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Welcome

Welcome to Fredrikstad and to the 8th International Conference on Engineering and Business Education.

The ICEBE conference is the eighth in a series of annual conferences on engineering and business education, organised by Wismar University, and this year hosted by Østfold University College, Fredrikstad, Norway. Previous conferences of the series have set high standards, and we believe the deliberations at this conference will stimulate and interest all delegates as much as ever.

Climate changes, environmental challenges and sustainability development are crucial global agenda for education. A number of researchers, engineering and business education professionals as well as business stakeholders from different countries will attend this conference and debate on questions around the theme “Sharing experiences globally and educating smart living locally - Interdisciplinary Education in a Connected World” during this conference.

The conference has a mission for sharing and disseminating the recent research outcomes in engineering and business education, innovative business applications, interdisciplinary and intercultural use experiences, as well as potential market analysis and development trends for conference attendants. This conference offers a unique opportunity for academics, business and also for students from around the globe to share their broad array of knowledge, perspectives and fresh research outcomes for innovation and business applications benefiting globally and locally.

We look forward to contributions from all academic disciplines and business communities. The conference is divided into plenary sessions, paper sessions, workshops and the business-academic forum. We expect representatives from countries all over the world to the conference.

The conference is designed as a 2 day event: 1st day for academic paper sessions, 2nd day for Business forum/EXPO with accompanying visiting program to an appointed local Norwegian business corporate. It is meant to provide representatives from business and sciences an opportunity to present their current work to peers, to engage in discussion and exchange – and to further expand their existing networks. We look forward to your contributions and will be delighted to have you on the program for our 8th ICEBE annual conference in Fredrikstad, Norway.

We wish to thank all of the sponsors, without whom it would have been impossible to hold this conference with such an impressive programme; the large team of committee members, who have worked tirelessly to put the conference together, but surely most of all the presenters and you the participants.

We hope you will also enjoy the chance to explore also the countryside of the Region around Fredrikstad.

Best wishes to you all.

Professor Norbert Grünwald
Wismar University
Wismar/Germany

Professor Kamil Dursun
Østfold University College.
Fredrikstad/Norway
These proceedings are a collection of original selected papers, which were accepted after the abstracts and full papers submitted were refereed by a panel of local and international peer evaluators, each a specialist in his or her own field. Every effort has been made to include only those papers that are of a high, scientific standard. The organisers and publishers do, however, not accept any responsibility for any claims made by the authors.

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INTERDISCIPLINARY EDUCATION IN A CONNECTED WORLD

STUDENT RESEARCH AND DEVELOPMENT TEAMS (SR&DT) –

PRACTICE PARTNERSHIPS BETWEEN INDUSTRY AND UNIVERSITIES,
INTERDISCIPLINARY AND INTERNATIONAL EDUCATION RELATED TO PRACTICE

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Abstract: With more than 17,000 islands Indonesia is one of the largest archipelagos of the world. This inducts a huge national development task. But it also holds the chance to become one of the world’s forerunners creating sustainable regional and local human-environment systems. Core problem of the development of small, outer islands is how to initiate and to sustain economic & social development whilst protecting environment/abundant biodiversity. The paper addresses this problem by presenting a holistic and integrated development approach. Under the framework of the Sustainable Island Development Initiative (SIDI), several interdisciplinary projects have been launched. The project Student Research & Development Teams (SR&DT) focuses on the intensive utilization of practice partnerships between industry and universities. The results from this project deliver valuable input for the elaboration of well-considered island development strategies. The paper gives an insight into two, island-specific concepts, the development of new concepts for island tourism, and the development of high-value products from tropical plants.

Keywords: Island Development, Sustainability, University-Industry-Partnership, Marine Tourism, Agroindustry

I. INTRODUCTION

This paper is a follow up of paper 1. From references.

Small, remote islands face particular challenges hampering the improvement of the social welfare of the inhabitants, in particular:

- Remote islands often face a very poor connectivity among islands in the surroundings and to other better developed regions. This is manifested in terms of low frequency, low reliability, low availability of transport and high cost of transport.
- The small size of islands makes them prone to environmental problems such as waste, lack of fresh water, degrading biodiversity which in turn lead to lower quality of life.

In spite of the fact that those small islands offer exceptionally natural beauty, the above challenges lead to severe consequences, namely low level of wealth, health and education.
Attempts of the island population to improve their situation by intensifying the exploitation of the natural resources often lead to environmental damage. As an example stands the destruction of coastal areas (fish populations, coral banks, mangrove belts) by applying destructive fishery methods.

Lessons learnt from the past show clearly that it can lead to adverse effects, if only singular measures are introduced. Here are two examples:

• One small island of only 44.6 ha with 1250 inhabitants, well-known in the surrounding area as weekend destination for recreation, extended their touristic capacities in a widely uncontrolled way. This was mainly caused by the decline of local fishery previously being the island’s main income. However, the increase in tourism did not match with the low level of sewage and waste disposal, which quickly destroys the unique marine environment and hence also destroys the island’s attractiveness required for sustainable tourism.

• In many cases, technology for energy and water supply has been installed on islands. However, frequently these plants achieve only a very short operating period. They often merely serve as short-term prestige projects. Fast break-down or becoming idle is caused by the lack of qualified operation & maintenance, but also by low identification of the island people with the “foreign” project, or even by missing connection to the island’s supply systems.

This paper addresses the problems of small / remote islands by presenting a holistic and integrated development approach. Supported by the Indonesian Government, two Indonesian islands have been selected for developing and proving “Best Practice”.

II. SIDI: SUSTAINABLE ISLAND DEVELOPMENT INITIATIVES

Indonesia is the world’s largest island state. Nusantara is another name of Indonesia - the meaning is “islands separated by the sea”. Most of these more than 17000 islands are small, with a population less than 5000 inhabitants. With a sea area of more than 3 million km², many of the Indonesian islands are located in a far distance from larger developed regions.

Whereas the main islands have already achieved considerable progress in economic and social development, the smaller islands, in particular those near to the sea boarder (the “outer islands”) still lack firm conditions for a sustainable, economic, socially prospering and ecologically friendly development.

The Indonesian Government has therefore initiated a national program targeting at the development and implementation of comprehensive (integrated) improvement schemes for about 30 smaller islands under priority. Public and private partners of research, education and business are invited to “adopt” one of these islands for initiating and conducting sustainable growth concepts, based on the specific natural, economic and social conditions of the particular island.

The “Sustainable Island Development Initiative (SIDI)” was established in November 2012, marked by collaboration agreement between ITS, the Ministry of Marine Affairs and Fisheries, the Regency of Berau (East Kalimantan) and Wismar University of Applied Sciences (Germany). From the beginning, SIDI also stands for Indonesian – German cooperation in science, education and business for the sustainable development of Indonesian islands.

Through SIDI, ITS has been appointed by the Ministry of Marine Affairs and Fisheries to "adopt" two islands, Poteran Island (Sumenep Regency, about 100 km East of Surabaya) and Maratua Island (Berau Regency, on the coastal shelf of East Kalimantan).

SIDI follows a strategy that is based on the premises that the sustainable development of even smallest islands requires

• sensitive consideration of all economic, social and environmental aspects of the specific island conditions and their interrelationships (holistic approach);

• smart-concerted interaction of all stake-holders of the island development, comprising the island population, regional administration and services, interested investors, education and research (integrated approach)

For both islands, an initial scanning of the island conditions has been conducted. Based on this assessment, for each island a preliminary development vision has been established:
Poteran Island is economically dominated by agriculture (rice, corn, beans, cassava), coastal fishery, and aquaculture (seaweed). There is almost none processing of the harvest on the island. The raw products are mainly for immediate own supply or for sales to the regional market at low price. On the other hand, the island provides rich and highly-diverse populations of valuable tropical plants such as MoringaOlifera, some of them having outstanding properties. This potential remains widely unused or the cultivation and processing is done at low quality level. Causes for the insufficient exploitation of the rich natural bio-resources are mainly to be found in the low education level of the island population. Poteran Island is projected to become a center of value-added agroindustry.

The socio-economic development of the island is supposed to be driven by the cultivation and local (pre-) processing of tropical plants with high value-added potential. The extraction of herbal substances with high market potential in nutrition, cosmetics or pharmacy is viewed potential. Usage of biomass of the plants’ remains should serve as an alternative and renewable energy source.

Maratua Island is traditionally living from coastal fishery (live groupers, napoleon wrasse, lobsters), with only few potential for agriculture. Now, the fishery is declining, mainly caused by overfishing and destructive catching methods. The island has an exceptional beautiful marine environment, being located within the coral triangle and having a rich biodiversity of tropical marine species (reef fishes, sea and green turtles, coconut crab, etc.). Marine tourism has been started to develop, driven by few (external) private investors and by (low-level) homestay offers. However, the socio-economic effects of the tourism activities on the island remain insignificant until now. This is mainly caused by the underdeveloped island-infrastructure, with large problems in energy and water supply, by insufficient accessibility of the island, but also by a low level of education, health and other community services.

Maratua Island is projected to be a sustainable marine tourism island. The challenge is to develop and implement a form of marine island tourism being a) well-attractive for paying (national and international) tourists, b) providing considerable income opportunities for the island population, and c) protecting the unique environment on the island and around. Clearly, the touristic business development has to be supported by investments in (renewable) energy supply, clean water supply, disposal & waste recovery solutions, by improving the island accessibility including information & communication, and by considerable improvement of education and health services on the island.

III. STUDENTS RESEARCH & DEVELOPMENT TEAMS

University-Business-Partnerships between higher education institutions and business partners in Germany and developing countries

The competitiveness of the global economy is increasingly dependent on whether there are sufficient and appropriately qualified employees available. In many developing and emerging countries, there are considerable differences between the capabilities of university graduates and the qualifications required by the industry. The lack of practical relevance means that university graduates are unable to find adequate employment opportunities. "Brain drain" on the one hand and the employment of imported specialists on the other hamper the economic development. Therefore, interaction between higher education institutions and enterprises is required. The "University-Business-Partnership" programme of the DAAD (German Academic Exchange Service) is intended to bring about a transfer of knowledge to foster close ties between universities and industry, thereby bridging the gap between university graduates and business communities and strengthening the dialogue between higher education and industry, thus being able to better satisfy the requirements and developments of the job market in the future.

Student Research and Development Teams (SR&DT) of Wismar University and ITS Surabaya

Wismar University and ITS Surabaya, in cooperation with industry partners from Indonesia and Germany and with the local administrations of the two adopted islands applied for grant at the DAAD “University – Business-Partnership” programme with a project called “Student Research and Development Teams (SR&DT)”. The highly-interdisciplinary joint
project “Student Research and Development Teams (SR&DT)” are assigned by the industry partners and by the local administration to deeper explore the conditions and development opportunities on the islands, doing necessary “pioneering work” for the establishment of profound island development decisions.

How can the teams of students support the sustainable economic and social development on the islands? Enterprises deliver ideas for products or processes or service developments for the development of the Indonesian islands. ITS and enterprise select jointly for each idea a team of ITS students from various disciplines/faculties/gender. Training on non-technical skills is provided to the students including leadership, teamwork, project management, creativity and entrepreneurship. The focus of the teamwork is less on scientific disciplines but more on research domains (e.g. green energy, water-and waste technology), associating them more closely with related or complementary fields (including humanities, social sciences, entrepreneurial and management skills) and fostering interaction between disciplines and sectors. The SR&DT are working together for at least 6 months on the idea to bring it closer to the market. They do their work during their internship or in parallel to their study. Each SR&DT has supervisors from university and from enterprise.

In batch 1 two SR&DT have been established and prepared since November 2013. In June 2014, both teams conducted their first excursions to the islands of Maratua and Poteran. The teams have been assigned with tasks closely related to the specific development problem of these two islands:

- Maratua Team: Exploitation of opportunities for the establishment of an autonomous energy supply on Maratua Island, using containers with solar plants and wind generators combined with liquefaction of carbohydrates (oil production);
- Poteran Team: Exploitation of opportunities for the development of Poteran Island based on the Fair Trade system, starting with the zoning of the prospective commodities and the available capacities (community, people, and capabilities)

Besides the valuable input these teams will contribute to the sustainable island development, there are some very effective feedback effects for all participating partners:

- Students obtain a deep insight in real-life problems, the demands of the job market. By working in interdisciplinary teams they improve their problem solving and soft skills and thereby raise their employment prospects.
- Universities obtain valuable information for the improvement of their study courses in terms of practical relevance and problem solving methodology.
- Industry partners and the local administrations, benefit the innovative capacity of students. This innovation works could be obtained through explorative works and developments for which there is no capacity available in daily operations in corporations.
- All partners may benefit from the networking which may form a seed for future cooperation.

Immediately after the island excursions, the teams commenced the evaluation of their findings and driving conclusions for the further explorations.

Part of the project is also the establishing of a forum for helping to understand the advantages of partnership between university and business, which should support:

- Industry awareness of how partnership can add value to their own strategic priorities,
- Faculty awareness of how partnership can benefit their own research,-
- Opportunities for university-industry collaboration that are diverse enough to meet the needs of business and universities.

The results of the SR&DT teams of batch 1 have been presented on the first “Understanding the Advantages of Partnership” forum as part of the MARTEC Conference 24-26 October 2014 at ITS Surabaya.

The announcement of two selected SR&DT batch 2 teams took place in the SR&DT/SIDI Workshop in February 2014. The focus of the workshop was the introduction and discussion of the task assignments. End of February 2015 both teams conducted their first excursions to the islands of Maratua and Poteran. In June 2015 the teams presented their first ideas and all results were presented in an interim report at the SR&DT/SIDI Workshop in September 2015.
IV. VALUE-ADDED RESEARCH & DEVELOPMENT

Based on the development visions for the two adopted islands, and on the explorative results of the SR&DT, two goal-oriented research and development areas have been derived. Their aim is to prepare respective core businesses, as the development drivers on the two islands, namely

- High-value products from tropical plants on Poteran Island
- New concept for island tourism on Maratua Island

High-value Products from Tropical Plants

Sustainable development of island regions needs value added production. Export of high-value products ensures economic base for self-driven island development. Idea for the establishment of an agro-industrial core business on Poteran Island is the cultivation of selected tropical plants and the extraction of highly-effective active substances from these plants. Besides MoringaOleifera, ten further plants on the island with high nutritional, cosmetic or medical potential have been identified. The team shall develop and test prototypes of the indispensable components of the value chain:

- Cultivation, plant processing& stabilisation, packing, shipping (on the island)
- Extraction, refinement, quality assurance (central processing facility)
- Marketing & trade in Asia and Europe (based on bio-product and fair-trade criteria)

A suitable test plantation site and interested local entrepreneurs on Poteran Island have been identified. Prototype technology will be provided by German and Indonesian industry partners. The local administration in Sumenep has agreed on financial support for related capacity building activities.

Starting with a small-scale prototype production, weaknesses in technology, product and process quality and human capacity will be identified. The whole value-chain will be continuously improved and expanded up to commercial scale. Obtaining the maximum of social benefits on Poteran Island is one of the main development objective.

In June the Poteran team of batch 2 presented their first ideas and a Moringa Cultivation Concept with the topics: Requirements Grow, Land Preparation, Plant Propagation, Cultivation, Leaf Production, Irrigation, Fertilization and Harvesting.

The Progress Report with the actual status of the works of Poteran batch 2 team has been submitted in the context with the SR&DT/SIDI Workshop at September 14th. The study presented in this report is the result of preliminary works which are still in progress. The objectives are:

- To analyse the international standard cultivation of Moringa / seaweed with concept of clean watering, fertilizing and pest protection.
- To analyze the feasibility of the establishing the prototype Moringa / seaweed production unit (washing, drying, powdering, packaging) and its logistic system.
- To analyze the feasibility of business plan to develop bio-certified Moringa / seaweed products.

New Concepts for Island Tourism

How can sustainable tourism be achieved under the limited resources and vulnerability of small islands? On Maratua Island with its 343 km² area and a population of about 3300 residents living in 4 villages, coastal fishery is the traditional and still most important source of income. The island has an outstanding beauty for maritime tourism. However, any kind of mass tourism will quickly overload the island’s capacities in terms of space, energy and water supply, waste and sewage disposal etc.

Two possible concepts have been identified which enable a necessary limitation of the number of tourists while also having the potential of economic feasibility, a) the “Cluster Resort Concept”, and b) the “Homestay Concept”. Both concepts try to balance attractiveness and economic and technical feasibility with social effects and protection of the island environment.

The Cluster Resort Concept can be considered as an “island on the island”–Within in a restricted area of the island a completely self-sustaining tourism base is developed. The base has a complete own infrastructure, including accommodation and catering, energy and water supply, shuttle service to and from the island, etc., which is exactly dimensioned to the limited number of tourists. The resort is able to operate completely independently from the overall infrastructure of the island.
Marketing offer and target customers are clearly and narrowly specified (e.g. “Coral diving tours”). With sufficient support from the local administration (providing land, licences), this concept can be implemented in a short term. It provides rich opportunities for private entrepreneurship and leads to very attractive touristic offers for a small segment of special customers. Disadvantage of this concept is its very limited effect on the overall development of the island. Even if the required start-up capital can be kept within manageable limits, there will be first of all investors from outside the island that are able to start-up with this business. The effects on improving the island’s employment are very limited as well, due to the relatively small number of staff for the resort which is in the range of 15 – 20 well-trained workers.

