DEMOLA, THE UPCOMING WIN-WIN RELATIONSHIP BETWEEN UNIVERSITY AND INDUSTRY

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ABSTRACT

One of the main fundamental reasons behind university education, is to provide well-educated work power for industry, as well as society in large. Both parts, here university and industry, should gain by having well developed and common strategies to bridge the inherent gap between those two, though, for instance, industry close project based courses. Still, experiences show that even though benefits from this should be clear, priorities on support for this seem to be quite low, by different reasons, from both parts. To overcome that there is a need for a completely new approach, where introducing a node between universities and industry, with well-prepared full sets of concepts and ways or working with projects, would illuminate on possibilities and roles of collaborating participants. Here Demola may have the position of such a node. Demola, originating from Tampere, Finland, is a collaboration platform with focus on industry supported innovative product developments. Here industry partners contribute with low risk with product ideas, where multidisciplinary student teams meet those ideas in projects, with their own innovative proposals and prototyping. Demola has proved itself to be a success, influencing several regions in different countries in Europe to adopt this concepts. The innovative educational framework CDIO, acknowledges student practice in developing real-world systems and products. Demola's contribution to this is the close relationship with industrial partners, where 'real-world systems and products' is especially emphasized. Still, responsibilities of university partners are to provide courses within their educational systems, and where students should meet certain sets of learning outcomes. Therefore, to avoid conflicting situations, it is essential to investigate the contribution of Demola in the context of university programs and syllabuses. We will here provide experiences on that. Demola, as such, will be presented, experiences from involved stakeholders will be shown, and correspondences with CDIO syllabus and standards, will be emphasized.

KEYWORDS

University-Industry cooperation, project based work, work based learning, Computer Science, multidisciplinary projects, Standards: 1, 2, 5, 6, 7, 8.

INTRODUCTION

The fundamentals of CDIO (www.cdio.org) lie in desires from industry for educations to provide students with experiences in developing real world systems and products. Still, CDIO does, neither in the standards nor in the syllabus, explicitly point out that experiences should take place in direct cooperation with industry. Propositions from universities, according such work based learning to improve employability, do, however, point out that industry close projects are strongly encouraged. Still, while it is easy to argue about the win-win of such projects, there seems generally to be strong barriers of resistance towards actually realizing such projects, both from university and industry. Hence, approaching new fundamental ecosystems that illuminates on the roles of those two participants should be strongly encouraged.

Demola (Demola, about), originating from Tampere, Finland, is a collaborative open innovation platform for students, universities and companies. Its successful award-winning approach has influenced several other European regions to participate in the Demola network. The concept relies on well-established agreements between universities, students and companies. Companies act with low risk and may experiment on innovative real-life systems with help from multi-disciplinary student teams. Projects are controlled by contracts between a student group and a company, where satisfactory developments are financially regulated. Here, innovation is in focus which makes Demola clearly different from more practice oriented work based projects. This in turn sheds light on the ownership of the product where this lies on the student group. The corresponding company may then in case of success choose to procure the full rights of the project results.

Demola has recently been introduced in what is called Demola South Sweden (Demola South Sweden), involving several participants from academia, companies and other organizations from that region. There are e.g., economy students from Lund university, that together with software developers from Kristianstad university, provide business models and system prototypes for, e.g., Sony Mobile, or Ericsson. Besides from design-build examples, aspects on enterprise are also emphasized, that besides the core of the CDIO syllabus, furthermore meet its expanded parts.

This contribution will present how Demola generally may contribute to CDIO based learning. Learning outcomes and CDIO Standards of interest, and how to plug in Demola projects as parts of university courses, will be discussed. Especially, how that may be done in thesis work projects will be covered. Moreover, experiences from Demola projects so far will be presented. Besides from that, the concept of Demola will be further investigated, and experiences from involved stakeholders will also be presented.

ON DEMOLA

Demola started at 2008 in Tampere, Finland, with initiative from Nokia to find models for co-creation involving students and companies. Demola means ‘places where demos are done’, and relates to an open arena for innovation. Another way of putting it is to say that Demola is a meeting place for universities, students, and companies, with the intension of providing real world value through creation of innovative prototypes by multi-disciplinary student groups. Companies cannot invest in all good ideas. Demola enables companies to be able to investigate ideas with a lower cost than if companies handled all ideas themselves. Furthermore, Demola enables universities to add work based projects into education

programs, and students may receive real world project practice, industry contacts, and increase their value of being employable. A conclusion of this is that the 'win-win' of the title of this contribution actually may be extended to a win-win-win relationship.

