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VIRTUAL PRODUCT ENGINEERING NETWORK CROSSES INDUSTRY AND UNIVERSITY CHASM

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ABSTRACT
The engineering and design education across Europe can vary from countries and types of universities. With special focus on the situation in Germany this paper discusses an industrial view on the current situation in engineering and design education. Furthermore, the education in design engineering is mainly structured in engineering domains – e.g. mechanical engineering, electrical engineering and computer science. Established and new approaches – such as Product Lifecycle Management (PLM) or Systems Engineering – lead to new set of skills required from university educations.
The field of study "Virtual Product Engineering" (VPE) combines knowledge and skills cross classic engineering disciplines: mechanical engineering, electrical engineering and computer science. Home-based in this interdisciplinary environment the "VPE Network" was established to leverage on the one hand interdisciplinary education at universities and on the other hand benefit from an active network within the industrial base. The VPE network is an association founded in 2012 by former PhD students of the Institute for Virtual Product Engineering at the University of Kaiserslautern in Germany. The VPE Network is a community for knowledge and experience exchange of practitioners, students, researchers and friends.
This paper will conclude with a first resume on the work of the VPE Network and the presented approach. Moreover, further activities and topics are identified to enlarge the impact on design and engineering education and enable to bridge the identified chasm between industrial need and university offer in the context of engineering education.

Keywords: Product Lifecycle Management, Virtual Product Engineering, Human Factors

1 SITUATION TODAY – FOCUS ON GERMANY

The way the education in engineering and design is structured varies from global region and country. In Europe the education systems developed very heterogeneously over many years with missing interdisciplinary education in European Universities [1]. For this reason in 1992 the so called "Bologna Process" was defined to harmonize studies cross Europe [2]. Engineering studies were also in the focus of this approach.
With a special focus on the German university system this paper wants to elaborate the current situation to derive discussion and possible solution approaches. The education system in Germany had and still has mainly two types of universities: first the traditional "Full University" where the German Diploma was hold. Second, the "University of applied science" (German: Fachhochschule) where students graduated with a Diploma (FH). With the Bologna Process both types of Universities introduced the Bachelor and Master degrees and were allowed to award both grades.
Beside the type of university the basic structure of studies was segmented at German universities like in many other European countries. With a focus on the field of engineering studies, mainly the fields of mechanical engineering, electrical engineering and partially computer science were strictly divided in research silos or segments. Each field often is sub-divided in many faculties with specific research topics and educational focus.
Established and new approaches – such as Product Lifecycle Management (PLM) and Systems Engineering – lead to new set of skills required from university educations. Educational knowledge and skills required by graduates need to cross those silos and gaps to enable the right mixture of knowledge and skill set to address those approaches. As an example from industry, the importance of IT in the mechanical product "automotive" is pointed out by a statement of Matthias Ulbrich as CIO at Audi AG: "For Audi, information technology is a core competency" [3].

Based on these observations and ongoing discussions with universities and students this paper is proposing an approach to bridge this chasm – based on the example of the field of study of Virtual Product Engineering.

2 INDUSTRIAL REQUIREMENTS

From an industrial perspective this paper is focusing on manufacturing industries – including mechanical, automotive and aerospace industry. In those industry segments – especially within companies with strong roots in the German industrial base – the organizational structure is traditionally segmented according to the phases of the product lifecycle: Research & Development (R&D), engineering, manufacturing and after sales. Within R&D and engineering the organizational structure very often also represents similar fields as can be found at universities: mechanical, electric/electronic and IT.
Since a couple of years the above mentioned trends – such as Product Lifecycle Management and Systems Engineering – drive also activities, programs and finally organizational structures in manufacturing companies. This relates to new requirements towards required skill sets of the employees. For existing staff this might lead to a need of change in mind-set and skill set. For new joiner in companies this lead to new types of requirements in their education – reflected in published job advertisements.
From an educational point of view this implies two different types of challenges, which need to be addressed in education approaches to prepare students for the described situation in industrial practice [4]:

Interdisciplinary knowledge: Students working in an interdisciplinary environment or position within a company need to be able to understand discuss and add value in all involved functional areas.

Social competence: As a second dimension in this situation students need to be enabled to understand the challenges they might face when joining in an interdisciplinary position within a traditional manufacturing company. Employees who have been working in established and strongly segmented organization structures already for a long time might have strong difficulties with the new required way of working.

3 NEW APPROACH

The field of study "Virtual Product Engineering" (VPE) combines knowledge and skills cross classic engineering disciplines: mechanical engineering, electrical engineering and computer science. Home-based in this interdisciplinary environment the "VPE Network" was established to leverage on the one hand interdisciplinary education at university and on the other hand benefit from an active network within the industrial base. The VPE network is an association founded in 2012 by former PhD students of the Institute for Virtual Product Engineering at the University of Kaiserslautern in Germany. The VPE Network is a community for knowledge and experience exchange of practitioners, students, researchers and friends [5].
This paper will introduce the VPE Network approach and present first results and further outlooks on the following main areas:

Engineering education: Within this area the objective of the VPE Network is to provide industry-relevant topics and leading practice which can be leveraged in lectures and educations.