Possible measures to improve the fostering effect on the development of the overall island, e.g. by providing training for the island inhabitants or by offering participation in the cluster-infrastructure (cluster - village cooperation) have to be analysed.

The Homestay Concept is directly approaching the interests and capacities of the island inhabitants (households) to develop touristic offers. In the elementary form it is a family-based business, where individual family-households provide simple “Bed and Breakfast” for island tourist. This concept is less attractive as the followings are obvious, which are hardly provided by single households:

- Lack of mobility infrastructure to islands.
- Lack of decent living conditions, as reliable energy and water supply, hygienic conditions, air condition are lacking.
- Lack of attractive touristic and cultural services, including respective facilities.

To overcome these weaknesses, new forms of “Homestay-Cooperatives”, “Community-based Homestay” or “Integrated Homestay” have to be developed and tested. Also a possible cooperation or even integration of Cluster Resort and Homestay Community shall be analysed in order to find the optimum concerning the intended socio-economic and environmental effects.

The Main Theme for the Maratua team batch 2 was the Integrated Development of Maratua Island Tourism. Combined with the excursion to the island the team discussed about and conducted a SWOT Analysis. One focus was on logistics and supply including the questions about transportation and infrastructure, water and energy, the other focus was on local attractions. The results were presented in a report and were the basis for the further research.

Under the main theme Integrated Development of Maratua Island Tourism the Students developed concepts for energy provision and energy consumption and for inland transportation. The Students designed a Community Center and most suitable houses for Homestay. The results were presented at the SR&DT/SIDI Workshop in September 2015.

V. OUTLOOK

The development of small islands has as complete aspects as those of bigger islands, only the size makes it different. A comprehensive approach for development is therefore necessary. In evaluation of the initial assessment of the two adopted islands, eight Creative Fields are defined:

- Value-added products from tropical biomaterial
- Sustainable island-base tourism
- Autonomous, sustainable, renewable energy
- Autonomous, stable, clean drinking water
- Environmental protection, waste handling
- Education, capacity building, entrepreneurship
- Transportation system for small islands
- ICT to serve as a soft infrastructure

Figure 1 Intersection of “Creative Fields”

These eight areas cover a wide range of problems related to the development of small, remote islands. All six areas are highly interconnected, the optimized solutions for matching specific island conditions can be found by intersecting solutions from these Creative Fields.
The creative fields will now serve as “light-houses” for further research and development, but also for the target-oriented involvement of business activities. Small innovative enterprises, e.g. for bioprocessing, touristic, information & communication technology are already involved. The above Creative Fields have been a valuable source to start new research initiatives, such the Digital Island which is to start in 2015.

VI. CONCLUSION

Small islands provide relatively modest opportunities to setup socio-economic-ecologic models. The system boundaries can be clearly defined, and the model complexity can be kept on a manageable level.

This first phase projects of SIDI is providing a solid database for the two adopted islands, with comprehensive descriptions of the recent social, economic, and natural/environmental conditions and development trends on the islands. Based on these data, feasible development visions for both islands have been derived, and valuable input for the island development Master Plan has been provided. This provides a solid platform for effective business and investment decisions, it also uncovers the need for further research.

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Abstract: The success of business related processes requires analysis of binary customer behaviour among others. For the evaluation of business related processes realistic models are an important prerequisite. The research question is as follows: How can binary customer behavior in a business related process be modeled? In situations where binary decisions are made in business processes such as selling or buying not only the event of selling or buying is of any interest but also how concentrated goods are sold or bought. That is why models which concentrate only on the event of buying or selling with a given probability are not exact enough to describe a business related process. Thus, in this work a new model is presented that allows a realistic description of binary customer behavior based on gap processes. The aim of the research is to carry out mathematical analysis of gap processes underpinning elaboration of a model of binary customer behaviour within business related processes. The meaning of the key concepts of business related processes, binary customer behaviour and gap-processes is studied. Moreover, the analysis demonstrates how the key concepts are related to the idea of simulation model and shows a potential model for development, indicating how the steps of the process are related following a logical chain: conceptual framework → a model development → conclusions. The results of the present research show that the use of a model with only one parameter makes it difficult to project the real buyers’ distributions onto the parameters of the model. This leads undoubtedly to an inaccuracy between the model setup and the real world characteristics. In this work the theoretical basis for modelling the binary customer behavior is presented. Our model is based on the assumption that the gaps between two buyers are statistically independent on each other. The novel contribution of the paper is revealed in the newly created model of binary customer behavior based on gap processes. Directions of further research are proposed.

Keywords: Business related processes, gap-processes, binary customer behaviour, model, simulation model.

I. INTRODUCTION
For the evaluation of business related processes realistic simulation models are an important prerequisite. Such simulation models as business planning and economic forecasting (Erdman, 1993) have been developed and widely applied. Analysis of the simulation models for business planning and economic forecasting (Erdman, 1993) revealed that:
- on the one hand, these simulation models for business planning and economic forecasting focused on nonlinear and simultaneous relationships as well as dynamic processes (Erdman, 1993), and,
- on the other hand, these simulation models for business planning and economic forecasting used such economic indicators as the gross
national product as business planning is closely related with the economic system, (Erdman, 1993).

The paradigm shift in business from input based business process to the outcome based business process facilitated the creation of new simulation models.

For the creation of a new simulation model, such an everyday business situation is considered as potential customers have to solve an issue formulated already in 1603 by William Shakespeare in his play Hamlet such as "To be, or not to be" (Shakespeare, 1603). Regarding a modern interpretation of potential customers' contemporary problems, Shakespeare’s words may sound as “to buy, or not to buy”. It should be noted that “to buy, or not to buy” is considered as binary customer behavior depicted in Figure 1.

![Figure 1: Elements of customers’ binary option](image)

Binary customer behavior influences the organization of business processes. The process of buying is considered as a business related process. Figure 2 shows a typical scenario in which buying is simulated (represented by “x”) within a sequence of people (represented by “-”) who visited a shop.

![Figure 2: Simulated buying process (represented by “x”) within a sequence of shop visitors (represented by “-”)](image)

However, the buyers can be more independently distributed over e.g. a day or they can appear really concentrated as highlighted in Figure 3.

![Figure 3: Simulated bursty nature of the buying process (represented by “x”) within a sequence of shop visitors (represented by “-”)](image)

In general, the buyers probability can serve as a clear indicator of how often people decide to buy e.g. a product. However, the buyers’ probability does not deliver any information about how concentrated the buying process is.

The research question is as follows: How can binary customer behavior in a business related process be realistically modeled? The aim of the research is to carry out mathematical analysis of gap processes underpinning elaboration of a model of binary customer behaviour within business related processes.

The meaning of the key concepts of business related processes, binary customer behaviour and gap-processes is studied. Moreover, the analysis demonstrates how the key concepts are related to the idea of simulation model and shows a potential model for development, indicating how the steps of the process are related following a logical chain: conceptual framework → a model development → conclusions.

For business related processes it is important how many shop visitors buy within a given period of time. For the analysis of this issue the synergy between business and telecommunications can be used as the phenomenon of buyers in business related processes as well bit-errors in data transmission appear to be of a similar nature, namely, the bursty nature. Such models that describe the bursty nature of bit-errors in data transmission have been successfully implemented in telecommunications for optimizing data communication protocols and will be adopted in this work to business related processes.

In our work a model, which takes the concentration in the buying process into account, is presented. Focusing only on the buyer’s ratio will not be exact enough to describe a business related process realistically. Taking the buyer’s concentration as an additional parameter into account will lead undoubtedly to a more realistic model assumption. Such a realistic model is enriched by considering the concentration in the buying process that may have different reasons: an offer from a shop, a popular product of limited quantity, etc.
II. CONCEPTUAL FRAMEWORK

In order to optimize a business related process a simulation model is required. It should be noted that optimization of a business related process implies quantity of goods to be delivered, number of the staff to be employed, etc.

The term *simulation model* has been widely discussed within many scientific fields such as engineering, business and computer sciences. In order to identify the term *simulation model*, the terms *simulation, model* as well as *simulation model* are analysed below.

Simulation means a whole environment in which a task or problem is set to which the participants react (Sturtridge, 1977). The purpose of simulation is to have participants interact in meaningful and realistic contexts, generating their own discourse (Porto, 1997).

The term *model* is of great research interests as well. In pedagogy, by model a pattern is meant (Beļickis, Blūma, Koče, Markus, Skujiņa, & Šalme, 2000). In mathematics, a model is an interpretation of a theory (Kühne, 2005). In engineering, business and computer sciences, a model describes a system (Banks, Carson, Nelson, Nicol, 2004). Interdisciplinary (pedagogy, mathematics, engineering, business and computer sciences) analysis of the term *model* leads to such a newly defined notion of the term *model* as a pattern of individual’s or individuals’ interpretation of a phenomenon. A model can be described by a number of characteristics as demonstrated in Figure 4. By a characteristic a distinguishing feature or attribute of an item, person, phenomenon, etc. is meant (Business Dictionary, 2015). As an example the *bursty nature of buyers* is a characteristic in the present work. The model characteristic is described by parameters such as the buyer’s probability and the buyer’s concentration in the present contribution.

![Figure 4: Model elements](image)

By a parameter, definable, measurable, and constant or variable characteristic, dimension, property, or value, selected from a set of data (or population) to understanding a situation (or in solving a problem) is meant (Business Dictionary, 2015). It should be noted that models can be presented in a variety of forms such as verbal, graphic, computer, etc.

In turn, a simulation model presents the behavior of a system that evolves over time (Banks, Carson, Nelson, Nicol, 2004). Interdisciplinary (pedagogy, engineering, business and computer sciences) analysis of this definition brings the authors of the present contribution to such a newly defined notion of the term *simulation model* as patterns of the management of phenomenon change in real-world situations. In other words, a simulation model generates results received from the obtained data that are similar to the results of a real world scenario. A simulation model should map the characteristic of the real world business process with the required precision.

In this section the conceptual framework for modelling the binary customer behavior is presented.

The creation of a simulation model of binary customer behavior is considered within the business related process. The word *business* is related in this work to any process such as selling or buying where binary decisions are made.

In the business related process, the bursty nature of the buyers is considered. Taking the bursty nature of the buyers into account, the buyers’ ratio is not any longer sufficient to describe the characteristic of the buying process. The buyers ratio (in the following referred to the buyers’ probability $p_e$) is defined as the number of buyers divided by the number people entering e.g. a shop. Here, using a model with only one parameter is difficult to project the real buyers’ characteristic onto the parameters of the model. This leads undoubtedly to an inaccuracy between the model setup and the real world characteristics. Hence, an additional parameter has to be introduced to describe the concentration of buying in the business process.

Within the binary decision paradigm, a business related process such as selling or buying is a success, if it finishes with a deal such as a sale or a purchase or, in other words, the outcome. A gap in the present contribution means the buying process which ends without a purchase or, in other words, without the outcome. The gap is located between purchases as shown in Figure 5 and describes the time-interval between two buyers. The terms *buyers* and *purchases* are used synonymously in the present contribution. By a gap process, the buyer’s concentration as well as the buyer’s probability can be taken into account in a realistic way. Therein, the gaps between two buyers are assumed to be statistically independent from each other.

Figure 5 highlights the theoretical basis for the new simulation model, where the buying process is described by gap-processes and illustrates the process between two buyers. i.e. how often visitors buy a product and how concentrated they appear.
For the optimization of process related parameters e.g. the expected time between two buyers a model such as the proposed one can be helpful.

Figure 5: Buyer’s gap for describing binary customer behavior

III. MODEL DEVELOPMENT

Analyzing the buyers’ characteristic, we can define a block interval \( n \) (identified as the probability \( p_B(n) \)) where at least one buyer appears. The parameter \( n \) refers e.g. to the number of people entering a shop in a given time e.g. a day. Choosing the parameter \( n = 1 \) the probability \( p_B(n) \) equals the buyers probability \( p_e \).

Now we can assume that the probability \( p_B(n) \) can be described as a function of the buyers’ probability \( p_e \) and the block interval length \( n \). Here the following approximation is used (Wilhelm 1976, Ahrens, 2000)

\[
p_B(n) = \begin{cases} 
p_e \cdot n^\alpha & 1 \leq n \leq n_0 \\
1 & n > n_0 
\end{cases} \quad (1)
\]

Rewriting (1), yields

\[
\log_{10} p_B(n) = \alpha \cdot \log_{10} n + \log_{10} p_e.
\]

Therein, the value \( \alpha \) denotes the linear dependence between \( \log_{10} p_B(n) \) and \( \log_{10} n \) and is a measure for the buyers’ concentration (also referred to the concentration of buying). The value of \( n_0 \) indicates the maximum interval length to which the linear-dependence can be maintained (see Figure 6).

The analysis of concentration parameters \( (1 - \alpha) \) (referred to the concentration of buying) has shown that parameters in the range of 0.0 until 0.5 describe realistic scenarios. Thereby, a parameter \( (1 - \alpha) = 0 \) describes the situation where the potential buyers appear independently distributed from each other. With increasing parameter \( (1 - \alpha) \) the buyers appear more and more concentrated and the probability \( p_B(n) \) decreased for a given \( n \). With the assumption that the distances (gaps \( k \)) between neighboring buyers are statistically independent from each other, the buyers’ characteristic, namely the occurrence of bursty buyers, is defined by the buyers’ gap-distribution function \( u(k) = P(X \geq k) \), which describes the probability of a gap larger than \( k \). The setup

\[
p_B(n) = \begin{cases} 
p_e \cdot \sum_{k=0}^{n-1} u(k) & 1 \leq n \leq n_0 \\
1 & n > n_0 
\end{cases} \quad (2)
\]

is used to develop the buyer’s gap distribution function \( u(k) \) for the buyers’ gaps step by step. Comparing (1) and (2), one gets:

\[
\sum_{k=0}^{n-1} u(k) = n^\alpha \quad 1 \leq n \leq n_0 \quad (3)
\]

and for the searched error-gap distribution \( u(k) \) we yield:

\[
\begin{align*}
n = 1 & : u(0) = 1^\alpha \\
n = 2 & : u(0) + u(1) = 2^\alpha \\
n = 3 & : u(0) + u(1) + u(2) = 3^\alpha \\
\vdots & : \quad \vdots \\
n \leq n_0 & : u(0) + u(1) + \cdots + u(n - 1) = n^\alpha \\
\end{align*}
\]

The buyer’s-gap distribution function \( u(k) \) can be calculated as follows:

\[
u(k) = \begin{cases} 
(k + 1)^\alpha - k^\alpha & 0 \leq k < n_0 \\
0 & k \geq n_0 
\end{cases} \quad (4)
\]

Re-writing of \( u(k) \) leads to the buyers-gap density function \( v(k) = P(X = k) \), which describes the probability of a gap \( X \) equal to \( k \):

\[
u(k + 1) = v(k + 1) + v(k + 2) + \cdots
\]

\[
u(k) = v(k) + v(k + 1) + v(k + 2) + \cdots
\]
and by calculating the difference between \( u(k) \) and \( u(k+1) \) the buyers-gap density function \( v(k) = P(X = k) \) can be obtained

\[
v(k) = u(k) - u(k + 1) .
\]  

(5)

Assuming that the buyers are independently distributed, i.e. \( (1 - \alpha) = 0 \), and using equation (4) and (5) one gets the following result for the buyers-gap density function \( v(k) \):

\[
v(k) = \begin{cases} 
1 & k = (n_0 - 1) \\
0 & k \neq (n_0 - 1).
\end{cases}
\]  

(6)

With this result, the disadvantage of the model setup becomes evident. The model setup defined in (1) leads to a deterministic buyers-gap process. In situations, where the buyers appear concentrated, i.e. \( (1 - \alpha) > 0 \), one can also find an enlarged value at \( v(n_0 - 1) \). This error leads to engraving inaccuracies in the simulation process. The reason is the discontinuity at \( n = n_0 \) in equation (1). A modification of this model setup is necessary. The following solution can be assumed: The linear increases of \( \log_{10} p_B(n) \) can only be accepted for small parameters of \( n \). The value of \( \log_{10} p_B(n) \) has to change steadily into the value \( \log_{10} p_B(n) = 0 \) for larger \( n \). To the minimization of the model inaccuracy at \( v(n_0 - 1) \) equation (4) has to be multiplied by the value \( e^{-\beta \cdot k} \) [7]. For the buyers-gap distribution function \( u(k) \) the following expression arises:

\[
u(k) = ((k + 1)^{\alpha} - k^{\alpha}) \cdot e^{-\beta \cdot k} \quad 0 \leq k \leq \infty
\]

with

\[
\lim_{k \to \infty} e^{-\beta \cdot k} = 0 \quad \beta > 0
\]

and

\[
\beta \approx p_e^{1/\alpha}
\]

Figure 7 illustrates the buyers-gap distribution function \( u(k) \) for different parameters \( (1 - \alpha) \) assuming a buyer’s probability of \( p_e = 10^{-2} \). The resultant buyers-gap density function \( v(k) \) is depicted in Figure 8. Finally, the proposed system setup is revealed in Figure 9.

