the Pertex analysis, the students were asked to produce a text about the course in accordance with the Pertex methodology. The texts were run through the Pertex analysis and analyzed according to three dimensions: Swedes-Chinese, Engineering-Business and Male-Female. The Pertex analysis reveals that the students perceive the course partly alike and partly different.

This paper presents the iMDE course and its outcome (the yearly eight inventions); the paper also presents the evaluation results from the Pertex analysis. Reflections about how the course can be further improved are provided, thereby increasing the chances for the students to continue working as entrepreneurs. The last part of the paper presents the conclusions.

II. THE IMDE COURSE

Development Phase

The idea of developing an international course with focus on innovation was born in 2011. After initial discussions at the respective universities—Lund University in Lund, Sweden and Zhejiang University in Hangzhou, China—the course development began. The instructors that displayed interest in the course agreed that the design, development and execution of the course should be a collaboration project; they became role models for the students that later collaborated in project teams.

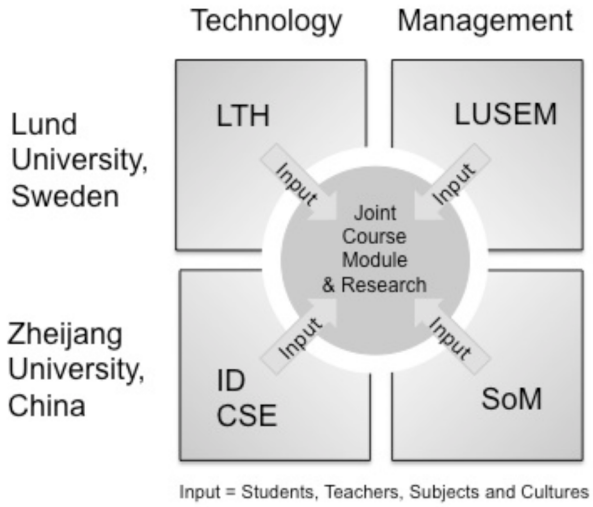

Figure 3: The parties involved in the iMDE course (iMDE-parties, 2013). From Sweden, LTH and LUSEM are involved. From China, ID, CSE and SoM are involved (ID = Industrial Design, CSE = Control Science and Engineering, SoM = School of Management).

The course intertwines the disciplines of Technology and Management in Sweden and China in four different ways: Students, Instructors, Subjects and Cultures.

For Subjects, the focus is on Innovation and Product Development, a subject that is of great relevance from the technical, economic and management aspects. The course contains both lectures and a project. For the Swedish students, the course also contains a few lectures on Chinese culture. At the end of the course, the students present their project through a written project report, a film and an oral presentation. The course is given to the 40 students from the Technology Management Program at Lund University (20 from LUSEM and 20 from LTH)[4,5] together with a minimum of 20 Chinese students (10 from SoM and 10 from the technical departments (ID and CSE)). Instructors from both Sweden and China in Engineering (LTH, ID and CSE) and Management (LUSEM and SoM) will be involved in the lectures. A minimum of two teachers with different aspects of the subject matter will be present at each lecture. The cultural aspects of project management and business behavior will be treated in the course and practiced in real life through the course project.

The design of the course took place during the academic year 2011/2012 and consisted of two face-to-face meetings lasting two days each and 16 Skype teleconference calls lasting one to two hours each. Between the teleconference calls, the instructors had time to develop their own teaching material and confirm setup with administrative personnel. Both of the face-to face meetings took place at Zhejiang University, China, allowing the Swedish instructors to also examine housing possibilities for the Swedish students.

Execution Phase

The course has been run on a yearly basis since 2012. It is held over six weeks, starting in early September and ending in late October. The students taking part in the course are split into eight mixed groups, each consisting of a mix of Swedish and Chinese students; Technology (including Design) and Business students; and Men and Women.