Students of a development team have the complete IPR (intellectual property rights), but a corresponding company has the right to buy the license of the project result. Universities contribute with teachers that supervise and examine projects, where a Demola project typically is about 7.5 credits (typically 1/4 of full time studies over one whole semester). Supervision and significant support is also provided by facilitators from a Demola organization. An organization running Demola is not owned either by a company or a university. Primarily, that organization's interest is only in students and to increase innovation.

Demola proposes an agile development style (Agile development), where conceive, design, and implementation evolve through iterative collaborative steps. Recurrent meetings take place with company representatives, feedback is provided by university teachers, and Demola facilitators are continuously in the discussion and feedback loop, with supporting seminars and workshops. Students should take at least their third year to be able to apply required amount of disciplinary knowledge. Furthermore, students have recurrent oral presentations, where they pitch their work so far. They should also document their work through project plans and project reports. Figure 1 below illustrates a plan for Demola based work. Here, autumn semester 2013 is outlined.

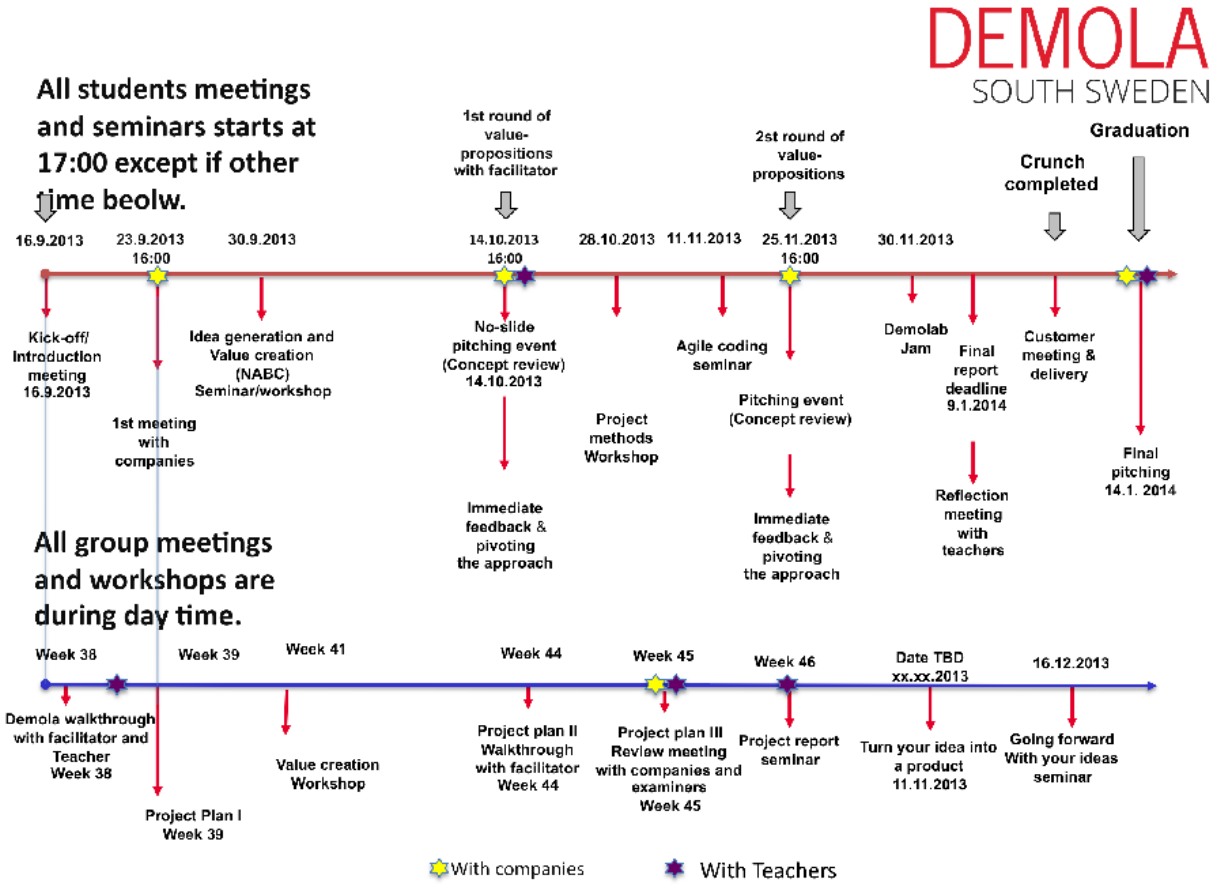

Figure 1. Theory studies on several levels

Demola has proved itself to be a successful approach where involved companies have bought all in all up to 85% of licenses of the student projects (BSR Stars – Demola). Furthermore, Demola has received the BSR Innovation Award 2012 (BSR stands for Baltic Sea Region), with the motivation: *a common open platform for where students and universities develop new products and services and together with companies create real solutions to existing problems and challenges* (Demola, award). Those facts together with desires for similar ecosystems have inspired also other European regions to adopt Demola, such as (besides from Finland): *Vilnius* (Lithuania), Budapest (Hungary), *Maribo* (Slovenia), *East Sweden* (including Linköping university ((Johansson et al., 2013)), and *South Sweden* (including Kristianstad-, Lund-, and Malmö university).

Since introduced outside the region of Tampere, it is clearly shown that Demola has inherent potentials besides from being only a local approach. Further potentials also lie in the fact that Demola may serve as a basis for international student projects. Discussions on this are ongoing, and are seen as especially interesting.

Demola South Sweden was initiated with a pilot project during spring 2013, and has continued during autumn 2013. Students from different disciplines as well as from different universities have developed projects towards companies and other organizations active in the region of southern Sweden, such as *Ericsson*, *Sony Mobile*, *AlfaLaval*, *Doctors Without Borders*, local newspapers, new startups, etc.

APPROACHING UNIVERSITY EDUCATION