Now, the buyers characteristic can be modelled by two parameters (the buyer’s probability \( p_e \) and the buyer’s concentration value \( (1 - \alpha) \)).
With the assumption that the distances between neighboring buyers are statistically independent from each other the model characteristic is described completely by the buyer’s distribution function \( u(k) \). For the creation of the gap processes a uniformly distributed random number \( Y \) has to be generated and the corresponding value of the buyer’s gap is determined. For this, the following equation

\[
Y \equiv u(k)
\]

(6)

has to be solved numerically.

IV. CONCLUSIONS AND RECOMMENDATIONS

The theoretical findings on the inter-relationship between model, model elements, the bursty nature of buyers and gap processes allow determining such criteria for binary customer behaviour in business related processes as buyers’ ratio and concentration. The theoretical analysis of the term simulation model assists in the development of a model of binary customer behaviour in business related processes.

The conceptual framework on binary customer behaviour in business related processes elaborated within the present research serves as the basis for the development of the theoretical framework on a model of binary customer behaviour in business related processes as well as a simulation model for the analysis of binary customer behaviour in business related processes.

The present research has limitations. The inter-connections between model, model elements, simulation model, binary customer behaviour, the bursty nature of buyers and gap processes have been set. Another limitation is the theoretical analysis carried out only. Therein, the results of the study cannot be representative for the whole area. Nevertheless, the results of the research, namely the definitions model, model elements and simulation model, may be used as a basis of the promotion of the theoretical framework on a model of binary customer behaviour in business related processes as well as a simulation model for the analysis of binary customer behaviour in business related processes. If the simulation results had been available for analysis, different results could have been attained. There is a possibility to continue the study.

Further research tends to facilitate the promotion of the theoretical framework on the development of a model of binary customer behaviour in business related processes. The search for relevant methods, tools and techniques for evaluation of the simulation model is proposed. Future research tends to analyse the implementation of the simulation model characterized by two parameters such as buyers’ ration and concentration. Future research activities could include the analysis of gap-processes in such life-domains as cultural or religious ones. A comparative research of simulation models for the analysis of binary customer behaviour in business related processes could be carried out, too.

References

IDENTIFYING THINKING AND INSIGHTS IN COMPANY CLUSTER ENGAGEMENT

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Abstract: This paper identifies thinking and arguments from company engagement in a cluster formation project. The ambition is to develop organizational memories on critical episodes in the cluster formation. It employs the learning history tool identifying thinking, arguments and insights developed in selected companies. The outcome recognizes critical episodes and mechanisms for us to learn from not only as a single company but also as a cluster of companies especially on the tension between the cluster as something both part of the company and on the outside of the company. We suggest systematic story telling and collective reflections on past experience to improve cluster collaboration awareness and performance.

Keywords: Cluster, Learning History, Critical episodes, Knowledge and technology transfer.

Work-in-Progress paper
NOTE: This paper is not yet fully developed. We still hope the paper may form the basis for discussions on company cluster engagement. Inputs are appreciated.

I. INTRODUCTION
Clusters (Porter, 1990) are understood to contribute to increased competitiveness and productivity (Organisation for Economic Co-operation and Development, 2007) encouraging diffusion of knowledge and best practices in a region (Nauwelaers & Reid, 1995). The cluster rational and arguments have been adopted by regional governance and made a major tool to support and encourage increased competitiveness and productivity in regions.

“It (current theory) cannot yet easily accommodate a network of independent firms engaging in collaborative entrepreneurship.” (Miles, Miles, & Snow: 85)

Little attention is given mechanisms to explain how clusters contribute to increased competitiveness in companies (Andersson, 2013) and models on how to maneuver in this kind of cooperative initiatives (Rubach, 2011).

The analytical and normative shortcomings and the added complexity and challenges introduced in the intra-organizational structures and relations, renew and actualize how organizations (and networks of organizations) often fail to learn from critical episodes.

“After a major event--a product failure, a downsizing crisis, or a merger--many companies stumble along, oblivious to the lessons of the past. Mistakes get repeated, but smart decisions do not. Most important, the old ways of thinking that led to the mistakes are never discussed, which often means that they are still in place to spawn new mishaps again and again.” (Kleiner & Roth, 1997: 172)

What proves difficult in organizations may be even more difficult in a cluster setting because the network of actors, structures and activities are both
weaker (or even missing as described by Rubach, Johansen, & Andersson (2014)) and more complex than inside an organization. The incomplete tools and practices for organizational and intra-organizational learning illustrate how governance miss to acknowledge the challenges of organizational learning. A list of best practices is inadequate.

“… improve performance by bringing to a situation more than a list of “best practices” but the thinking, experimentation, and arguments of those who have encountered the same situation.” (Roth & Kleiner, 1998: 43)

This study explores how companies reflect, think and argue on own engagement and events in a cluster project to systematically improve cluster collaboration performance.

II. METHOD AND MATERIAL

In this paper we draw on the Learning history tool to make sense (Kleiner & Roth, 1997) of company cluster engagement identifying thinking, arguments and insights developed in selected companies. It is understood to enable collective reflection on past episodes in a group of people, like a modern version of community storytelling.

“As in the old practice of community storytelling, people re-experience an event together and learn its meaning collectively.” (Kleiner & Roth, 1997)

The Learning history takes the shape of a written narrative in a distinct two columns layout, organized in four sections:

1. The lead set the scene and introduce the organization.
2. The exposition develop the challenge and critical event discussed.
3. The main body in a two columns format tells the story as a dialogue between the insiders and the learning historians usually a small team of trained outsiders.
4. The ending summarizes the history but keeps an open ending to allow the history to grow and be reinterpreted as the organization change.

The Learning history is especially interesting for us because it differs from the usual consultant best practice report in the richness and divergence in both reflections and conclusions and how it is written for everyone in the organization. A Learning history may also address problematic events difficult to discuss elsewhere. Learning histories “raise issues that people want to talk about but have been afraid to discuss openly” (Kleiner & Roth, 1997).

Kleiner and Roth (1997) put forward four effects from using Learning histories:

1. They build trust in the organization and thus an environment for collective reflection and learning both as individuals and as an organization.
2. They open up discussions on difficult but important issues.
3. They actively transfer and translate knowledge within the organization.
4. They build generalizable knowledge from unique events.

The following excerpts and findings draw on a project analyzing company cluster engagement, part of a nationally funded regional research program on innovation spring 2014. Students (part of the course Organizational Development) were trained and guided by researchers, acting as learning historians in companies in two different clusters. Together with key actors in the companies they developed a total of eight learning histories on events linked to company cluster engagement. The individuals and companies are anonymized because our interest is not who, but what and how.

III. RESULTS

In exploring how companies reflect, think and argue on own engagement in a cluster project several issues are highlighted. First what kind of challenges and events the companies identify as critical episodes in own cluster engagement. Second the line of arguments developed in the dialogue between what is stated explicit and what is interpreted. Third the rational and insight, both as it is summarized in the learning history and suggested implicit in the text.

A. Case 1

The first learning history analysis why a common national regulation in 1995 triggers different solutions and split a set of common practices inside the cluster of public services.
The line of arguments includes how the environmentally motivated regulation is reduced to a reactive, economical argumentation; what do we think is cheapest? The intentions for the regulation are replaced with what is believed to be the easiest way out and a vague basis for decision-making.

Many decisions seem based on what someone thinks and not facts or systematic investigations. Organizations behave as closed systems (even when part of a cluster). It is difficult for facts, good ideas and best practice to spread in a cluster.

B. Case 2
The second learning history analysis why data acquisition involving the participating companies is so difficult even when the goal of mapping the situation as basis for shared projects for developing the sector should be important for everyone involved. “Why was the data acquisition only partly successful?”

A repeating argument is the failure to properly communicate the benefits and values for the participating companies. The same argument is used to explain challenges to anchor the project inside the companies.

Communication is difficult. Communication is especially difficult between organizations. It is a gap between the cluster project management and the participating companies, establishing an understanding of the cluster as something outside the companies.

C. Case 3
The third learning history analysis the situation where a company representative return “home” from a cluster workshop full of new knowledge, perspectives and ideas. The company wanted to use the cluster for expansion in the national market.

They see the potential and benefits from working together with other companies in the cluster. Different time horizons in the company (short) and the cluster (long) is a returning argument for the passive company role developing over time resulting in leaving the cluster project in fall 2013.

Synchronizing activities in two different domains like that of a company in a build up phase and a divergent cluster of companies and public organizations is difficult. There are also issues on how to balance expected results with resources used to exploit the opportunities given in the cluster (is it enough with one person as the link between the company and cluster?).

D. Case 4
The fourth Learning history elaborate many of the same issues found in case 3 linked to expected economical effects from taking part in the cluster versus own role and contributions in the cluster.

They link own continued participation to short term economical results but acknowledge at the same time the need to contribute over time (as they also do being part of the board in cluster). They challenge the cluster project management role as too rigid, limiting the innovative potential in the companies.

The company understand the cluster as an arena for meeting potential customers and identify market needs. They also understand the long term agenda for developing knowledge in the cluster. The presence of two partly contradictory understandings of the cluster is left open.

E. Case 5
The fifth Learning history explores results versus time and efforts put into the cluster engagement.

The company has a local perspective and argues that they do not prioritize time to cluster activities, but wants to be present and (passively) support the initiative. They argue that they are open for projects initiated in the cluster but they do not actively use the cluster in own business development.

The company understand the cluster as an arena for supporting local initiatives. The cluster is an element outside the company.

F. Case 6
The sixth Learning history builds on a search conference (Klev & Levin, 2009, Chapter 9) held November 2013 as joint venture between the cluster project and the local university college. The conference titled developed findings from the cluster mapping done earlier the same year, focusing on new business opportunities.

The dialogue centers around competence and especially formal competence. The participants experienced the search conference as a success
building relations in a fragile network. It also reminded the participants on the low engagement (illustrated in the low numbers of participants on the conference members in the cluster).

The sector suffers from lack of formal competence and lack of engagement (possibly interlinked?).

G. Case 7
The seventh Learning history investigates how a company merger affects company cluster engagement.

The old way of doing things is replaced with the new business group’s practice and the merger represents a major disruption in the workplace. The company also shift from the core of the organization to a small unit among many.

The merger introduces stress among local management and operators and moves focus from the regional cluster to the national business group. It proves difficult to communicate changes from a central group to a local workplace.

H. Case 8
The eight Learning history goes into change as a result of the growth of the cluster project. How does a cluster project organization experience the journey from an informal small network of friends to a facilitated cluster project of diverse organization and interests?

The story emphasizes how failures (like rejected applications and projects) was essential for establishing the cluster project, but also the ability to change and adapt to criteria in national research & development funding incentives.

The link to national research & development funding is a red thread. This is done continuously adapting and changing the organization as new programs and new opportunities are introduced. A cluster is seen as an organic entity.

I. Findings
Critical episodes identified in the learning histories include:
- Reacting to new national regulations relevant for the cluster
- Engaging in cluster activities like workshops and conferences
- Localizing knowledge from cluster workshops
- Balancing efforts and profits from cluster engagement
- Evaluating time used versus results achieved
- Developing sector business strategies
- Merging and takeover responses
- Adapting to funding agencies programs

Insights developed in the Learning histories include:
- Flow of knowledge and practices are difficult inside a cluster
- It is a rationality gap between the cluster project management and participating companies
- A cluster is out of sync with business (to slow on acting on opportunities)
- A cluster is an arena for meeting potential customers and new market segments
- A cluster is support for local community (not business)
- Missing formal competences and structures challenge the cluster rational
- A merger or takeover threaten cluster engagement
- A cluster needs to continuously change and transform to stay relevant and viable

IV. DISCUSSIONS
In the introduction we asked how companies reflect, think and argue on own engagement and events in a cluster project.

Findings from the Learning histories bring forward the tensions between the cluster as something the company is an integrated part of and something outside of the company, illustrated in the rationality gap described, the out of sync statements and not least the cluster as an arena for meeting customers. The cluster is understood as a commodity and something someone else should fix to match “our” needs, or else we will leave the go somewhere else (as one of the companies also did).

Andersson (2013) illuminates these tensions challenging the traditional understanding of workplace innovation describing how it in contributions from suppliers, technology and knowledge breaks the organizational boundaries.
He suggests for us to rethink and rework our understanding of competitiveness and productivity as something at the same time embedded in the workplace and going beyond the organizational boundaries. This new rationality on workplace innovation could contribute to the understanding of the cluster as a meeting point with potential allies in own workplace innovations (and not as something outside the organization).

Findings also challenge the governance assumptions of diffusion of knowledge and best practices as an effect of the cluster. Diffusion of knowledge and best practice is described as a problem, not at all solved within the structure of a cluster alone. This is important insight because it links up to the initial critique of a simplified governance adoption of the cluster concept and because it points to the weak bounds between the company and the cluster. An example of the latter is the one person returning from a workshop full of ideas, but with little impact on practices in own organization. It is the classic example of individual but not organizational learning.

Rubach (2011) introduces the “dual OD model” (Figure 2) for making sense of the challenges involved in bridging what goes on in the cluster domain and company domain.

The dual OD model identifies reflection (both in the organization and in the network) as a mechanism for translating and transporting knowledge between the two domains.

The representative (in the middle) becomes a critical part of the knowledge path and the main focus for how we could maneuver the troubled path (Figure 3).

Rubach (2011) suggests for us to think of the link between the organization and network as a bridge that the representative has to walk (do work) supported from both sides (more work and more actors), on a “surface” of converging problems and practices.

A. Conclusions

This study draws a multifaceted picture of company cluster engagement in what the companies identify as critical episodes. We are led thru discussions on national regulations, knowledge transfer, balancing resources invested, search conferences and take overs. The different episodes remind us about the different perspectives and heterogeneities in how we understand a cluster, challenging the very rational for governance support.

The Learning histories illuminate two ongoing discourses in cluster and governance literature. First, the debate on the cluster both part of the company and on the outside of the company. Second the debate on knowledge diffusion in a cluster.

We suggest using learning histories to develop organizational memories and build localized knowledge, awareness and best practices on how to maneuver in a cluster. We think it is important to develop the Learning history tool to adapt to a cluster setting, enabling collective reflections on past experiences and potentially improving cluster collaboration performance.

V. References


Abstract: This study examines active learning in an international cooperation between two universities. It defines the common forms of active learning as most relevant for faculty involved and critically examines the core element of each element. The main focus is on student research investigated employees involvement in innovation investigating firms in two regional industries in Norway and Russia.

Keywords: Innovation management, HII, EDI, active learning, student research.

I. INTRODUCTION (HEADING 1)

The globalized business and innovational environment create a growing need for managers that can operate in a variety of socio-economical and cultural conditions and capable of handling the complexities that arise while working in an international context. Training of academic teachers has been shown to improve teaching skills i.e. by increasing focus on the student and student activity, make the teaching more effective, improve student evaluation of the teacher and improve student learning (Gibbs and Coffey, 2004).

Training courses for academic teachers in early stages of the carrier might not be enough to prepare them for changing demand and new methods of teaching and Brownell and Tanner (2012) find lack of ongoing training, time and incentives to be the main barriers for changes in teaching. Training courses for academic teachers in early stages of the carrier might not be enough to prepare them for changing demand and new methods of teaching and Brownell and Tanner (2012) find lack of ongoing training, time and incentives to be the main barriers for changes in teaching.

The program, joint courses and research project provide Norwegian and Russian students with a systematic understanding of innovative management and a critical awareness of current problems together with new insights. “Cooperation management education” program is run as an international initiative between Østfold University College (HiØ) in Norway and Southern Federal University in Russia (SFedU) with the support of Norwegian Centre for International Cooperation in Education (SIU).

II. PROGRAM DESCRIPTION OF PROJECT GOALS

The overall project goal is to evolve and strengthen the academic cooperation by means of the development of courses, improvement of the quality of education through a mutual exchange of knowledge of the involved universities. To reach these objectives an outline of topics and activities is discussed below. The student benefits from international cooperation are numerous and the future carriers in enterprises and organizations could depend on how well they are managed in this context, because project managers need to be prepared for the challenges involved with working in international settings with people from other cultures. Good effective project management requires appropriately balanced combinations of explicit and tacit knowledge, professional practical experience and professional behavior. This perspective stimulates program that is designed to engender a partnership between student, university and industry. The program focuses on providing our students with integrate research in domestic and international environment, including communication, team building and motivation in international projects, as well as innovative management approach. Working
together with students from other university provides an opportunity to exchange knowledge during the study period. The international view is strengthened by studies at two different universities in two different countries.

II.1) The two participants are Østfold University College (NO) represented by the Department: Business, Languages, and Social Sciences with project manager John-Erik Andreassen (john-erik.andreassen@hiof.no). Southern Federal University (RU-SFedU) represented by the Department: Management, Innovation and Technology with project coordinator Victor Lankin (lankin@tsure.ru).