Engineering internship & thesis: Identified by the VPE Network as the major opportunity to experience "industrial reality" internships is in the special focus of the network approach. Out of the existing industrial network relevant internship positions are identified and pragmatically linked to active students at universities. By providing an informal and pragmatic platform students are supported in preparation of bachelor or master thesis. Industry-relevant topics and research questions are combined and tailored to individual situations – for students and respective company.

Student trips: As the opportunity to get "first insights" across many different companies the VPE Network is offering organized industry trips for students. As part of the overall approach students are offered to get in contact with different companies and by this providing both company and student the opportunity to exchange information and to network.

3.1 Engineering Education

The traditional education at universities is often focusing on theoretical knowledge as the basis for engineering capabilities. From an industrial perspective there are more competencies required to enable a graduate to perform in an industrial environment. For this reason many universities and institutes enlarged their offers for students with lectures including more dimensions than only theoretical knowledge. Typically those dimensions cover following aspects [6]:

- **Theory input:** For all relevant engineering disciplines of the respective lecture the required basic knowledge will be taught. This is typically split between relevant institutes and lectures.

- **Industrial focus:** Often based on alliances with universities and institutes companies provide real scenarios or existing challenges with some background information and data for the lecture.

- **Distributed team work:** As the work in industrial companies often is on a global and distributed level the student teams are faced with scenarios of distributed staffing and work split. It is possible to simulate such a situation by involving partner universities in the lecture situation.

- **Human factors:** Beside technical knowledge students realize the importance of performing as a team. The human factors or soft skills are as important as the technical skills in a collaborative situation.

To support such new formats of lectures in engineering education the VPE Network supports and coordinates contributions from industrial companies tolectures and practical courses. This helps to fulfill the objective of the association to enable exchange of information and experience in the context of engineering and design work.

3.2 Engineering Internship & Thesis

The collaboration of science and industry is one of the key enablers for continuous development and progress. Therefore many companies keep close cooperation with universities all over the world. The VPE Network and its members from different industrial branches are aware of this huge potential and support active students and PhD candidates in performing engineering thesis. Figure 1 shows the three main fields of interest in the pre-mentioned tension field (ref. Figure 1):

- Science
- Communities
- Industry

As Alumni of the institute VPE all members have a close cooperation to science and a lot of experience in this working field. Often active doctoral candidates or Alumni of the VPE are also involved in different industry and science communities. As an example Alumni of the VPE are often involved in working groups of the ProSTEP iViP association with focus on different topics such as Product Lifecycle Management, CAE or 3D- and structure data formats (e. g. ISO14306, ISO10303-242). As Alumni of course the main focus of the working field changed to work within the industry. There a broad range of different branches are covered by VPE Alumni's such as automotive, ship building, consulting etc. Of course also on industry side a lot of different work groups exist – with partly overlapping topics to the pre-mentioned communities and activities within science.

Now it gets obvious, that such a network build up on science activities, broaden within communities and industry is an enabler for new science and industry topics and connects highly educated experts from science, industry and communities. The connection within these different fields is shown abstractly by little documents exchanged between the science, industry and communities. The added value is therefore shown in the middle of this tension field (ref. Figure 1).

The VPE Network supports and connects students to industry partners and is platform for discussion. With their scientific background and industrial experience, the VPE Network members on the one hand help to prepare and create engineering thesis following scientific methodologies. On the other hand state of the art inputs from industry are provided. Especially in the context of VPE it is important to validate the solution concepts of engineering thesis against realistic use cases [7].
One example is an engineering thesis that has been carried out in a field of an upcoming ISO Standard, the STEP AP 242 Standard (ISO 10303-242). In this case the VPE Network provided a close collaboration in the tension field within science, industry and industrial communities. In this field many new and upcoming topics are discussed and developed. In this very fruitful working area many bachelor and master thesis were created, with benefits for both sides – science and industry.
The student worker even interacted in all three working areas. Beside science and industry the industrial communities – in this case the ProSTEP iViP association – were involved. The student worker made a very beneficial thesis in which a comparison of different formats (gap analysis) could help to create first industrial software prototypes on the one hand and to support the final development of an upcoming ISO Standard on the other hand.