For universities to approach Demola based projects, there are to start with at least three main aspects that have to be considered:

- How to take a Demola course as a program independent course
- How to plug in such course projects within a program
- How to guarantee that a Demola project meet certain learning outcomes

We will here discuss this from observations and experiences made so far, which means that we in first place regard the two latter points above. This will primarily be done in the context of Computer Science at Kristianstad University, Sweden, but where the discussions may be applicable also to other programs.

Plug in a Demola project in a program

A first obvious way to implement a Demola project in a program is to adjust the program to introduce a corresponding project course. With propositions from universities on Work Based Learning, and student employability, this may be an appropriate alternative. As has been mentioned previously, a Demola project runs as a 7.5 credit course over one semester, at ¼ speed. Still, it should be clear that significantly more effort is required at the later parts of the project, than at the earlier parts.

For Computer Science at Kristianstad University we have, so far, included Demola projects in two ways:

1. As a case study in degree work
2. As part of an existing Software Engineering course

Degree project

A first Demola pilot for Demola South Sweden took place at spring 2013. At that start up pilot the Demola projects ran half time, the second half of that semester. This fits well in time with degree work at Computer Science at Kristianstad University, where that degree work (at bachelor or master level) is a 15 credits full time job for that part of the year. With the Demola project's 7.5 credits spread over the whole semester this implies that semester's previous courses to be slightly adjusted to provide space for initial activities of Demola.

Requirements on scientific approaches as well as industry close projects are well met by the 7.5 credits from Demola, where that project may serve as a case study in a bigger disciplinary context that in turn corresponds to the other 7.5 credits part. This also meets traditional criticism towards industry close degree project for being too much 'hands on solutions', and with less effort on academic reflections.

As an example from spring 2013; Two master students from the program on embedded systems, are software developers in a Demola project group, where Sony Mobile is the corresponding company. The project task deals with systems that in easy and intuitive ways may share information to hand held devices within restricted distances. To do this the students have to study several layers of theories, as illustrated by Figure 2. To understand and implement the case study, Bluetooth was here used as a communication protocol, and an example of a technique for wireless communication were studied and used. Wireless communication is typically used in contexts of Internet of Things (Wikipedia IoT), a concept used to achieve Ubiquitous Computing (Wikipedia UbiComp), here in turn studied as an example of modern Embedded Systems.