II.2) Stages in the project
In order to reach the goals of the project, there are several milestones in the project divided into topics and activities as discussed below.

II.2.1) Topics and introductory activities to develop courses with integrated research
To integrate empirical research of firms as part of education will be novel for these particular courses. However, to conduct empirical research requires access to the firms. In Østfold, useful sponsors are considered to be the local trade associate, trade union, and local government. These contacts are established. The industry to study will be discussed with these sponsors. Two industries, the IT industry and construction/building industry, are options considered to be selected for researching employees’ driven involvement in innovation (EDI) within firms both in Norway and Russia. Russian lectures have established contact with firms in similar industries in their region through local government. Students will conduct the research of firms in two industries and will be supervised by lecturers. The education research by students is planned to be four in number; two industries researched in each country. These planned researches provide the opportunity to do a comparative analysis of the involvement of employees’ in innovation in a Russian and Norwegian region. To achieve these contributions through student research is reliant on the quality of education and student interaction, as well as dependent on the academic cooperation.

II.2.2) Topics and activities to strengthen the academic cooperation
To promote student research depends on the academic staff’s ability to provide students with the necessary skills within the field. Therefore, both effort and resources will be spent to secure the motivation and engagement of the staff. It implies activities to plan improvement of education and integrate joint lecturing as part of curricula. To conduct research in the field of EDI requires updated knowledge about the subject, as well as planned activities for student research. It has be jointly planned by professors and students from the universities involved, and requires coordinated actions for project activities like joint education, research methodology, selected businesses and industries, exchange of data collected and joint lecturing within the scheduled project period. As illustrated in the project plan below, two activities are planned for this purpose. A first preparatory visit is an activity to begin the planning of the joint development of courses in the field of the subject of EDI and research methodology and activities to enhance the quality of education, and the next activity is a workshop to build competence of faculty and staff in these two fields. After accomplishing these preparations, the next activity is the start-up of teaching and supervision, where the students are introduced to the subject and the research tasks to be dealt with. To accomplish student research, the quality of education is a crucial issue.

II.2.3) Topics and activities to improve the quality of education
As part of the first preparatory visit, two issues will be addressed to improve the quality of education: The first issue is related to the methods and technique applied for improvement of students’ learning. To promote the learning environment of students in the project, active student learning forms like working in project, team work, workshops and seminars, prepare reports for feedback, in addition to lecturing will be discussed for improving the input to the learning processes. The second issue is related to how to apply these methods is to provide a higher learning outcome for students where research is an integrated part in the education. Based upon the discussions between the university parties regarding these two issues, one will form the basic learning principles applied for the education of students. During this period of education there will be an exchange of guest lecturers from both universities that follow the education principles complied with. The exchange of lecturers within a
course subject will provide another education perspective both from a culture and business point of view. That would be valuable for the students’ learning process. To motivate and activate students, interaction created between the two student groups through gatherings is an important matter.

II.2.4) Topics and activities for student interaction
Two gatherings are planned with meetings with students, where the first gathering (one group of students’ visit) taking place after research methodology has been planned. The second visit of the student group is scheduled after the student research has been accomplished. The first meeting is planned to take place after the students have been introduced to the subject matter and have organized the research. There will be performed a seminar where both students and lecturers are gathered. In this seminar student groups present their plan for feedback before starting their research process. The second meeting takes place after the students have finished their research and present their findings in a joint seminar.

Between these two periods student interactions will be performed through learning management system as well as Skype-contact. Relationships established between students group and lecturers, it will enable a learning environment to acquire mutual knowledge and understanding of each other’s culture through exchange of knowledge and competence in a specific field like EDI.

II.2.5) Topics for mutual knowledge exchange
If the students’ research deviates regarding involvement of employee driven innovation in businesses between the two countries, these differences could be discussed both from a business, regional and national point of views. It will provide an insight students otherwise would not have accessed through ordinary curricula. The integration of research in the planned education, establishment of student relationships, provides a basis for mutual understanding of culture differences, through the planned two students meetings and students contact in the period between.

II.2.6) Topics and activities to evaluate results, publication and dissemination
After the project results are analyzed and evaluated in a joint seminar, the next activity to accomplish is to start organizing publication and dissemination both of students and lecturers work. At least there four research projects are planned. In addition, another two studies could be considered to compare employees’ involvement in innovation, and to analyze the results between two different industries in two different regions in two different countries.

II.3) Project activities
The following activities are planned milestones to contribute to the achievement of the project goals:
A1: Project starts when the application is accepted by SiU
A2: Preparatory visit for jointly development of courses
A3: Workshop for competence-building of faculty and staff
A4: Joint teaching and supervision - guest lecturing
A5: Joint gathering for student interaction
A6: Students interviewing business enterprises
A7: Project results are discussed in a joint seminar
A8: Publication and dissemination - prepare papers and articles for conferences.

II.4) Evaluating the project’s risk factors
The risk factors that may hinder the implementation of the project can be divided in three groups:
Resources – availability and recruitment of students and staff. Since the project is integrated in the present education, the risk for availability and recruitment of students and staff is reduced.
Time – that the project is not conducted within the planned schedule is generally a problem for most projects. However, the project is well planned on the main activity level and with a close follow-up of the progress on these activities through regular reporting, and this reduces the risk factors that may impede the implementation.
Conducting research with firms in industries cause a risk that the activities are delayed, but this can be mitigated through close contact with the firms as well as a close student’s follow-up for collecting data.
Quality – on two levels; improving the quality of the education, and quality of research. On both levels this might be mitigated through close cooperation in the planning between the academic staff from both universities, and that the involved staff is trained for the tasks.

The risk factors on the three levels mentioned above are small, because there is established close cooperation between the universities.

III. METHODOLOGY
III.1) Theoretical models

In modern economics a major emphasis in business education has been to make the experience more authentic for students, and to instill skills that are transferable to real world applications (Cinebell & Cinebell, 2008). One target that is often stressed during higher education design and improvement is to show the importance and relevance of interdisciplinary areas working together in business operations. Applying the theories, approaches, concepts, and techniques from university business program to a specific enterprise is a challenge for the student.

Research in Education is focused on ways to optimize opportunities for students to actively engage science by direct experience, working on practical cases and field settings, interviewing with questions, collecting evidence, making interpretations, and developing “scientific habits of the mind” (NRC, 2007).

Research and Education: developing mechanisms to translate new scientific discoveries into effective instructional practice, including delivery of real-time (or near real-time) data, tools and interfaces to effectively use scientific databases, brokering collaborations between research and educational programs, and coordinating priorities between the research and educational missions.

Research on Education: using the recent advances from the cognitive and learning sciences on “How People Learn” (e.g., Leontiev 1975, Bransford et al., 2000) to optimize emerging instructional technologies (e.g. visualizations, modeling programs, virtual learning environments). This area of study also encompasses student learning motivations (Edelson, 2001, Gordeeva 2013), diversity issues and learning barriers (Zimnya 1997, Vigotsky 1983), and an complex of assessment instruments that are available to demonstrate learning outcomes.

Education in Research: instructional practices necessarily impact the research enterprise. The quality of educational experiences is a major contributing factor to the recruitment and retention of students as young scientists (e.g. Seymour and Hewlitt, 1994).

III.2) Implementation of active learning

Integrating the theoretical material with real practice and holding students accountable for making such research is something that has been beyond the reach of business educators until recently. In contrast to passive learning, active learning includes "any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing […]. The core elements of active learning are student activity and engagement in the learning process." (Prince, 2004:223).

Our project is aimed to use research-based education model for developing joint shared education within specific subjects like “innovation management”; integrating research as part of the education offered to students in both countries; introducing and developing project based student learning using local businesses as cases in both countries; preparing for common student research in the mentioned fields between the institutions involved and cooperating for dissemination of common work. To foster student activity and engagement, there are three examples of educational technologies, which are relevant for our project: Collaborative learning as team work to solve the student research task in regional firms in Norway, Russia through problem based learning, cases, project work; structured discussions, and development of intellectual products.

Student research as integrated learning and education method of different forms such as research led education, research based education, research oriented education, and research informed teaching (Griffith, 2004).

Flipped classroom as teaching outside class; use class time for active and social learning activities that require that students prepare before and after to benefit from class-work (Abeysekera og Dawson, 2014.)

III.3) Student research

Ron Griffith (Griffith, 2004) proposed four models of the links between student research and education as:

Research-led education in the sense that the curriculum is structured around subject content, and the content selected is directly based on the special research interests of teaching staff; education is based on a traditional information transmission model; the emphasis is laid on understanding research findings rather than research processes; little attempt is made to capture the two-way benefits of the research and teaching relationship.

Research-orientated education in the sense that the curriculum places emphasis as much on
understanding the processes by which knowledge is produced in the field as on learning the codified knowledge that has been achieved; careful attention is given to the education of inquiry skills and on acquiring a research ethos; the research experiences of teaching staff are brought to bear in a more diffuse way.

Research-based education in the sense that the curriculum is largely designed around inquiry-based activities, rather than on the acquisition of subject content; the experiences of staff in the processes of inquiry are highly integrated into the student’s learning activities; the division of roles between teachers and student is minimized; the scope for two-way interactions between research and teaching is deliberately exploited.

Research-informed teaching in the sense that it draws consciously on systematic inquiry into the teaching and learning process itself.

III.4) The courses with integrated student research

The overall objective to increase academic cooperation is through improvement of education in “innovation management”. Both institutions involved offer courses in these subjects. For HiØ these two courses are offered to students in the bachelor program “Business and Management”, while for SFedU these two courses are offered to bachelor students and master students. The quota students that follow the International Business program will have to write a Bachelor thesis. One available option is to offer these students to write their thesis related to employees involvement in innovation, where they can take part as a student group in the gatherings with Norwegian and Russian students. Through their attendance they will get access to information about the subject for their thesis, e.g., doing a comparative analysis of the Norwegian and Russian student group, or as an alternative to attend as a mixed group. Thus the participation of these quota students could contribute to achieving the goals of this project cooperation.

III.5) Research topic and target group

The study investigated the challenges which international research students experience in their academic studies. By understanding the challenges which these students encounter, it was anticipated that the findings could lead to the development of a practical knowledge for international students who conduct research.

The research focuses on employees’ involvement in innovation processes in firms within in two industries in the regions of Østfold and Taganrog. The students’ research will provide data collection about the researched businesses’ involvement of employees in innovation, and capability to innovate in selected industries.

III.6) Cultural background, language barrier and time management

Cultural background is other academic factor that affected international research students, particularly in terms of attitudes and expectations about teaching and learning styles of Norwegian and Russian enterprises.

A major concern for international students who study abroad is the language barrier. Language plays an important role in the academic life for international students. Both spoken and written English challenges those international students who are from non-English speaking countries, especially those with limited practice of the English language. To solve this problem we are planning to use both English and Russian language during lectures and seminars.

Beyond any language barrier, time management is another aspect which is felt to impact upon academic success. All participants in the study emphasized the importance of time management to achieve on-time completion and quality of the research.

IV. EDUCATIONAL METHODS

The program offers a mixture of conventional lectures and seminars held by guest lecturers from HiØ (Østfold University College) in Norway and SFedU (Southern Federal University) in Russia, supported by online resources and a variety of external sources of information from local industries. It benefits greatly from the use of practical oriented approach. Student presentations, team work and research project are important parts of the program.

V. EXPECTED RESULTS AND RECOMMENDATIONS

The expected results of the project are research of employees’ involvement in innovation in two industries both in Russia and in Norway. These findings will be disseminated as conference contributions, and published as articles. This will strengthened the academic cooperation of the involved universities through an increase in staff and
student mobility, an expected quality enhancement of the education, and strengthened research cooperation between the participating universities. The universities will have access to knowledge about EDI that can nurture further research within other industries and businesses that impact regional development. Businesses researched can be benchmarked against the industry target for EDI. Getting access to the results from research may enable managers in the researched regional businesses to improve performance and competitiveness of their businesses.

The results from the project will or are expected to strengthen the joint research between the partner institutions that impact the development of regional businesses and society. Added value is expected to occur from graduated when employed in different companies/official services. An improved scientific competence in the regions is expected to strengthen both businesses and social services.

A. References

Abstract: The success of interdisciplinary education requires analysis of students’ needs in interdisciplinary education. The research question is as follows: what are engineering students’ needs in interdisciplinary education? The aim of the research is to analyse engineering students’ needs in interdisciplinary education underpinning elaboration of a new research question for further studies. The meaning of the key concepts of needs analysis and domains of needs analysis is studied. Moreover, the analysis demonstrates how the key concepts are related to the idea of interdisciplinary education and shows a potential model for development, indicating how the steps of the process are related following a logical chain: interdisciplinary education → needs analysis from the students’ perspective → empirical study within a multicultural environment → conclusions. In the empirical study, explorative research was employed. Interpretive research paradigm was used. The empirical study carried out in June 2015 involved 30 engineering students. The results of the present research show engineering students’ needs in interdisciplinary education. The novel contribution of the paper is revealed in the newly formulated research question. Directions of further research are proposed.

Keywords: Interdisciplinary education, students’ needs.

I. INTRODUCTION
Design, construction and maintenance of engineering phenomenon is a complex task as engineering phenomenon may be affected by a number of circumstances which could be and could not be foreseen. This complexity issue requires engineering students’ broad understanding of social, philosophical, environmental, ethical and other contexts in which engineering phenomenon is to be integrated.

Interdisciplinary education for engineering students helps to turn the complexity issue of design, construction and maintenance of engineering phenomenon into success as interdisciplinary education ensures the holistic perspective on an engineering phenomenon. The holistic perspective ensures engineering students with a broad understanding of social, philosophical, environmental, ethical and other contexts in which engineering phenomenon is to be integrated. Interdisciplinary education for engineering students is shaped via analysis of needs from three perspectives (Zaščerinska, 2013) as demonstrated in Figure 1, namely from
- experts’ perspective,
- educators’ perspective, and
- students’ perspective.

![Figure 1: Three perspectives of needs analysis](image_url)

Particularly, the students’ perspective is highly significant as students are to apply interdisciplinary knowledge for the design, construction and maintenance of engineering phenomenon in complex...
circumstances of real life. Hence, the success of interdisciplinary education requires needs analysis from the students’ perspective. Against this background, the previous research focused on the assessment of success of students’ participation in interdisciplinary subjects through formative and summative evaluations (Golding, 2009) as well as analysis of engineering students’ attitude to interdisciplinary research (Bassus, Ahrens, Zaščerinska, 2014). The research question is as follows: what are engineering students’ needs in interdisciplinary education? The aim of the research is to analyse engineering students’ needs in interdisciplinary education underpinning elaboration of a new research question for further studies. The meaning of the key concepts of needs analysis and domains of needs analysis is studied. Moreover, the analysis demonstrates how the key concepts are related to the idea of interdisciplinary education and shows a potential model for development, indicating how the steps of the process are related following a logical chain: interdisciplinary education → needs analysis from the students’ perspective → empirical study within a multicultural environment → conclusions. The remaining part of this paper is organized as follows: Section 2 introduces the definition of interdisciplinary education as well as analysis of students’ needs. The associated results of the empirical study will be presented in Section 3. Finally, some concluding remarks are provided in Section 4 followed by a short outlook on interesting topics for further work.

II. THEORETICAL FRAMEWORK

The notion of interdisciplinary education has been identified by a number of researchers. To start with, education is identified as:
- purposefully organized
  - acquisition of society historical experiences,
  - inheritance of cultural values,
  - formation of systematic knowledge and skills, personality traits, beliefs, attitudes and values,
- the formation of appropriate practical set of actions and
- its results (Belickis, Blūma, Koče, Markus, Skujiņa, Šalme, 2000).

In education the paradigm has changed (Kincāns, 2015)
- from the humanistic mission of education
- to the level of training of specialists needed by society and production.

It means that education widely employs a competence based approach. In turn, competence is considered as knowledge, skills and attitudes (European Commission, 2004) as shown in Figure 2.

![Figure 2: Elements of competence](image)

Knowledge is the body of facts, principles, theories, practices (Commission of the European Communities, 2006, p. 16) and concepts (Zogla, 2001, p. 4).

In pedagogy, experience that is an education element (Belickis, Blūma, Koče, Markus, Skujiņa, Šalme, 2000) includes knowledge, skills and attitude (Zaščerinska, 2013) as shown in Figure 3.

![Figure 3: Elements of experience](image)

Consequently, the terms experience and competence are used synonymously in pedagogy in general and in education in particular.

Further on, students’ experience or, in other words, competence serves as an indicator of acquiring interdisciplinary education.

By discipline a particular branch of learning or body of knowledge such as physics, psychology, or history (Moran, 2010, p. 2), etc is meant. Disciplines are distinguished from one another by several factors such as (Repko, 2012, p. 4)
- the questions disciplines ask about the world,
- their perspective or worldview,
- the set of assumptions they employ, and
- the methods they use to build up a body of knowledge (facts, concepts, theories) around a certain subject matter (Newell & Green, 1982, p. 25).