2012
37 Swedish students
- 18 from LTH
- 19 from LUSEM

33 Chinese students
- 12 from ID
- 12 from CSE
- 9 from SoM

2013
39 Swedish students
- 20 from LTH
- 19 from LUSEM

42 Chinese students
- 12 from ID
- 15 from CSE
- 15 from SoM

2014
40 Swedish students
- 20 from LTH
- 20 from LUSEM

25 Chinese students
- 6 from ID
- 8 from CSE
- 11 from SoM

Figure 4: Cohorts from the years 2012, 2013 and 2014 respectively.

The students that participate in the course have a set of ten lectures, providing them with materials and knowledge related to the innovation process. These include market analysis and inspiration; ideation, implementation and prototype development; and marketing and sales. The students also have access to coaching sessions where they can discuss their projects with the instructors. The course also includes two company visits.

In addition to the lectures, the students practice the innovation process in real life though the execution

of a project. The students work in eight international and cross-disciplinary teams of eight to ten students per group. The teamwork gives the students valuable insights into and experience with working in an international context. The groups are responsible for running a project of their own within a common theme. The theme is relatively open to allow ample room for the students to define a specific topic for their group. The deliverables from the student groups are:

- A market and business plan for their product
- A physical prototype of their product
- A marketing film for their product
- Documentation of the group process by filming their work along the way
- An oral presentation of their market and business plan
- A written report containing a market and business plan

III. OUTCOME

At the final presentation of the course, each student group makes an oral presentation of about 15 minutes. At the presentation they should argue their innovation from the three perspectives of Feasibility, Viability and Desirability. These three perspectives mirror the three central characteristics of a successful innovation and highlight the importance of collaboration between design, business and engineering students.

While engineering students know if and how a technical innovation can be brought into reality (feasibility), management students can determine the market and financial aspects of bringing an innovation to the market (viability) and design students can make sure the innovation is experienced and presented in an attractive way (desirability).

2012: Helping every day life

Naptop – sleep comfortably in public places on top of your laptop.
Beddy Teddy – a teddybear for children connected to the parents' cellphone.
iLock – maintain control of your computer while taking small breaks.
SoLED Lights – a safety product for e-scooters.
EAchair – elderly accessible (EA) chairs for public places.
Onewake – waking the user up in a quiet way.
EasySpace – everyday life recycling made easy.
PoPo – a photo-receiving phone making interaction with family members easy for elder people.

2013: Inclusion

UniteMe – a service for foreign students coming to a Chinese university.
BraceMe – baby monitoring making parents more involved in their baby's life.
BackApper – help backpackers meet and find activities.
MoveYouSeeMe – increasing road safety through the use of reflective earphones.
CharmExpress – instant beauty for everyone, anywhere and anytime.
EasyFeel - accurate measurement for visibly impaired.
ActiWe – making friends though activity.
iStick – adding technological features to the classic wooden stick.

2014: Cars and Clean Air

Aware – driving monitoring.
SlimShady – electro chromic shades that make you see.
VEM – improving the driver's ability regarding eco-driving.
The Modular Car – different sizes at different occasions.
Playground – educating all family members.
Eco Bonus Program – instant feedback regarding eco-driving performance.
EcoSense – develop the environmental friendly driving skills.
Portable AC system – ecofriendly air-conditioning system to use in the car as well as elsewhere.

Figure 5: The eight yearly inventions resulting from the iMDE-course. Each invention (left side) is also described in words (right side).

IV. PERTEX

The Pertex analysis[6] is best described as intuitive text-analysis. As opposed to traditional analysis methods, Pertex uses the text writer's frame of reference as found embedded in the text, rather than

translating to categories defined by the analyzer. Pertex uses three axiomatic human functions as the basis for analysis: objective, action and orientation. A writer writes based on his/her objectives, actions and orientations to the phenomena at hand thus producing a "fingerprint" of the text. Pertex deciphers this fingerprint thereby revealing the writer's frame of reference.