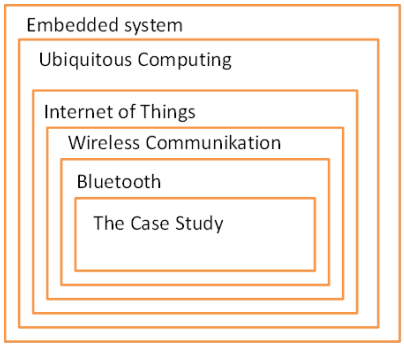

Figure 2. Theory studies on several levels

A Software Engineering course

At autumn semester 2013, students at the third, and last year of a bachelor program in Computer System Development, take a course in Software Engineering. The course is on 15 credits, and runs on ½ time for the whole autumn semester. The course in itself has been covered in previous CDIO conferences (e.g., Einarson 2012), and in that context as an example of a CDIO based project based course, with theories, labs, and a larger project. Adding a Demola project to this course was appropriately applicable where the previous course project was replaced with the Demola project, and where more effort on theories and

labs were put at the beginning of the course, and more effort were put on the project development at the later part of the course.

Meeting learning outcomes

Besides from the learning outcomes of a university course that involves a Demola project, that project also comes with required learning outcomes, with clear correspondence to learning outcomes of CDIO syllabus. While Section 1 of CDIO syllabus is not taught, but rather assumed by Demola, Sections 2, 3, and 4, are all addressed, for instance (example from a Demola course description at Demola South Sweden, with correspondences to CDIO syllabus, at level 2):

Course objectives

1. *Achieve experience in project work and project methods and management*. Corresponding to: 4.2, 4.3, 4.4, 4.5
2. *Achieve oral presentation skills*. Corresponding to: 3.2, 3.3
3. *Achieve documentation skills*. Corresponding to: 3.2, 3.3
4. *Achieve experience in developing an idea from scratch to a demo or a prototype. Corresponding to*: 2.1, 2.2, 2.3, 4.3, 4.4, 4.5
5. *Achieve team working skills*. Corresponding to: 3.1

Demola has English as first language for communication, which mean that since most of the students (Swedish, and international) don't have English as their native language, the 3.3 (as well as 3.2) is met. Even though 2.3, and 2.4 are not explicitly covered from the Demola course objectives point of view they certainly also have to be considered in one way or the other. 4.1 is partially met through contacts with companies, and depending on case, it is furthermore of significant interest to study the target context of system use. What is furthermore interesting to see is how Demola projects also correspond to expanded parts of the CDIO syllabus, such as, 4.8 on entrepreneurship. Especially, 4.8.2, 4.8.4, 4.8.5, 4.8.7, 4.8.8, are regarded, which can be seen from the perspective of multidisciplinary student teams, where typically economy students handle entrepreneurship issues.

On CDIO standards

When it comes to learning outcomes we can see that most of those from the CDIO syllabus, at level 2 are met. What is furthermore interesting is to see how Demola projects correspond to CDIO standards (CDIO standards). For instance:

- **Standard 1**. Demola projects support the view on CDIO as a whole, and contribute well to CDIO based educational program, based on the same engineering spirit.
- **Standard 2**. Demola course learning objectives contribute well to those of a CDIO based engineering program. Stakeholder from companies are directly involved.
- **Standard 5**. A Demola project corresponds here to a Design-Build example on an advanced level.
- **Standard 6**. Demola contribute with an arena for creativity and innovation. Students work together there and also meet Demola facilitators and company representatives.
- **Standard 7**. Demola contributes clearly to integrated learning experiences.
- **Standard 8**. Similarly, Demola contributes to active learning, in being one piece of a full CDIO picture.

CDIO LEARNING OBJECTS

In order to meet national demands on educational learning outcomes it is of significant importance to investigate and clarify on those for courses and programs as a whole. CDIO has proved itself to correspond well to several national educational frameworks, including the Swedish National Agency for Higher Education according engineering education, as well as UNESCO's Four Pillars of Learning (CDIO syllabus). That is, meeting learning outcomes of CDIO Syllabus, implies a correspondence with, in this case, requirements from Swedish National Agency for Higher Education.

In previous section we motivate Demola's contribution to CDIO based education, on the basis of CDIO Syllabus level 2. We will here take this a step further and investigate how well Demola contributes also at level 3.

Learning Outcomes

We arrange for questionnaires where we provide both quantitative and qualitative investigations. While the qualitative investigations are done in free forms, the quantitative investigation is mapped towards parts of the CDIO Syllabus, level 3, as shown below. It is, however, out of the scope of this presentation to have a full view on all covered learning outcomes.