Analysis reveals that a primary focus of the ongoing debate over the meaning of interdisciplinary education or interdisciplinarity concerns integration (Repko, 2012, p. 3; Griffin, Medhurst, Green, 2006, p. 11). Integration literally means “to make whole” (Repko, 2012, p. 3). In the context of interdisciplinarity, integration is a process by which ideas, data and information, methods, tools, concepts, and/or theories from two or more disciplines are synthesized, connected, or blended (Repko, 2012, p. 3).
In the present research, by interdisciplinary education, the synergy between knowledge, skills and attitude from two or more disciplines is understood. Interdisciplinary education for engineering students is shaped via needs analysis. Need is defined by the reasons for which the engineering student is learning, which will vary from research purposes such as sharing data, publishing research results to work purposes such as participating in project meetings, collaborating internationally, commercializing research product or having demonstrable impact that are the starting points which determine the educational content to be taught (Dudley-Evans and John, 1998, 3).

It should be mentioned that needs are a subjective component of motivation (Špona, Čehlova, 2004). However, the emphasis of the System-Constructivist Theory on the subjective aspect of human being’s experience does not allow analyzing the needs objectively: human beings do not always realize their experience and their wants (Maslo, 2007, 44).

Needs analysis helps to bridge the gap between the students’ needs in interdisciplinary education and the process of interdisciplinary education (Oganisjana, Koke, 2008, 225). Moreover, regular analysis of needs becomes a means of development of students’ experience or, in other words, knowledge, skills and attitude within the process of interdisciplinary education (Lūka, 2008, 7).

III. EMPIRICAL RESEARCH

The present part of the contribution demonstrates the design of the empirical research, survey results, and findings of the comparative study.

A. Research design

The design of the present empirical research comprised the purpose and question, sample and methodology of the present empirical study as illustrated in Figure 4.

![Figure 4: Elements of the design of the empirical study](image)

The empirical study was aimed at analysing engineering students’ needs in interdisciplinary education underpinning elaboration of a new research question for further studies.

The guiding research question was as follows: What are engineering students’ needs in interdisciplinary education? It should be noted that the elements of competence, namely knowledge, skills and attitude shown in Figure 2 serve as a basis for designing the survey to be carried out within the present empirical research.

The sample was composed of 30 participants of Indian Summer School for electrical engineering students held at Hochschule Wismar, University of Applied Sciences, Technology, Business and Design, Wismar, Germany, June 15 – July 26, 2015. The sample included four females (F) and 26 males (M). The age of the respondents differed from 20 to 24. All 30 students were involved in Bachelor studies in different fields of electrical engineering such communication, shipping, robotics, etc. Working experience of the students was different, too. The students represented the different regions and, consequently, cultures of India. Therefore, the sample was multicultural as the respondents with different cultural backgrounds and diverse educational approaches were chosen. It should be mentioned that the sample’s multiculturality contributes to the study of individual contribution to the development of engineering students’ interdisciplinary competence (Lūka, Ludborza, Maslo, 2009). Thus, the group (age, field of study and work, mother tongue, etc.) was heterogeneous.

The interpretive paradigm was used in the empirical study. Interpretive research paradigm corresponds to the nature of humanistic pedagogy (Luka, 2008). The interpretive paradigm aims to understand other cultures, from the inside through the use of ethnographic methods such as informal interviewing and participant observation, etc (Taylor & Medina, 2013). Interpretive paradigm is characterized by the researcher’s practical interest in the research question (Cohen, Manion, Morrison, 2003). Researcher is the interpreter. Exploratory research was used in the empirical study (Mayring, 2007). The exploratory type of the comparative study aims to generate new hypotheses and questions (Phillips, 2006). The exploratory methodology proceeds as demonstrated in Figure 5 - from exploration in Phase 1 - through analysis in Phase 2 - to hypothesis development in Phase 3.

Phase 1 Exploration is aimed at data collection. Phase 2 Analysis focuses on data processing, analysis and data interpretation. Phase 3 Hypothesis Development ensures analysis of results of the empirical study and elaboration of conclusions, hypotheses and research questions for further research.
B. Survey Results

In order to analyse the engineering students’ feedback regarding their needs in interdisciplinary education, the survey was based on the following questionnaire:

Question 1 (Knowledge): Do you know the concept of interdisciplinary education? It should be noted that concepts present forms or levels of knowledge (Žogla, 2001). Further on, knowledge is part of experience (Zaščerinska, 2013).

Question 2 (Skills): Do you take part in an interdisciplinary education?

Question 3 (Attitude): Do you wish to extent the field of your studies by interdisciplinary education?

The evaluation scale of five levels for Question 1, 2 and 3 was given, namely, strongly disagree “1”, disagree “2”, neither disagree nor agree „3“, agree “4”, and strongly agree “5”. The evaluation scale for Question 1, 2 and 3 was transformed into the level system as illustrated in Table 1.

Table 1: Indicators and levels of students’ needs in interdisciplinary education

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Levels</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students’ knowledge, skills and attitude to interdisciplinary education</td>
<td>Very low</td>
<td>low</td>
<td>average</td>
<td>optimal</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neither disagree nor agree</td>
<td>Agree</td>
<td>Strongly agree</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of Question 1 (Knowledge) reveal that
- one student’s – one male – evaluation of his knowledge of interdisciplinary education refers to the very low level,
- five students’ – one male and four female – evaluation of his knowledge of interdisciplinary education refers to the low level,
- 11 students’ – 11 male – evaluation of their knowledge of interdisciplinary education refers to the average level,
- six students’ – six male – evaluation of their knowledge of interdisciplinary education refers to the optimal level,
- seven students’ – seven male – evaluation of their knowledge of interdisciplinary education refers to the high level.

The results of Question 2 (Skills) reveal that
- 19 students’ – 16 male and three female – evaluation of their interdisciplinary skills refers to the very low level,
- four students’ – four male – evaluation of their interdisciplinary skills refers to the average level,
- seven students’ – six male and one female – evaluation of their interdisciplinary skills refers to the high level.

The results of Question 3 (Attitude) demonstrate that
- two students’ – one male and one female – evaluation of their attitude to interdisciplinary education refers to the very low level,
- one student’s – one female – evaluation of her attitude to interdisciplinary education refers to the low level,
- six students’ – five male and one female – evaluation of their attitude to interdisciplinary education refers to the average level,
- 11 students’ – 11 male – evaluation of their attitude to interdisciplinary education refers to the optimal level,
- 10 students’ – nine male and one female – evaluation of their attitude to interdisciplinary education refers to the high level.

C. Findings of the Empirical Study

The data were processed applying Excel software. Frequencies of the students’ answers were determined in order to reveal electrical engineering students’ needs in interdisciplinary education as shown in Table 2.

The survey results demonstrated in Table 2 showed that the students’ knowledge of interdisciplinary education is of the average level (36.6%), particularly, male students (42.3%). The students’ interdisciplinary skills is of the very low level (63.3%), particularly, female students (75%).
The students’ attitude to interdisciplinary education is of the optimal level (36.6%), particularly male students (42.3%).

Further on, the mean results indicated in Table 3 determine the average level of the students’ knowledge of interdisciplinary education (3.43), the low level the students’ interdisciplinary skills (2.2), and the average level of students’ attitude to interdisciplinary education.

The findings of the empirical study allow concluding that the male students demonstrated a higher level of knowledge (3.65), skills (2.42) and attitude (4.04) to interdisciplinary education in comparison to the female students’ knowledge (2.0), skills (2.0) and attitude (2.75) to interdisciplinary education.

The summarizing content analysis (Mayring, 2004) of the data reveals that the students’ interdisciplinary competence (knowledge, skills and attitude) is of the average level.

IV. CONCLUSIONS AND RECOMMENDATIONS

The findings of the present research allow drawing conclusions on the average level of electrical engineering students’ interdisciplinary competence. Therein, there is a need for the increase of the level of engineering students’ interdisciplinary competence.

The following research question has been formulated: What other disciplines are of interest of electrical engineering students?

The present research has limitations. The interconnections between interdisciplinary education, students’ knowledge, skills and attitudes to interdisciplinary education have been set. Another limitation is the empirical study conducted by involving only the electrical engineering students of one higher education institution. Nevertheless, the results of the research – the notion of interdisciplinary education - may be used as a basis of analysis of students’ interdisciplinary competence in other institutions. Further research
tends to implement empirical studies in other institutions. The search for relevant methods for evaluation of students’ interdisciplinary competence is proposed. A comparative research of universities’ different programmes and levels could be analysed. A comparative research of different countries could be carried out, too.

References
INTERNATIONALISATION OF THE ENGINEERING CURRICULUM: A TWO-DECADE JOURNEY, SPANNING THREE CONTINENTS

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Abstract: This paper describes a move to internationalize the engineering curriculum that began, following German initiatives, in the late 20th century. It provides the rationale that led to a course on professional ethics, and an overview of how the subject has evolved over the period. It reviews different cultural perspectives, following delivery in Australia, Germany and New Zealand. It concludes with a review of post-course feedback from German students – this group was chosen in light of the course being delivered in English, rather in their native language. Irrespective of this, feedback has been consistently positive. The university in which the course has been run was once part of East Germany. Although reunification in 1989 provided opportunities to embrace greater access to international mobility and the global academic community, initially the resources to accomplish this, especially to access English literature, were absent. The first two or three cohorts of students that enrolled in this ethics course began their schooling with Russian as their second language of tuition and it was to take several decades before English was widely taught. Any lack of proficiency in English however was balanced by enthusiasm to embrace new opportunities. This is reflected in their feedback.

The course is heavily based upon group work, with peer assessed student presentations; it is woven around a series of case studies of increasing complexity that illustrate ethical conundrums in the workplace. The course has been a success because it not only provides a framework for professional conduct, but because it challenges participants to make (and then defend) ethical judgments arising from these case studies. And it does so in English.

Keywords: Non-technical engineering and professional education, curriculum benchmarking, internationalization, Australia, Germany, New Zealand.

I. INTRODUCTION

Although information technology had its genesis in the mid twentieth century, it was as late as 1989 before Tim Berners-Lee, then working at the Conseil Européen pour la Recherche Nucléaire (CERN), developed a concept that would lead to the World Wide Web (www). Berners-Lee’s proposal included the fundamental protocols that remain today: an ability to format and link documents, a unique addresses for each resource and hypertext transfer protocols (http) which permit document retrieval. Surprisingly, there were some deliberations before these were accepted in October 1990, but the important break-through came three years later, in April 1993, when CERN announced that access to the www would be royalty-free – i.e. it was to be universally available and at no cost (Berners-Lee, 2000). By the mid 1990s, the world had become truly global.

At the same time a quiet revolution was underway in tertiary education. In the United Kingdom, the Further and Higher Education Act 1992 empowered polytechnics, which had been established to provide professional education, to call
themselves universities. Although initially with a focus on advanced and applied engineering and sciences, these new universities quickly expanded to include business and humanities as part of their offering. Development of new “technical universities” soon spread, e.g. to Australia, Germany and New Zealand. The university sector remains somewhat two-tiered however, with many technical universities continuing to focus on their perceived strengths – teaching and integration with industry (Buckeridge & Grünwald, 2011).

The course “Ethics & the Professional” was introduced in Australia and New Zealand to address perceived shortcomings in the then curriculum in professional practice. These shortcomings, identified through industry surveys by professional engineering bodies, were incorporated into guidelines that would need to be addressed by universities pursuing professional accreditation through the Washington Accord (1989). Accreditation of a degree through this accord, initially restricted to English speaking nations, would give graduates equal opportunity to apply for professional membership of the engineering profession in all signatory countries. This was an initiative of remarkable foresight, and placed engineering in an advantageous light for young people who were unsure about which discipline to study at university. In subsequent years, the Washington Accord has grown to become truly international, and although Germany is not a full member, many German Universities see advantage in pursuing the ideas espoused in the accord.

The European equivalent of the Washington Accord is the 1999 European Network for Accreditation of Engineering Education (ENAE). This network began through the Bologna Process, a series of ministerial meetings and agreements between European countries which will ensure more comparable, compatible and coherent systems of higher education in the European Higher Education Area (EHEA). However it was not until March 2010, that the Bologna Process members signed the Budapest-Vienna Declaration that formalized the EHEA. The European network ENAE authorises accreditation and quality assurance agencies in Europe to award the EUR-ACE® label to accredited engineering degree programmes. EUR-ACE® is the European quality label for engineering degree programmes at First Cycle (Bachelor) and at Second Cycle (Master) level. The EUR-ACE® system encompasses all engineering disciplines and profiles, is internationally recognised and facilitates both academic and professional mobility. Thus the EUR-ACE® framework and accreditation system provides a set of standards that complements the Washington Accord by identifying high quality engineering educational programmes in Europe and abroad. Most importantly, a commitment to professional ethics is an integral part of the EUR-ACE® Standards for the Accreditation of Engineering Programmes.

A delegation from Hochschule Wismar to an international engineering education conference in Auckland, New Zealand during 1998 was sufficiently enthused about a professional engineering ethics course being run there to adopt the course as a benchmark in their university. It has remained so since then, with the same course (including examination) being taught in Germany as in Australia.

There have been cultural differences – especially manifest in tutorials; these are seen to reflect past perspectives rather than current, e.g. with Australians and New Zealanders less concerned about privacy than their German counterparts (Buckeridge and Wilichowski, 2003). However any differences since about 2005 are minimal.

II. COURSE OUTLINE
The course is delivered as an intense workshop, designed to run over a 10-day period, with a weekend between the last session of the workshop and the final examination (See Figure 1). Classes are scheduled to begin at the start of semester to minimize clashes with other courses.

**Figure 1, Course outline.** This simplified version of the course outline, includes cross-references to the primary text in parentheses, i.e. *4 Es: Ethics, Engineering, Economics & Environment* by J. St J. S. Buckeridge, 2011. The examination is scheduled generally a day or so after the course is completed.
III. COURSE DELIVERY

It is always informative to reflect upon pedagogic changes that occurred during the time period being evaluated. Although there has been pressure to increase class size, it was considered imperative that in Germany, this particular course should be capped at 25 students. This has been maintained, as has the block-course-style format, running over a four-day period, within which students work in competitive groups. These groups are involved in peer assessment, and this approach has been pivotal in focusing the energy of participants.

The course is based on analysis of case studies, and to help with this, an ad hoc text was published in 2002 (Buckeridge, 2002), the current text (Buckeridge, 2011) is a subsequent refinement. Case studies are introduced to the participants in a workshop setting with a 30-minute introductory lecture followed by group discussion and debate.

When the course started, the discussion in workshops was liberally augmented using

### Figure 1

<table>
<thead>
<tr>
<th>Day 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900: Introduction to programme: Student groups and assignments etc.</td>
</tr>
<tr>
<td>1000: Lecture: &quot;The concept of Morality&quot; [1-4]</td>
</tr>
<tr>
<td>1030: Discussion: What does it mean to be moral? And why should we be moral? [2]</td>
</tr>
<tr>
<td>1045: Short break</td>
</tr>
<tr>
<td>1100: Lecture: What is a professional? What is the role of a professional?</td>
</tr>
<tr>
<td>1130: Discussion: Can a professional have two lives – professional and private? [4-6]</td>
</tr>
<tr>
<td>1200: Lunch</td>
</tr>
<tr>
<td>1315: Discussion and Lecture: &quot;Understanding the concept we call value&quot; [7-10]</td>
</tr>
<tr>
<td>1400: Lecture: &quot;Relativism, Morality and Conflict&quot; (virtue ethics) [13-22; 42-46]</td>
</tr>
<tr>
<td>1430: Discussion: &quot;Is there an ultimate truth?&quot;</td>
</tr>
<tr>
<td>1515: Short break</td>
</tr>
<tr>
<td>1530: Facts and Myths quiz. Discussion of results... plus Heisenberg’s Uncertainty Principle?</td>
</tr>
<tr>
<td>1600: Overview, and review of tasks to be completed for Day 2 &quot;consequences vs duty&quot;. Close.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Day 2</th>
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<tbody>
<tr>
<td>0900: Review</td>
</tr>
<tr>
<td>0950: Discussion: &quot;Is there an ultimate truth?&quot;</td>
</tr>
<tr>
<td>1000: Lecture: &quot;Moral Theory: Part 1&quot; (from utility to deontology) [47-70]</td>
</tr>
<tr>
<td>1030: Break</td>
</tr>
<tr>
<td>1045: Lecture: &quot;A conflict of values&quot; [22-31]</td>
</tr>
<tr>
<td>1100: Discussion on case studies</td>
</tr>
<tr>
<td>1200: Lunch</td>
</tr>
<tr>
<td>1330: Lecture: &quot;Science, Research &amp; Ethics&quot; [86-97, 113-114]</td>
</tr>
<tr>
<td>1400: Discussion</td>
</tr>
<tr>
<td>1430: Lecture: &quot;Developing a Code of Ethics&quot; [33-34]</td>
</tr>
<tr>
<td>1500: Break</td>
</tr>
<tr>
<td>1515: Discussion on case studies concerning &quot;codes of ethics&quot; [34-41]</td>
</tr>
<tr>
<td>1530: Lecture: &quot;Moral Theory: Part 2&quot; (existentialism) [70-76]</td>
</tr>
<tr>
<td>1545: Discussion and presentation on decision-making</td>
</tr>
<tr>
<td>1620: Feedback session: overview of progress and tasks for Day 3</td>
</tr>
<tr>
<td>1630: Close</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900: Review and consolidation</td>
</tr>
<tr>
<td>1000: Lecture: &quot;Stochastic Urban Accretion&quot; [38-39]</td>
</tr>
<tr>
<td>1050: Break</td>
</tr>
<tr>
<td>1045: Ethics in practice: Introducing Biotechnology Ethics Guidelines</td>
</tr>
<tr>
<td>1115: Discussion: Case studies including &quot;Andrew Wakefield&quot; [94-95]</td>
</tr>
<tr>
<td>1200: Lunch</td>
</tr>
<tr>
<td>1300: Student working groups</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Day 4</th>
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</thead>
<tbody>
<tr>
<td>0900: Quick Review, then discussion: &quot;Biodiversity &amp; Engineering&quot; [64-65; 77-78; 104-107]</td>
</tr>
<tr>
<td>1000: Short break</td>
</tr>
<tr>
<td>1015: Lecture: Why bother about biodiversity? [83-84].</td>
</tr>
<tr>
<td>1030: Student Group Presentations (with peer and faculty assessment)</td>
</tr>
<tr>
<td>1230: Summary of programme; course appraisal, details of end of course assessment. close</td>
</tr>
<tr>
<td>1:40: Close</td>
</tr>
</tbody>
</table>
diapositives (35 mm slides). The use of MS PowerPoint software, began in 2002, five years before the period surveyed here. The effectiveness (and flexibility) of PowerPoint has significantly improved over the last decade, as has the potential to use the World Wide Web for on-line resources, including self-paced learning and testing, which for this course, became available in 2010 (see https://www.dlsweb.rmit.edu.au/set/LearningObjects/ethics/).