For the Pertex analysis the students were asked after the course to produce a text about the course in accordance with the Pertex methodology. The analysis setup consists of three dimensions each with two groups: Swedish-Chinese, engineering-business and male-female. The texts of the respondents have been run through a Pertex analysis for each of the eight analysis groups of (2^3 groups). The Pertex analysis reveals a nuanced picture of the meaning and utility of the course. The means of the course for seven of the groups is cooperation, teamwork, mixing of cultural backgrounds and educational background[7]. The single most wanted addition to the class involved social interaction between the working groups in the class.

The Pertex analysis further reveals that the students' take-away from the course differs most in the dimensions in the following order, arranged from most to least:
a) Attitude: (Positive – Negative). One group stood out with 2 distinct subgroups (Swedish Female Engineers). The subgroups differ in attitude toward the course: positive and negative hence affecting the whole analysis. Our view is that the explanation is found on an individual level and has nothing to do with Swedish Female Engineers as a category.
b) Home University: (Swedish –Chinese) Swedish students found more overlap with prior courses than did the Chinese students. Otherwise no major differences were found on this country/cultural dimension.
c) Major: (Engineering – Business) Business students reasoned more around goal and problem solving that did the engineers.
d) Gender: (Male – Female) Little differences were found relating to gender.

V. DISCUSSIONS

In short, the course aim is to expose students to the innovation process and international collaborations and to open their eyes to entrepreneurship. Did it succeed in its attempts?

Understanding The Innovation Process

The term innovation can be defined as "the application of better solutions that meet requirements or needs"[8]. Innovations could of course be sprung out of research; but they could also very well be based on new insights or market-discoveries. The latter type of innovations could be generated by undergraduate or graduate students as well as by senior researchers[9]. The iMDE-course includes aspects such as Inspiration-Ideation-and-Implementation from the innovation-process. Through the innovation project, the students gain hands-on experience on the three aspects.

Views On International Collaborations

Samples of the students' feedback on the aspect of international collaboration states:

- "The best with the course was to meet students from other country and different culture."
- "I think how to work in a group with different culture and in a free environment is the best thing. As a group, we should overcome the language, the culture, a lot of difference between two countries. But we worked well and understood each other very well."

- "In my opinion, the group work mixed with different professional background students from different countries is most attractive."
- "The cultural differences became very clear clear in the course, this gave us a possibility to learn from each other. By working in this cross-cultural setting I was given an experience and a possibility for learning that I believe I will never again get. Thank you!"

The feedback indicates that many of the students learned a lot from the international collaboration setup used in the course. Many of the students will work in international contexts after graduation, implying that the experience is valuable independently of their career path (entrepreneurs or not). This is also confirmed though the Pertex analysis[10]. The overall result reveals that there is an overwhelming advantage to mixing groups of students in many dimensions for academic work involving innovation, business planning and marketing. Hence, international collaboration is strongly recommended because it has proven to be very appreciated.

Impact On Career Choice

To find the frequency of entrepreneurship, we compared Swedish students from the three years who had taken 14 Technology Management classes prior to iMDE to those who did not enroll in iMDE. This revealed that, before the introduction of the iMDE course, ≤1 of 40 students (one student every other year) pursued an entrepreneurship career directly following graduation. In the three classes taking the course, 1-4 out of 40 chose entrepreneurship, an increase of about 500%. The course increases the number of startups among the students.

Possible Post-Course Improvement

One of the groups from the 2012 cohort continued collaborating after the course and have since applied for and received a patent in China. This work was all performed outside of their studies.

Presently, there is no help for students that wish to continue their work on innovation. It would be helpful to create a succeeding course on entrepreneurship that interested students could take. In this course, they could move forward with their invention and learn about fund-raising, pitching and entrepreneurial mindsets. These are aspects that are currently not included in the iMDE course.

VI. CONCLUSIONS

The world is becoming more international. Cutting edge marketing knowledge and engineering are becoming valuable assets on the job market in this global world. There is a lack of people with skills in both fields with the ability to connect market needs and innovations with product development, especially in an international context. International Market Driving Engineering (iMDE) is aimed at providing this knowledge and these skills.