2.4.1 Initiative and the Willingness to Make Decisions in the Face of Uncertainty…… 1_____2_____3_____4_____5
2.4.3 Creative Thinking…… 1_____2_____3_____4_____5
2.4.4 Critical Thinking…… 1_____2_____3_____4_____5
2.4.5 Self-awareness, Metacognition and Knowledge Integration…… 1_____2_____3_____4_____5
3.1.1 Forming Effective Teams…… 1_____2_____3_____4_____5
3.1.4 Team Leadership…… 1_____2_____3_____4_____5
3.1.5 Technical and Multidisciplinary Teaming…… 1_____2_____3_____4_____5
3.2.1 Communications Strategy…… 1_____2_____3_____4_____5
4.3.2 Defining Function, Concept and Architecture…… 1_____2_____3_____4_____5
4.4.4 Disciplinary Design…… 1_____2_____3_____4_____5
4.4.5 Multidisciplinary Design…… 1_____2_____3_____4_____5
4.4.6 Design for Sustainability, Safety, Aesthetics, Operability and other Objectives…… 1_____2_____3_____4_____5
4.5.3 Software Implementing Process…… 1_____2_____3_____4_____5

Interestingly enough, a first investigation seemed to lead to confusing reactions. Students did not know what was expected from them, and they did not seem to understand the learning outcomes in themselves. A second investigation was then prepared and implemented with further explanations on the meaning behind it. A conclusion from this is that there is a need for preparing students early in the Demola projects on what they may gain from that, in terms of learning outcomes.

Student Achievement

Below we present the result of the investigation. While there are many conclusions to draw from this, it is out of the scope to go into more details. Table 1 below presents that result from a of CDIO Syllabus level 3 perspective, while Table 2 outlines some of the best with Demola.