Course assessment is both formative and summative. The former revolves around group and class discussion on case studies provided, the latter involves both peer and faculty assessment of a group project and a final written examination.

The group project is 50:50 peer/faculty assessed and grades awarded over more than a decade have shown very close correlation between the peer and the faculty scores. It could be tempting for some students to simply award each other maximum marks, with a prior agreement that their presentation would be similarly graded. This would certainly have placed them close to passing the course prior to the written exam. However participants are advised that any attempt to do this would soon be recognized, and in that instance any party awarding 100% would be awarded zero for their own presentation.

IV. STUDENT FEEDBACK

Although student assessment of this course has been undertaken in Germany since its inception, it is only in the last decade that the assessment format has been consistent in format. Student assessment has taken two approaches – the first, where students are asked to comment on their enjoyment of the course has consistently been very positive. Although some of these results have already been published (see Buckeridge, 2008; Buckeridge & Grünwald, 2010; Buckeridge, 2013), this paper provides the first comprehensive analysis of the future utility (i.e. value), of their overall enjoyment of the course and of their perception of the delivery style. These data have not been published before. The delivery style is primarily a reflection of their understanding of the language used in the course, which in Germany was not the student’s native tongue; in particular, it provides feedback of any difficulty that arose from this delivery (Figure 2).

<table>
<thead>
<tr>
<th>Year</th>
<th>( L_a )</th>
<th>Participant #</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1.8</td>
<td>21</td>
<td>1 comment, undergraduates only</td>
</tr>
<tr>
<td>2008</td>
<td>1.7</td>
<td>15</td>
<td>0 comment, undergraduates only</td>
</tr>
<tr>
<td>2009</td>
<td>1.4</td>
<td>23</td>
<td>0 comment, undergraduates only</td>
</tr>
<tr>
<td>2010</td>
<td>1.8</td>
<td>22\textsuperscript{1}</td>
<td>3 comments, undergraduates only</td>
</tr>
<tr>
<td>2011</td>
<td>1.6</td>
<td>19</td>
<td>1 comment, undergraduates only</td>
</tr>
<tr>
<td>2012</td>
<td>2.3</td>
<td>10</td>
<td>1 comment, mixed u/grad &amp; p/grad</td>
</tr>
<tr>
<td>2013</td>
<td>1.7</td>
<td>19</td>
<td>1 comment, mixed u/grad &amp; p/grad</td>
</tr>
<tr>
<td>2014</td>
<td>1.9</td>
<td>21</td>
<td>0 comment, postgraduates only</td>
</tr>
</tbody>
</table>

Figure 2: Student Evaluation of “language” 2007-2014: \( L_a \) is the arithmetic mean for each year, determined from the most favorable (score of 1), to the least favorable (score of 5). \textsuperscript{1}Includes a diverse group of nationalities, including Norway and China. Only nine students elected to complete the survey in 2012.

The student group targeted by this course has also changed, it became fully post-graduate in 2014, although a transition to this, with mixed undergraduates and postgraduates began in 2012 (Figure 2). Finally, with assistance from the English Department at Hochschule Wismar, a comprehensive glossary of terms, in English and German, was developed and this has been available to students since 2009.

V. ANALYSIS

The raw data from three categories has been used to determine trends. These are shown below arithmetically (Figure 3) and demonstrate a gradual “improvement” in the student’s perception of the course. Student evaluation has been undertaken after each course. It is done so anonymously. Students are asked to grade their experience in a series of
categories; they are instructed to award a grade of between 1 and 5 for each category, 1 indicating strong agreement with, or strong/acceptance support, 5 indicating strong disagreement of negativity about the criterion. The criteria are:

- The language or mode of delivery (in particular this is an evaluation of how clearly they understood the concepts introduced in the oral component of course delivery).

- The value of the course (i.e. a measure of whether they thought what they had learned in the course would be of use in their careers and lives).

- Their enjoyment of the course (a measure of how they felt about the learning environment, the interaction with each other and faculty, the topics and the assessment).

Figure 3

**Figure 3, Course Evaluation 2007-2014:** Changes in student’s perception of the language used (i.e. their comprehension of the delivery in English); the value, or the perceived utility in their future careers; and their overall enjoyment, or how much they appreciated the all aspects of the course, such as timing, content, engagement. Vertical axis is a measure of student satisfaction. 1 being the most satisfied, 5 (not recorded) the least. Horizontal axis = time.

Although some clear trends may be observed in Figure 3, if the data set is evaluated geometrically a clearer assessment of trends is permitted (Figures 4-6). In these, the three aspects, language, value and enjoyment are assessed separately. Standard deviation is included, providing a guide to the diversity of responses to these three criteria.

VI. LANGUAGE

The language of delivery throughout the course is English. This was done to provide an opportunity for German students to have active (and interactive) exposure to the English language through a native speaker. A further outcome in this particular situation has been to bring students a “southern hemisphere” perspective of global issues – something that would not have been possible if a UK based facilitator had been used. Use of a native English-speaking facilitator also provides a conduit to the very broad, and diverse body of literature on environmental ethics that today is predominantly in English. Figure 4 shows a very positive student feedback on language (comprehension). Although the trend line (log - geometric mean) shows a slight drop over the period, it should be noted that any
assessment above 2.5 in this analysis should be viewed as appreciative.

Figure 4

**Figure 4:** Student perception of language used in the course. The analysis is based upon geometric means. The standard deviation bars demonstrate greater uniformity in time except for 2012, when three nationalities participated: Norwegian, Chinese and German. Vertical axis is a measure of student satisfaction. 1 being the most satisfied, 5 (not recorded) the least. Horizontal axis = time.

VII. VALUE

Whilst there may be difficulties for participants to assess how, or whether a course will be valuable in their future careers, students are nonetheless prepared to make a judgment – which is clearly a reflection of how the course meets expectations in their current learning programme. As noted, there are two deliverables in the course: the intellectual content, and the English language immersion. Figure 5 demonstrates a slow, (although very gradual) increase in student appreciation of value.

Figure 5: Course Evaluation 2007-2014: Changes in student’s perception of the value of the course, or

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1 One of us (MW) also observed that the slight recent “decrease” can be correlated with an overall improvement in the English skills of students. This, in turn, encouraged the use of more challenging English in class.
how useful they found it in their current studies, and/or future career paths. Standard deviation bars included. Vertical axis is a measure of student satisfaction. 1 being the most satisfied, 5 (not recorded) the least. Horizontal axis = time.

**Figure 6**

**Figure 6: Course Evaluation 2007-2014:** Changes in student’s overall enjoyment, or how much they appreciated the all aspects of the course, such as timing, content, engagement. Standard deviation bars included. Vertical axis is a measure of student satisfaction. 1 being the most satisfied, 5 (not recorded) the least. Horizontal axis = time.

**VIII. INTERPRETATION**

Any assessment of human behavior can be expected to have bias. Variables that lead to bias are diverse and include age, gender, life experience as well as how a student was feeling at the time of filling out the course evaluation survey. Clearly, some variables will be unknown to us; others we may speculate upon, with one of the more interesting in this category being the political and cultural climate. Change in political culture has been particularly dramatic in Germany in the last 25 years: On the 3rd October 1989, the Deutsche Demokratische Republik (DDR, or East Germany) was unified with West Germany becoming the Bundesrepublik Deutschland (Federal Republic of Germany). The ramifications for education were immediate, with Russian language being replaced by English as the primary second language starting from secondary schools (class 5 at age about 11). There were an initial problems, as in many schools in eastern Germany, there were insufficient numbers of teachers available with the requisite level of English to deliver the classes; this resulted in a “transitional” period for up to four years, when Russian remained the primary second language.

By 1993 however, most students in eastern Germany were receiving tuition in English from age 11. Nevertheless some primary schools started teaching English from class 3 (age 9) before it become compulsory in 2004. Nowadays English starts at some schools as early as class 1 (age 6/7). This early immersion in English flowed through so that in 2005, high school graduates began to enter tertiary education with a reasonable command of English. However many of the students in the Hochschule system (= Universities of Applied Sciences) do not begin their studies immediately after graduation from secondary school. Rather they spend up to five years in the workforce prior to embarkation on their tertiary studies; thus up until 2013, many students who undertook postgraduate study at Hochschule Wismar would have been educated for a large part of
their formative years under the DDR system (Figure 7). The very slight decrease in the student’s appreciation of English is probably too small to make any useful observations about. The appreciation may well be a little more critical in later years simply because the students are more mature, and feel more confident about expressing their views. Nonetheless, all student feedback forms are written in German.

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Age at start</th>
<th>Age at finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Schooling with English as primary second language established.</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>2011</td>
<td>Tertiary Education (bachelor level)</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>2014</td>
<td>Tertiary Education (post graduate level)</td>
<td>21</td>
<td>22</td>
</tr>
</tbody>
</table>

**Figure 7**

Theoretical post-graduate student profile at Hochschule Wismar: This shows the earliest date that a student who has had “post unification English immersion” from primary school age on, can enter the postgraduate programme. It assumes that no time is taken out for work experience prior to postgraduate study, an unlikely situation for all students.

**IX. CONCLUSION**

Maintaining a rigorous independent survey of student satisfaction with the ethics course has permitted an annual review of delivery and structure. As a result there has, overall, been a gradual improvement in the student perception of the course. In part, these results highlight the importance of English in earlier education as an important factor in course engagement.

**A. References**

INTEGRATED APPROACHES FOR IMPLEMENTING BUILDING INFORMATION MODELLING (BIM) IN ENGINEERING EDUCATION

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Abstract: The construction industry faces high demand for candidates with relevant Building Information Modelling (BIM) competency, yet higher education continues to struggle in providing such competencies. This conceptual paper explores the use of an integrated approach to implement BIM into the curriculum for undergraduates and graduates in engineering. The curriculum under study employed the Technological Pedagogical Content Knowledge (TPACK) pedagogical framework for integrating three BIM related standards and methods: the Information Delivery Manual (IDM), BIM-based Model Checker and BIM Execution Plan. As a case, this study uses the development of a 2-year master’s program in structural engineering and building technology. We have developed a concept called iBIMe, an acronym for integrated BIM in education. This concept has the potential to enable universities to support industry demand for BIM competency within existing curricula and resources.

Keywords: BIM education, TPACK, engineering curriculum

I. Introduction

The demand for Building Information Modelling (BIM)-related expertise is rapidly increasing in the entire AECOO industry (architects, engineers, construction, owners and operators industry). Despite this clear demand, BIM remains understudied in the engineering curriculum at the undergraduate and graduate levels.

Succar (2012, p.10) point out this situation by saying, “Introducing BIM education to academia is a difficult change process and – like any major change process – it is likely to encounter resistance. Some of the reported difficulties include:

1. The difficulty of introducing new topics into an already crowded curriculum.
2. Unfamiliarity of lecturers with BIM and other fast-paced technologies and workflows.
3. Reluctance of some lecturers to alter established teaching methods coupled with an unwillingness by some to retrain in new topics.
4. Inability to bridge the traditional educational silos of architecture, engineering and construction and deliver collaborative courses and programs.”

This paper begins with a short presentation of BIM education and research, followed by examples of ongoing discussion of BIM for future educational settings. This discussion intends to elucidate on factors that support a change in paradigm. Next, this paper explores educational approaches for BIM in higher education by introducing the Technological Pedagogical Content Knowledge (TPACK) program as a pedagogical framework (Koehler, Mishra, Kereluik, Shin & Graham, 2014). The applied profile is presented using three methods for learning BIM as an embedded part of the curriculum. These methods are based on established standards, tools and processes in the AECOO industry (architects, engineers and contractors).
As part of this study have we developed a concept for integrating BIM in education is called iBIMe, an acronym for integrated BIM in education. The next sections provide an overview of how the proposed iBIMe concept relates to the TPACK pedagogical framework. To give the practical context, this paper reflects the ongoing development of a 2-year master’s program in Structural Engineering and Building Technology at Oslo and Akershus University College of Applied Sciences (HiOA) in Norway; this program provides an example where the iBIMe concept has been integrated into the curriculum. The conceptual paper closes with a discussion and proposals for future work.

II. Understanding of BIM in research and education

2.1 Short introduction of BIM

BIM can from practical a point of view be regarded as an extension of Computer Assisted Drawing (CAD) which have digital representation of geometry by lines and surfaces. This visualization can be recognized as buildings or building components by human interpretation, but not by a computer. In BIM this representation of the built environment is presented by identifiable objects. The object oriented approach means that a beam can be identified as a beam – with defined properties like material, quality, fire rating, environmental information, in addition to its exact location, both geometric and functional, like roof on 3rd floor (Eastman, Teicholz, Sacks & Liston, 2011). In a drawing, this would have been just two parallel lines. This enables a new mindset where the BIM model can be regarded as an information model, which can be visualized in 3D. This structured information can be utilized in operations and tools that do not need visual representation, like calculations in spreadsheets, or linked to external registries. Broadly speaking BIM can be an enabler to bring the AECOO industry into the information society.

The focus on BIM over the last 5 years has expanded from being an option to become the default solution. This has happened due to a combination of technological development and demand by major stakeholders. Public builders in countries like the UK, Denmark and Norway now demand the use of BIM as criteria for participation (McGraw Hill, 2014). However, a study by Murphy (2014) confirms that competence in deeper understanding of how BIM can be utilized in new ways is a bottleneck for pervasive implementation. Too often is BIM just replacing traditional ways of working and collaborating by adding new software, but keeping the old process.

The variation in understandings of BIM influence for different ambitions or purposes of how to use of BIM. The abbreviation “BIM” has several definitions depending on the perspective (Hjelseth, 2015). B stands for building, either as the physical building, or as a process. I stands for information. M can stand for either:
- Model of a virtual, often 3D representation of the building.
- Modelling with focus on specification of relevant information to perform defined tasks,
- Management with focus on the design process and collaboration.

It is important to be aware that these three perspectives can be integrated and support each other in practical projects (ibid.). This concept paper use the modelling perspective to focus processes for specification of relevant information to perform calculations, analyses simulations and assessment of engineering tasks. This is done by of integrating established solutions, methods and standards like: the Information Delivery (IDM) standard for specification of exchanged information, methods for BIM-based model checking (BMC) and procedures for development of BIM execution plans (BEP).

2.2 Status of BIM in higher education

It is difficult to find detailed quantitative studies regarding implementation rates and education levels. However, based on demand from the
AECOO industry, the general opinion holds that there is a need for more candidates with better BIM skills and knowledge. It is therefore an increasing interest for integrating BIM in education, both from the AECOO industry and from academia. The NATSPEC survey by Ronney (2014) demonstrates this increased interest and identifies the use of BIM in a number of countries:

“It would appear that the majority of BIM education available to date focuses on training in the use of particular BIM software packages, particularly seen as a lot of training for professionals appears to be provided by the software vendors. Training for both graduates and professionals in open BIM concepts, BIM management and working in collaborative BIM environments, appears to be still in its infancy” (Rooney, 2014, p. 1).

This statement illustrates the current state of BIM in education. A similar perspective is apparent in a study by Barison and Santos (2010, p. 1) about BIM teaching strategies: “It is still unclear how BIM should be taught as most experiences are very recent.” They identify BIM in education by looking for single courses, interdisciplinary projects and distance collaborations.