The iMDE course was developed 2011/2012 and has since been run on a yearly basis. The course is six weeks long, takes place in China, and uses English as the course language. In the course, the students are grouped in eight teams of eight to ten students each. Each group consists of a mix of: Swedish and Chinese students; technology and business students; and men and women. For a course that strives to encourage innovations, it is vital to have diversity among the students. In the iMDE course, the diversity is manifested in terms of gender and different academic and national backgrounds.

	Total number of students	Swedish/Chinese	Technology/Business	Male/Female
2012	70	53% / 47%	60% / 40%	54% / 46%
2013	81	48% / 52%	58% / 42%	57% / 43%
2014	65	61% / 39%	52% / 48%	33% / 67%

Table 2: Gender, Academic Background and National Background Cohort Diversity Across Three Years

The course intertwines the two disciplines of technology and management in Sweden and China in four ways: students, teachers, subjects and cultures. Design is considered part of the technology discipline. The mix of design, business and engineering students is a powerful combination because knowledge in these three disciplines mirrors the three central characteristics of a successful innovation: feasibility, viability and desirability.

Each year, the outcome of course is a set of eight inventions. However, most important is the increased knowledge, understanding and interest in innovation processes and entrepreneurship that the students gain upon completion. The increased interest is confirmed by the Pertex analysis and through the increased number of students that continue the innovation path and create startups.

REFERENCES

1. iMDE-homepage. 2013. Online. http://www.control.lth.se/Education/EngineeringProgram/TMAF10-2014.html, 150426
2. Nilsson, C-H. Technology Management - A multi-disciplinary Master Program in Lund, Proceedings of 6th International Conference on Management of Technology. June 25-28, 1997. Göteborg, Sweden. 1997.
3. Pertex-homepage. 2013. Online. https://sites.google.com/site/aaoaxiom/pta-pertex, 130705
4. Ibid. Nilsson 1997
5. Johnsson, C. and Nilsson, C-H. Teaching about Manufacturing Operations and Strategies in Higher Education. The 3rd World Conference on Production and Operations Management. August 5-8, 2008. Tokyo, Japan. 2008.
6. Helmersson. Pertex Handbok för användare (User manual in Swedish). 2010.
7. Nilsson C.-H., Johnsson C., Helmersson H. Evaluation of a cross-cultural, cross-faculty course – iMDE international market-driven Engineering using traditional course evaluation and Pertex. 22nd Nordic Academy of Management Conference 2013. Reykjavik, Iceland. August 21-23, 2013.
8. Wikipedia. “Innovation.” 2013. Online. The term Innovation, as per 2013-10-13.
9. Johnsson C., Yang Q., Nilsson C.-H., Jun J., Larsson A., Warell A. “Fostering Automatic Control Students to Become Innovators.” 19th World Congress. IFAC 2014. Cape Town South Africa. August 24-29, 2014.
10. Nilsson, C-H., Johnsson, C., Jin, J., Yang, Q. and Luo, S. SME creation facilitation process at Universities. West Lake International Conference on SMB. Oct. 13-15, 2012. Hangzhou, China. 2012.

Authors

Charlotta Johnsson was a Visiting Scholar at the Sutardja Center for Entrepreneurship & Technology and the Fung Institute for Engineering Leadership at UC Berkeley in 2013-2014. She holds a position as Associate Professor at Lund University, Sweden where she also serves as the Program Director for the master program in Technology Management. Charlotta Johnsson has PhD in Automatic Control from Lund University, Sweden. Her research interests include technology management and innovations, entrepreneurship, automation, operations management and pedagogy. She is also teaching and advising students in undergraduate, graduate and industrial programs.

Carl-Henric Nilsson holds a position as Associate Professor at Lund University, Sweden where he also serves as the Program Director for the master program Technology Management. Carl-Henric holds a PhD in Industrial Management from Lund University, Sweden. Carl-Henric also work as management consultant at Kunskapspartner. His research interests include; technology management, strategy, innovations, entrepreneurship and pedagogics. He is teaching and advising students at undergraduate and graduate level as well as in industrial programs.