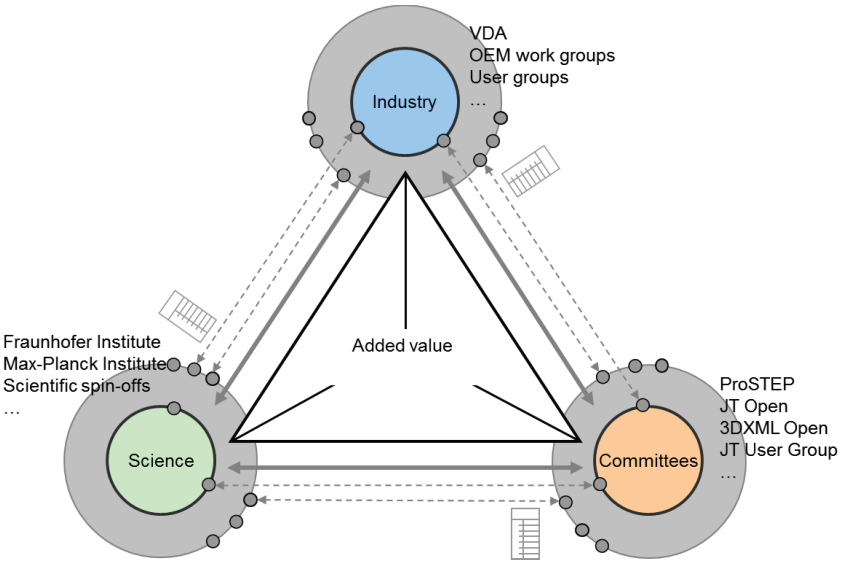

Fig.1: Cooperation of science, industry and industry communities in the context of engineering thesis [8]

Another example is an engineering thesis that aimed at a new solution concept for PLM-integrated Systems Engineering. It has been conducted by a student worker at :em engineering methods AG, a service company partnering in the VPE Network, and at the institute VPE. The intention of the student worker was to deliver a concept that is on the one hand beneficial from the point of real life industrial use cases and on the other hand raising the potentials of actual IT-solutions. In this case the challenge for the student worker was to elicit the broad topic of Systems Engineering in theory and industry while focusing on a solution concept that can be validated by a prototypical implementation. Therefore several workshops have been carried out with an industrial partner form the German automotive industry for the provision of use cases as well as for the validation of the solution concept and prototypical implementation. This close cooperation of all three partners from in the VPE network – industrial company, service company and research institute – is one of the major preconditions that made this engineering thesis successful.

3.3 Student excursions

Student excursions can be a key differentiator for both, students and industrial companies. The motivation of students to take part in excursions is mainly driven by the lack of knowledge about companies and the "real life" in business. Students want to get to know more about potential employers and their company culture. Moreover, students often believe that attending such events is positive for their CVs and demonstrate their motivation and passion as potential employee. On the other hand, companies often take the opportunity of supporting student excursion due to demands in new employees. Meaning companies want to position their brand as a potential employer as early as possible towards the future graduates.

The VPE network supports this idea together with the institute VPE and orchestrated a two day student excursion with a multi-industry-program. The program includes visits at several companies from the automotive and mechanical industry as well as a visit at a global service company. The tour provides a great opportunity to understand the spectrum of activities and potential jobs that can be addressed based on education in engineering and design. By this the VPE Network is trying to cross the often existing chasm between university education and expectation existing in industries.

The first "prototype" of such a student excursion will be launched in July 2014. Currently the VPE network, together with the respective institute, is finalizing the program of the two days and further preparation. At this point in time, first experiences show the very positive feedback of students, research students and university staff – even before the "official" marketing campaign was kicked-off.

Around 30 students and 5 research students will take part in this excursion. The major benefit for student and university perspective is the get insights in different companies and different types of "jobs of an engineer" in a very short time. On the other hand this is a great opportunity for students to figure out potential areas in industry where they might want to position themselves for entering the business world. For companies this event provides a great chance to present their company and inform the students about potential intern or trainee programs. Moreover, companies get direct access to very professional and specialized students in the field of engineering and especially Virtual Product Engineering.

Experiences made during these types of events will shape future excursions to continue bringing both sides closer – universities and industrial companies.

4 DISCUSSION

The VPE Network is an association originated in the area of research and education; trying to bridge both worlds: university and industry. At universities different kind of "alumni" groups and association do exist, with various types of focus. Having a closer look at the industry side a slightly different situation is depictured – and might provide some perspectives that can be adapted.

Especially in the service industry – where no physical products do exist and it is all about the human resource – networks and alumni programs are used to keep current and former employees together in some kind of community. From an outside-in perspective, this especially applies for those companies which are very focused and specialized in their services – and often combined with a high price segment.

5 CONCLUSION & OUTLOOK

This paper described aspects and point of views on the topic "design education" from an industrial perspective. The intention of this paper is to show where a "chasm" exists between education as it is done today and the requirements or expectations on young graduates which exist in industrial companies.

Moreover, a new approach for "crossing the chasm" was introduced – pointing out several aspects that the VPE Networks sees as critical to be addressed and which are aligned with activities of the association. This paper is part of these series of activities which the VPE Network wants to focus on – knowing at the same time that this can only be a starting point and that the approach and network will evolve and change over the time.

As one strategic initiative of the VPE Network, the launch of a new information platform is evaluated, where students are informed about specific opportunities in the area of virtual product engineering –

such as new internship, bachelor/master thesis or PhD work. The idea is to have not only open job descriptions provided, but also direct and personal contact into the respective companies via friends and members of the VPE Network. By this, the respective offers can be more easily tailored to the needs of the students – such as specific time constrains or adjustments on the bachelor/master thesis focus.

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