2.3 Understanding of BIM in education

As above observations indicate, has BIM in education has traditionally been synonymous with the use of BIM-based software in a course. There exist a large number of definitions of BIM in use (Hjelseth, 2015). This situation continues to influence BIM in education and can be expressed as: when something is hard to define, it can also be difficult to teach.

It is therefore to be aware of other qualitative based studies and experiences show that the understanding of BIM goes much deeper and extends more broadly than the use of software. This includes collaborative processes and processing of information that serves understanding and solving of tasks.

McGough (2013) emphasizes the importance of taking BIM beyond drawing/modelling with software: “Teaching needs to be clear that BIM goes beyond that of the 3D model, with efficient information sharing a critical factor which needs to be adopted and understood.” This perspective brings about this conundrum: “The solution or challenge, depending how you look at it, may be for education to integrate BIM seamlessly within the structure of existing courses and modules rather than attempting to create brand new BIM specific courses or modules, which will directly compete for timetable space with existing modules.” (McGough, 2013, p. 1).

Crawley, Malmqvist, Östlund, Brodeur & Edström, (2014) highlight the importance of reflecting this complexity with new ways of working: “The purpose of engineering education is to provide the learning required by students to become successful engineers—technical expertise, social awareness, and a bias toward innovation. This combined set of knowledge, skills, and attitudes is essential to strengthening productivity, entrepreneurship, and excellence in an environment that is increasingly based on technologically complex and sustainable products, processes, and systems” (Crawley et al., 2014, p. 1).

These emerging perspectives indicate a possible change of paradigm regarding BIM in education. This change relates to a shift from BIM occurring in separate courses using BIM-based software for traditional tasks to a focus on BIM as an enabler for increased awareness of information or facts used in professional calculations and assessment. This integrated approach supports implementation of BIM in existing curriculum.

III. Pedagogical framework

3.1 Use of pedagogical framework

Pedagogical frameworks can be understood as models for identifying elements and their relationships, enabling generalization and transfer to other situations. This approach stands in contrast to case-based solutions. Compared to using case-based studies for presenting educational solutions, using
pedagogical frameworks enables a higher degree of understanding and capacity to generalize, increasing transparency and the ability to transfer experiences into other situations. Educational studies are mostly case-based, focusing on either the utilization of new technology (software) or experiences from a single course or training in the industry related to a certain project. This situation is exemplified by following statement:

“Most educational technology research consists of case studies, examples of best practices, or implementations of new pedagogical tools. Of course, good case studies, detailed examples of best practices, and the design of new tools for learning are important for building understanding. But they are just the first steps toward the development of unified theoretical and conceptual frameworks that would allow us to develop and identify themes and constructs that would apply across diverse cases and examples of practice” (Mishra & Koehler, 2006, p. 1018).

This concept-based paper introduces the use of the Technological Pedagogical Content Knowledge (TPACK) as pedagogical framework to illustrate how BIM can be integrated into the curriculum of higher education in schools of building engineering.

This concept-based paper does not evaluate pedagogical frameworks against each other. Use of TPACK is therefore an example of using frameworks to understand approaches using BIM in higher education. The connection between iBIMe and TPACK is explained further in the next sub-chapter.

The proposed iBIMe concept can be further developed, integrated or supplemented with other methods and frameworks. In this respect, the Integrated Design and Delivery Solution (IDDS, 2015) is a relevant framework for multiple perspectives of BIM in education. IDDS is a priority theme in the International research and innovation for Building and Construction (CIB) research organizations. The three imperatives in IDDS are collaboration, integrated processes and interoperable technologies.

The Conceive-Design-Implement-Operate (CDIO) format represents another relevant framework related to developing pedagogical solutions in engineering education (CDIO, 2015). This framework has been developed within the engineering education community and is mostly used in project- and problem-based learning environments.

3.2 Technological Pedagogical Content Knowledge (TPACK)

The TPACK framework (Koehler et al., 2014) focuses on the complex interplay of three primary forms of knowledge: content (CK), pedagogy (PK), and technology (TK). The TPACK approach goes beyond seeing these three knowledge bases in isolation. It emphasizes the new kinds of knowledge that rest at the intersections between them. Figure 1 illustrates the relationship between these forms of knowledge.

![Figure 1. The TPACK framework (Koehler et al., 2014).](image)
technology and content. At the intersection of T and P, we find Technological Pedagogical Knowledge (TPK), which emphasizes the existence, components and capabilities of various technologies used in teaching and learning. The intersection of all three elements is defined as Technological Pedagogical Content Knowledge (TPACK) (ibid.).

IV. Presentation of the integrated approach: The iBIMe concept

4.1 BIM education based on the iBIMe concept

The proposed methods in the iBIMe concept are related to the TPACK framework is presented in Figure 2.

![Figure 2. The iBIMe concept related to the TPACK framework.](image)

These relationships are based on following:

- Information Delivery Manual (IDM): specifications for relevant content of professional information relates to Pedagogical Content Knowledge (PCK)
- BIM-based model checking (BMC): automatic checking/control of information relates to Techn. Content Knowledge (TCK).
- BIM Execution Plan (BEP): the process for exchange of information relates to Technological Pedagogical Knowledge (TPK) in the TPACK framework.

These relationships indicate that the integrated approach in the iBIMe concept can be applied into the TPACK framework. Further pedagogical support for practical use of the iBIMe concept can be sourced form established experiences from the TPACK framework.

Outcomes from the methods and standards have separate deliverables relating to professional understanding and to performance of learning objectives in education. In this way, BIM competency can be a deliverable (IDM-, BMC, BEP-reports) while performing professional tasks, such as calculations in structural, building physics and suitability assessments. These methods contribute to understanding the information needed prior to performing professional tasks as an engineer.

The core element in this new approach is the focus on professional tasks – and the type of information required by these tasks for processing. If the information is complete and the methods are predefined, automatic processing is enabled. This approach allows engineering students to become aware of the potential to rationalize working tasks by implementing them into software-based solutions.

4.2 Specification of relevant input – IDM

The Information Delivery Manual (IDM) approach corresponds to the modelling perspective of BIM. IDM is based on the building SMART Process standard, which is founded on ISO 29481-1: Building information modelling – Information delivery manual – Part 1: Methodology and format. A revised version will be published in 2015 (ISO 29481-1, 2014). The methods in this standard specify relevant information to be exchanged for defined tasks.

Learning relevance: For collaboration and coordination when using process maps based on
Business Process Model and Notation (BPMN), it is necessary to identify who is receiving what information from whom at which time. Process maps can be produced by freeware, such as Bizagi modeler (Bizagi, 2015) or similar software. Alternatively, one may simply use tables and boxes in word processors. The required professional information is specified as an exchange requirement. To know which information is relevant, one has to know which information is required for assessment or compliance checking (e.g., a formula or criteria). Courses like structural calculations or environmental assessments require a great deal of information. The content of information in the BIM file (e.g., in IFC-format, Industry Foundation Classes) can be verified by using a BIM-based model checking software.

4.3 Control of relevant information – BMC – BIM-based model checking

This method supports the insight, overview and control of exchanged information in the BIM file. It gives hands-on experience, putting “the I in the BIM,” and it can be used as a supplement in understanding and identifying relevant information through use of IDMs.

There are two types of software that can be used for BIM-based model checking. First, the general type uses open source IFC viewer software and works like PDF readers for IFC files. There are multiple viewers available, each with their pros and cons. In addition, the authoring tool can be used to explore content. Second, there are specialized tools like commercial software for information and/or model checking. Software support, like Solibri Model Checker (2015), Tekla BIMsight (2015) or Navisworks (2015), helps the student to understand that information is an asset (like the physical objects of products) to the IDM and makes it more “practical.” Using a BIM server is an option for more BIM technical studies.

The function of information take off is an especially important part of BIM-based model checking. This function enables classification, ID and color-coding. In addition, it can free the IFC-viewer to be used to explore the information content in IFC files.

In terms of learning relevance, it can be used in all courses that use software for calculation, assessment and documentation – and in any course where one must know, or document, the foundation (input) of these tasks. It is especially useful for courses focusing on information about building and all its components/parts, such as investment cost calculation, life cycle costs and CO2 calculations.

This information-centric approach supports the understanding of compliance checking and the automation of engineering tasks. It is important to be aware of what is possible to implement with computers and what needs to be done manually.

4.4 BIM execution plan - BEP

The purpose of the BIM execution plan (BEP) is to focus on the management aspect of BIM. BEP contributes to setting all of the IDMs in a system. There is an increasing number of BEP frameworks available. Most offer templates and other solutions that contribute to making these plans applicable. The UK BIM specification BSI PAS 1192-2 (2013) is under development as ISO 19650-2 standard (ISO 19650-2, 2015). It includes references to frameworks including templates for practical use.

The BIM execution plan (BEP) is the first planning issue in the project delivery plan for the information management circle. The purpose of BEP is to develop and disseminate structured procedures for the adoption and implementation of BIM in projects.

As for learning relevance, it relates to all courses that include collaboration, coordination and decision-making. These processes require relevant information, and the BEP concept prepares the engineering student for future roles within information management.

It also provides a foundation for learning new ways of working and collaboration. Information is not generated by software, but by professionals controlling software.
V. BIM in a new study program

Providing an example of an integrated approach, this concept paper relies on the ongoing development of a new two-year master’s program called “Structural Engineering and Building Technology” at Oslo and Akershus University College of Applied Sciences (HiOA) in Norway. The majority of candidates is expected to work as consulting engineers with specializations in structural engineering and building technology. The application will be submitted to the Norwegian Agency for Quality Assurance in Education (NOKUT) by 1st March 2016 for approval. The first students will begin in August 2017.

Interestingly, the new study could respond to the industry’s need for BIM competency by introducing separate BIM courses. Use of BIM has a relatively long tradition at HiOA. Two associate professors with specializations in BIM enhance the education’s competency and capacity. HiOA has been host to buildingSMART student seminars for years, and a bachelor thesis from HiOA won the BuildingSMART award in 2013 (bSN, 2015). Despite the capacity to establish separate BIM courses, the new curriculum has no separate courses within BIM. Instead, BIM will be integrated into traditional courses within structural engineering and building technology. Structural analyses is performed according to methods specified by standards. The required information as input for these methods is specified by BIM-based methods.

VI. Discussions and further research

6.1 Impact of this concept

An embedded approach can enable increased BIM competency in higher education. The most important benefit of the embedded approach is that it requires that no formal change in study program or courses, which is especially relevant in established curriculums. However, in the design of new study programs, or curriculums, the introduction of BIM can be a challenge. Competition between a new BIM course and an advanced course in structural engineering will often go in favor of the engineering course. The integrated approach enables BIM to be a part of the curriculum. BIM can support the learning process by increasing awareness of the facts or information used in professional calculations and assessments. The change of paradigm will involve a change from talking about BIM to embedding it into practical use. The proposed concept, with the support of other initiatives presented in this paper, can support this change in paradigm.

6.2 Further experiences from HIOA

Experiences regarding the practical use of this integrated approach will be presented following establishment in 2017. HIOA is interested in contact with other educational establishments to share experiences and collaborate on research.

References:


CO-CREATION OF KNOWLEDGE AND ACTOR CONSTELLATIONS IN A CLUSTER FORMATION PROCESS

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Abstract: This paper uses a path creation lens to follow the emergence of a Norwegian cluster. Cluster formation is a central issue for development of technology and business in local and global contexts and the aim is to understand how cluster formation emerges through involving multiple actors and artefacts based on co-creation of knowledge and actor constellations. These co-creation processes unfold in different activities in the cluster, such as in projects with specific partners, joint workshops with all cluster participants or in cluster project adaptions to cluster funding programmes. The outcome recognizes changing involvement of actors and materiality together with the generation of new knowledge and how this lead to non-linear innovation processes and unexpected outcome in the formation process. Different activities in the developing cluster gives rise to new or rearranged combinations of actors, but such actions are coupled to the knowledge generation that takes place simultaneously. A path-creation approach is put forward to fulfil the ambition to give additional knowledge of how the co-creation unfolds and at the same time affects the cluster formation process.

Keywords: Cluster, Co-creation, Path-creation, Non-linear Innovation, Knowledge and technology transfer

I. INTRODUCTION
Formation of clusters had been a central issue for development of technology and competences in order to create growth and prosperity for national and local areas. Much of the literature had focused on the competitiveness of clusters by creating competitive dynamic processes (Porter, 1990, 1998) and/or by creating competitive advantage through state intervention by stimulating research, education and competences (Lundvall, 2010).

There are many merits to these arguments but they fail to understand the critical micro processes that have to do with learning and agency (Karnøe & Garud, 2012), i.e. the ability to act independently. The dynamics of micro processes between multiple actors and artefacts are important for the way clusters emerge and develop. Competences emerge through multiple learning processes created between actors and action net (Karnøe & Garud, 2012).

The article is structured in the following way. First we discuss why it is important to understand the micro dynamics of cluster formation. Second we discuss the importance of changing the analytical perspective from the dominant focus on clusters as path dependent to clusters as path creation. In the third section we shortly present our methodological framework that combine a disciplined empirical framework inspired by ANT with a socio-cognitive model (Garud & Rappa, 1994). Fourth we follow the processes of formation of a Norwegian Cluster NCE through co-creation of action nets and technology. In the findings section we analyse the formation process by use of the socio-cognitive model before discussion and conclusion.

II. CLUSTERS AS A FORMATION PROCESS
The regional clustering of companies, academia and government are said to enhance competitiveness (Porter, 1990) and learning (Lundvall, 2010), and are important elements in the development and implementation of national cluster policies and programmes throughout Europe. But less is known about clusters in making e.g. how clusters become the clusters we know through nets of actions and how the capabilities of the clusters are created through these nets of action.
This is important because governments and cluster programmes have the ambition to create clusters that can generate local competitiveness and innovation by replicating existing concepts of competitive clusters (Andersson, 2013). These replicating activities have strong limitations because they are informed by theories of clusters that take clusters as given facts and determined through agglomeration of technological, human and economic resources. This can be understood as a path dependent approach. These geographical and structural explanations, like proximity and concentration of the cluster and the role of the university, government and industry (Asheim, Boschma, & Cooke, 2011), as means to strengthen the cluster companies competitiveness, productivity and innovative capacity.

But as the participants engage in the project, when they discuss, gather knowledge and act, they shape the activities and changes the cluster. The change is thus an effect of the network of relations (Andersson, 2013), both human and non-human actors, that form an actor network (Latour, 2005) and not the other way around. The policy explanations of the emergence of the cluster do not sufficiently identify the events and processes that that are meant to increase competitiveness and productivity. As the participants of the cluster attempt to shape the emergence of the cluster, the notion of path dependence miss out and fail to explain the micro-dynamics where change occurs. The question then arises: How do the actors create the cluster path?

III. CLUSTERS AND PATH CREATION

The dominant (traditional) explanations of the cluster is right on identifying the competitiveness and productivity of clusters but fail to identify the emergence of events and processes that increase competitiveness and productivity in a satisfactory way (Andersson, 2013). The formation of a cluster project can thus be understood as a path dependent process that evolves as a consequence of the process’s own history (David, 1993).

Path dependence suggests that "temporally remote" events play a key role in the development of novelty and that these events only gain significance post hoc. Indeed, proponents of a path dependence perspective often celebrate historical accidents to explain the emergence of novelty. They relegate human agency to "choosing to go with a flow of events" that actors have little power to influence in real time. (Garud & Karnoe, 2001)

The dominant theories do not account for the dynamics at the micro level in the process and miss out “the agencies involved in bringing about new clusters in industrial regions” (Karnøe & Garud, 2012). Innovation is non-linear and involve complexities of co-evolutionary, relational, inter-temporal and cultural nature (Garud, Tuertscher, & Van de Ven, 2013), which show that change is definitely a part of innovation.

Entrepreneurs set path creation processes in motion in real time. Specifically, they attempt to shape institutional social and technical facets of an emerging technological field. But, to the extent that they are unable to generate momentum with their own approaches, path creation requires an ability on the part of entrepreneurs to shift their emphasis to alternative approaches that may have greater promise. This ability to create and exercise options, we think, is crucial. (Garud & Karnoe, 2001)

Path creation offers a view that see agency emerging from the interaction of actors and artefacts in sociotechnical action nets (Garud, Kumaraswamy, & Karnøe, 2010), i.e. the development of actor networks. The agent and the network is not divided, but part of the same (Callon, 1990) as an actor-network (Latour, 1993). A company may be seen as an action net with its “network of people, structures and technologies that goes beyond the organizational boundaries” (Andersson, 2013) and is part of the processes of the company. Similarly in a cluster setting the distributed actions such as a joint subproject or a repeating seminar series might be an action net, where the actors involved navigate through the processes.

The perspective of path creation implies that the results are an effect of the network of relations and not be bound by history, and as such should be studied in the making (Karnøe & Garud, 2012). We use framing (Karnøe & Garud, 2012) to identify actions that are changing the cluster over time. The cases are organized in four frames covering a pre-clustering frame, an environmental frame, a prosumer frame and a smart city frame.

IV. METHOD

Cluster formation processes are difficult to trace and map because of the complex processes of connections and interactions in and between different action nets. In order to trace and map the formation process we follow the activities and actors through interviews, observations, documents and media.