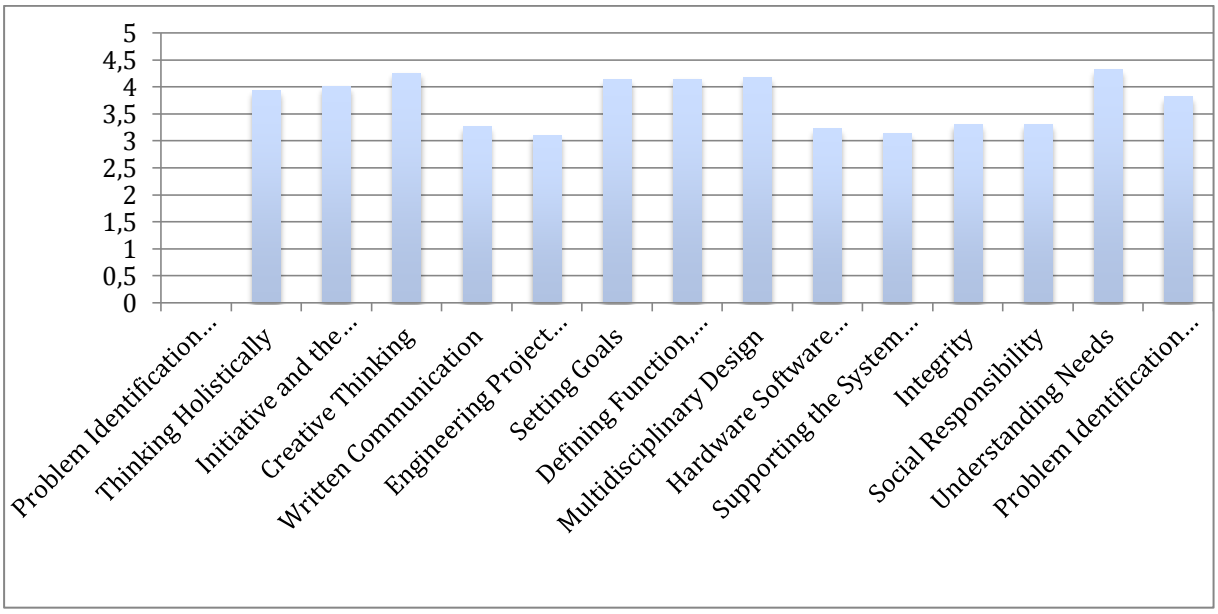

Table 1. Student achievement survey

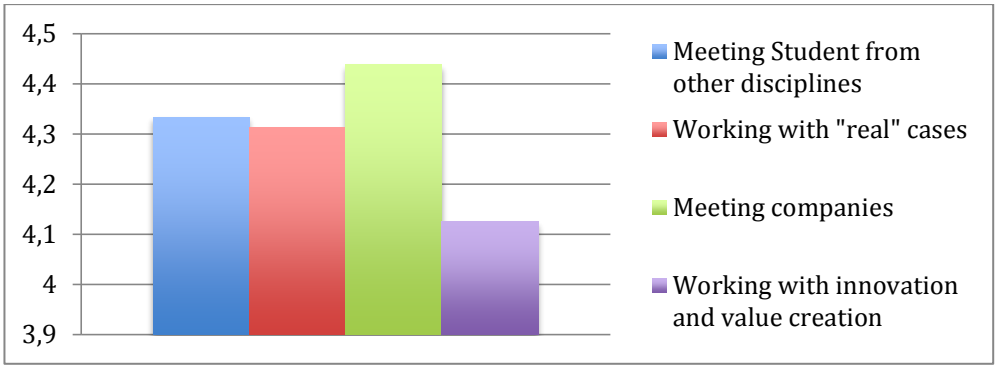

Table 2. Best with Demola

According project work: "Thank you for lettings us daring to take the risk to fail. At university you focus on getting the right grade, optimizing your planning for that. At Demola knowing that we could pass also from a project failure if we had learnt something, we could take the risk to fail and thus daring to aim high, which we did."

According employability: "Henrik, it's funny, writing my cv and job application more the 50% of my letter and experience comes from taking the Demola course."

According entrepreneurship and employability, Demola South Sweden, so far:

- 1 company being started from the first Demola course (out of 5), 2 summer jobs was provided(one for a none native swede) and 1 employment through reference were provided (for a none native swede)
- 1 company beings started from the second Demola course (out of 8).

Additional Resources

The questionnaire form can be found at (Demola, evaluation survey). The investigation tool is based on Google free software and was mailed out to students of Demola projects so far. The result of the quantitative study is accessed at (Demola, evaluation outcome).

SUMMARY

The Demola concept constitutes a node between academia and companies (and other organizations) with facilitators, and fully developed rules, for cooperation between those parts. Focus is on students, and innovative multi-disciplinary projects. Companies have a chance to experiment on ideas, academia is gained by contacts with industry partners, to provide industry close projects to students. Furthermore, students get contacts with possible future employers, and generally improve their values of being employable. That is, Demola provides an ecosystem with several winners.

Still to be applicable in educational systems we have to find suitable forms for this. On one hand a Demola project has to fit well into an educational program, it may be provided as a stand-alone course, or may be plugged in into existing project based courses, or degree project courses. On the other hand, defined sets of learning outcomes have to be met, where examiners from universities still have responsibilities for the guarantee of this.

We have here, besides from presenting the Demola concept, illuminated on how Demola projects may be included in education. We have provided examples on experiences from that, through two occasions, spring 2013, and autumn 2013. Learning outcomes of Demola based projects have been discussed and put within the context of CDIO Syllabus. We have illuminated on clear contributions from Demola to CDIO Syllabus, as well as to the CDIO standards. This has been seen in context of Computer Science, but may as well, due to its multidisciplinary approach, be seen also from other disciplines.

All in all, we have good experiences in Demola in itself, as well as in the context of education. Stakeholders, i.e., students, professors, and industrial partners, have been very satisfied so far. Demola seems to have great potentials in contributing to future multi-participatory ecosystems, with focus on innovative student projects. A further obvious and interesting contribution lies in the pedagogical discussions and developments between several academic parts, nationally as well as internationally.

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BIOGRAPHICAL INFORMATION

Daniel Einarson has a PhD in Computer Science and has several years of experience in teaching Computer Science and Software Engineering. Furthermore, he has been experimenting with several different forms for project based learning. Moreover, with inspiration from the CDIO initiative he will strive after developing the educational forms for Software Engineering even further. He is also the key contact person between Kristianstad University and the Demola South Sweden team.

Henrik Lundblad has a long industrial experience from smaller as well as larger multinational companies. Henrik Lundblad has the last years worked at Mobile Heights, a triple helix organization in Sweden, with a focus on implementing new platforms for increased innovation and entrepeneurship. He is currently working at Lund University Open Innovation Center supporting the implementation of Demola in the southern Sweden.

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