The analysis is divided in two steps: First step is to map the formation process by following actors and activities, and how these are framed. We investigate how the cluster is developed by carefully observing and interviewing the on going practice actors and actor nets. In this process we are careful not to
explain the acts, statements and actor net and avoid switching conceptual repertoires when in the description (Latour 2005). This allows us to describe the formations processes and identify the transformative periods/events, and how they are connected to constellations of actor nets.

The second step is analysing how actors and actor nets are able to create and construct cluster content and direction, and how actors and actor nets at the same time are able to change/transform cluster content and directions and create new development paths. We have chosen a socio-cognitive model developed by Garud and Rappa (Garud & Rappa, 1994) to understand these complex and dynamic socio and cognitive processes. The model was developed to explain the dynamic and complex innovative processes in technology studies. The model is also useful to analyse cluster formation as a complex and innovative processes.

The model help us to understand how actors and action nets create and re-create cluster content and direction by analysing how actor and actor nets build on different: beliefs, Artefacts and Evaluation routines. Cluster evolution can be seen as interactive processes between beliefs, artefacts and evaluation routines in action nets. The original descriptions of the key concepts are as follows:

- Beliefs as the actors’ understanding or knowledge of the technology at the time
- Artefacts as the form and functional characteristics of a technology, and evolution over time
- Evaluation routines as the manifestation in practices in a community, and emergence over time

All of these three elements emerge or change over time, and these elements are, for chosen actors/actor nets, identified and form the basis for the analyses. The chosen actor networks are then the unit for analysis. Figure 1 shows how the three elements function as an integrated system (captured from (Garud & Rappa, 1994)).

The socio-cognitive perspective is emphasised by identifying and analysing how the actors, both human and nonhuman, interact in action nets. It is therefore important to understand how the socio-cognitive elements are co-constructed through interaction between actors in action nets and how the constellation of actors in action nets develop through the cluster formation processes.

We use framing of action nets from Czarniawaska (Czarniawaska 2108, Karnøe & Garud, 2012) to identify actors and action nets that are changing the cluster over time. The evolution process of the cluster is organized in four frames covering the pre-clustering frame, the greening frame, the prosumer frame and the smart city frame.

The process and the emergence of actor nets have been studied over several years. The researchers have had first hand access to some part of the process. The analysis is based on data as interviews and observations, and analysis of documents and field notes. One researcher has participated in the cluster formation processes through workshops and seminars.

V. CLUSTER FORMATION IN THE NCE – FROM TRADE BASED SYSTEMS TO SMART GRID AND SMART ENERGY

In this section we describe the evolution of the cluster formation process through the way actors and action nets frame the cluster development. The periodization of the cluster evolution is based on major transformations of both the cluster content and direction and the dominant action net as describe through the actors own narrative and texts. The periods are described in the following way:

Frame 1: Transition from IT cluster to energy trade cluster. Arena / NCE evaluation criteria as facilitator for change of criteria and action net. The core energy oriented IT supplier companies originates from a branch of a regionally base national research institution for energy, which worked with IT knowledge and solutions linked to the deregulation of the Norwegian energy market. In mid 2000 they worked well together with leaders in the local business community in forums like the local Industry Association, the IT forum and the Chamber of Commerce. Still the companies did not work much together, and hiring personnel when needed in projects was the preferred form for concrete cooperation at the time.
Transformation 1: The constellations and activities of the application for Arena/NCE Energy and Emissions

As the Research Council of Norway and Innovation Norway co-launched the national cluster excellence programmes for funding and development of clusters, the core actors saw a mean to expand on already known knowledge of energy trade. At the core of action net in the application process were the energy suppliers, the local IT incubator, and two locally anchored research institutions. The county council funded the application process that was managed/driven by a three-party cooperation. These were the local research organization with its environmental focus, the local incubator company that worked to strengthen the local IT milieu and the local serial entrepreneur who had an interest in building a larger local knowledge base.

A first application including energy, resource waste and IT was rejected by Innovation Norway as it was considered “too broad” according to their evaluation criteria. As a result of the evaluation and following advice from Innovation Norway the core group decided to focused both the action net and to focus on energy trade with a greening touch: emissions trading exemplified with green certificates. The other IT companies in the region supported this to strengthen the local community, signified with statements, as “all that is good for the city is good for us” (from interviews and talks). The main objective as stated in the application was “to contribute to a significant increase in competitiveness, innovation, wealth creation and employment in knowledge and high technology industry in the region”. The new constellation succeeded and the application was granted and 3 mill NOK was awarded a year for a period of three years, with option to further two years. Two years later the core applicants group produced a new application directed at a NCE call, with substantially higher prestige and funding. This application too was accepted.

Frame 2: Transition from energy trading systems to energy trading and green certification systems (exploring the core capabilities to develop new technological systems for decentralised trading of energy and green energy certificates). The acceptance as an Arena, and later NCE, cluster project is the beginning of an expansion into emissions (green certificates) trading as an integral part of the energy trade concept. The project is a coupling energy trade and environmentally issues, acknowledged through the R&D cluster project focusing on energy and environment. The three-year project, funded by the research council, is in line with international trends and consists of two cluster companies, four energy companies, and three research partners. The cluster does not explore the greening approach further in concrete actions as projects.

Transformation 2: The constellations and activities of the quest for smart grid

The cluster development of cluster activities and direction was facilitated through a series of workshops network actors. During one of these kick-off workshops of the foresight process, two business leaders who are formerly acquainted, get together in a meeting room to discuss smart grid. With the announcement of a forthcoming call for smart grid, they discuss and propose a smart grid project and necessary partners. One is keen to move focus onto smart grid, his interest in smart grid is based on his company’s knowledge from the telecom sector and the possibility for knowledge transfer. He believes the energy sector will go through the same deregulation as the telecom sector and see an option to utilize their knowledge from this area in the energy sector. The other has a need to consolidate his office’s local presence, as the company is an international enterprise with head office in Oslo, and not overly interested in the local branch per se. He believes smart grid to be an opportunity for growth and to strengthen the local branch in competition with the national main office.

In this meeting they draw, on a napkin, a sketch for an energy system where both parts play a role. They also acknowledge the need for optional partners and see the cluster as a mean in this. This is further developed through the initiation of an R&D project that explores the potential of Smart Grid and Advanced Metering Infrastructure (AMI) for improving energy efficiency, both in private homes and larger buildings. Simultaneously, together with the local serial entrepreneur, they establish a new company set in position to exploit eventually positive results of the project. The three-year R&D project, funded by the research council, invites actors from the research sector and industrial customers as project partners, as well as the cluster project organization and their own new company, to address the issue of energy efficiency in light of a future whereby AMI systems and Smart Grids dominate.

Frame 3: Transition from centralised grid system to decentralised grid systems with a changing roles of consumer and production the "prosumer". Flexibility and general criteria for the operation of energy systems. Here the cluster is utilizing knowledge to exploring and entering the smart grid market, where customers are both producers and consumers (prosumers). New demands are put on the existing grid and give rise to new business and technological solutions. Enrolment of new actors
energy companies enter the discussion together with new related IT companies, and industrial partners.

Transformation 3: The constellations and activities of the emergence of the test lab on the archipelago
At the time the local energy distributor get ready to roll out AMS (digital power meters) in their electricity network, they announce the net as a test lab for the participants of the cluster. The lab contains approximately 3,400 inhabitants and 30,000 summer guests, and totally 6,700 AMS located in the archipelago on the coastline. In a cluster workshop they promote the testlab as a place to test and verify products or solutions, or gain knowledge through research activities. One year after they stand up in a subsequent cluster workshop and complain that the testlab is not used, “no single company has contacted us” about the possibility of testing or researching. It takes another year before the lab is used and then another before the test lab is upgraded to a programme for greening solutions.

This upgrading takes place in a mutual project between the cluster management, the local municipality and the energy company. The lab is now embedded in a funded program and a variety of activities now take place. These include selling PV solutions for private production of electricity, collecting continuous data of power use and participating in national R&D projects. Several adjacent commercial actors, research institutions and some cluster companies are involved in these activities.

Frame 4: Transition from grids to smarter cities.
(exploring new capabilities and constellations for developing new capabilities systems to making smart cities. Utilizing market knowledge to expand flexibility thinking, where the concept of smart cities work as an umbrella for the exploring of new markets and possibilities.

Transformation 4: Constellations and activities from grid to smart cities
With AMS implemented at the end user, coupled with local generation of power, the demands for understanding, testing and predicting this effect to the grid becomes important. Actors with different interests implement several projects related to energy management in buildings, to end user flexibility and to the management of flexibility in the transmission net. This includes large national/international R&D projects with actors as communities, county council, industrial users and energy companies.

There is an exploration into new domains, two examples here are water management and telecom, as cluster companies approach or are approached by actors from other domains. This gives raise to new and unexpected actor nets and activities. The cluster companies are now also looking outwards.

VI. FINDINGS
In line with Karnøe and Garud we have in the former section described the evolution of the cluster as a path creation process, a path that are created through co-construction of clusters and action nets. The actors’ construct and re-construct clusters and networks, where actors and concepts create new possibilities through interactive processes. This is very different from the dominant understanding of cluster evolution as path dependent evolution, locked in by an agglomeration of accumulated actors, competences and technologies (Martin 2010).

Figure 2 is a (preliminary) presentation that shows the development dynamics of the cluster formation process.

![Fig. 2, working sketch for process](image)

The cluster evolution was initiated by the call for cluster development funding from the government. The call gives the opportunity for local actors set up joint activities with the aim to build up local industrial capabilities by clustering business and public activities focused on energy trade. An action net is formed of actors with adjacent interests and, after refining of discussion, results in a commitment to energy and emissions trading.

The now funded cluster project act as a meeting place for the participants and contact point between local private and public actors, across established sectors and spatiality. The joint grid project and thinking lead to a change in the cluster to smart energy market. Following this new direction energy companies get a more central role in the action net. One of these new actors an energy company establishes a test lab and invites the other cluster companies in. The test lab is organised as a programme open for all, as a joint venture with the municipality and the cluster. The transformation from grids to Smart cities open up for at new action net and constellation between the different actors.
And the public sector is now also included, as end user and big data come into focus in the cluster.

VII. DISCUSSION
The transformative shift in the cluster development through co-development of cluster and action net raise the question of how it is possible for the actors to create and implement new technologies and services on one side, and on the other side to terminate these when the opportunities and resources are going in other directions. In order to understand this development we have to look at the process from a socio-cognitive perspective.

VIII. CONCLUSIONS AND RECOMMENDATIONS
The process starts out as a path dependent cluster formation, where energy trade is focus and driver of the development. Soon though the actors break out of this dependence and create their own path (path creation). The findings show us how the actors act accordingly to possibilities that arise, and are able to “shift their emphasis to alternative approaches that may have greater promise” (Garud & Karnøe, 2001). In doing this they develop the “network of people, structures and technologies that goes beyond the organizational boundaries” (Andersson, 2013), and they fulfil the prerequisite of company learning (as opposite to individual learning) (Rubach, 2013). The action nets are shown to emerge and change during the process, and are responsible for change in the technological / business focus in the cluster.

A. References
THE PEESA PROJECT – INTERNATIONAL COOPERATION
ADDRESSING THE CHALLENGES OF ENERGY ACCESS AND EFFICIENCY IN SOUTHERN AFRICA

Abstract: A sustainable access to energy is an essential precondition for meeting basic human needs and for increasing economic and social welfare across southern Africa. Technical universities in their role of innovation drivers for regional economic and social development have the priority to develop an adequate framework for educating well-qualified engineers, equipped with the required market-orientated skills to solve the energy challenge. The PEESA project is an example for international cooperation for building academic and scientific capacity to address the energy efficiency problem in South Africa and Namibia.

This paper focuses on the market-driven and solution-based engineering curriculum designed in accordance with internationally recognised standards for engineering education. The emphasis is on the PEESA project, which aims to create four post-graduate-programmes in Energy Efficiency complying with both national and European quality standards. The main outcomes of the PEESA project along with the new Master programmes are Guidelines on Engineering Programme Design and Engineering Faculty Training Programme to be implemented in South African and Namibian context.

Keywords: energy efficiency, engineering education, international cooperation, academic capacity building, quality assurance

I. INTRODUCTION

Engineering Education and Training (EET) enables individuals to begin, continue and develop the professional and social competences they require on a lifelong basis in order to pursue a skilled occupation. EET that is geared to the needs of the labour market enables people to find adequate work, generate an income and, especially in countries with growing economies, escape from the spiral of poverty. This strengthens their personality, their welfare and their wellbeing and enhances their options for social participation. Moreover, all countries need qualified personnel in EET in order to achieve sustainable economic development. A competent and qualified workforce is needed for further economic and social development as well as future technological innovation and implementation, particularly in the countries in the Southern part of Africa with its growing economies.

Labour market-oriented EET combines theoretical and practical learning and forms graduates, equipped with an optimal blend of expertise, engineering and social skills required by the labour market. Formal and non-formal EET should transfer employment-relevant knowledge and practical skills, in order to enable employment and self-employment opportunities for all groups in urban and rural areas.
For Africa, addressing the challenges of energy access and efficiency is both a prerequisite for reaching the Millennium Development Goal of halving the number of the world’s hungry and poor by 2015, and reducing the effects of global warming effect (UNESCO, 2010). To achieve these goals, it is essential to focus on using existing energy resources as efficiently as possible by developing new technologies and methods. It is therefore a primary task and responsibility of Higher Education Institutions, as recognised drivers of regional development, to facilitate the change processes in engineering in the field of energy access and efficiency. In order to address these challenges, and recognising the need to adopt high-quality educational standards, it will be incumbent on African universities to develop a range of new programmes, particularly at Master level. Projects such as PEESA (Programme on Energy Efficiency for Southern Africa) are therefore necessary for enhancing innovative capacity, networking capabilities and market responsiveness of the relevant African institutions.

This paper addresses the role of engineering education in solving emerging technological problems in Southern Africa, such as energy access and efficiency. It focuses on the market-driven and solution-based engineering curriculum designed in accordance with internationally recognised standards for engineering education. The emphasis is on the PEESA project, which aims to create four post-graduate-programmes in Energy Efficiency complying with both national and European quality standards.

The paper is structured in four sections. The first section explores the challenge of energy access and efficiency in South Africa and Namibia as a global problem to be addressed by relevant engineering education in the African HEIs. The following section provides a brief analysis of the availability of manpower and the need to increase the number of well-qualified engineering professionals in the energy sector. The third section suggests as a problem-solving method to combine regional solutions and international quality assurance in engineering education. The section describes the PEESA project as a pilot programme following the suggested approach. Finally, the paper discusses the estimated outcomes and the impact of the PEESA project, and appeals for strengthening the collaboration efforts to overcome the energy challenge in southern Africa.

II. PROBLEM BACKGROUND – THE CHALLENGE OF ENERGY ACCESS AND EFFICIENCY IN SOUTH AFRICA AND NAMIBIA

Energy access and sustainable supply is one of the most demanding challenges the developing economies in southern Africa currently face. In the case of South Africa, the instability in the energy sector has led to an investment decrease, currency fluctuations and to a decline in economic growth by 0.5% in 2014 (Jablonski, A., 2014). Systematic power shortages continue to threaten the economic prospects of the country.

Up to 95% of the electricity in South Africa is produced by the state-owned utility company ESKOM. Its overloaded capacities are unable to meet the peak demand causing financial losses for the industry. Despite the large energy consumption, the power production has been declining since 2011 reaching a drop of 1.4% in 2014 (Stats SA, 2014). The inefficiency in the energy sector is a consequence of the outdate power generation system of ESKOM and the poor technical maintenance. The energy crisis has not only economic but also a social and environmental implications. Nearly 90% of the energy production is coal-based. South Africa, with its coal- and oil-based high energy consumption, is the largest energy consumer and greenhouse gas emitter in Africa (Stats SA, 2014). The pollution caused by the current energy use and production practices has significant environmental and health impact in the region.

The provision of sustainable energy is a regional problem in southern Africa. South Africa’s northern neighbouring country Namibia is also dealing with energy issues in terms of supply and distribution in order to ensure long-term economic stability and growth. The country’s own mix of electricity production, comprising of hydro, coal, and diesel power, can only meet about 25 percent of demand. The balance is heavily dependent on imports from Zimbabwe, Botswana, and South Africa. (Kumar, T., 2013) Furthermore, only about 43 percent of Namibia’s population has access to electricity, due to the high-costs of grid access in rural areas. (World Bank, 2014)
While both South Africa and Namibia enjoy political and economic stability, a strong education system, and a thriving business environment, this energy situation is unsustainable and severely hinders further development (Kumar, T., 2013). Both South Africa and Namibia have established country strategies and related actions to address the energy challenges. These actions include a range of government support programmes: such as the Industrial Energy Efficiency Project driven by UNIDO, the Green Economy Strategy of the Department of Economic Development, the Namibian Energy Shops programme. These are supported by a number of implementation agencies, such as the National Cleaner Production Centre, SA National Energy Development Institute, Petroleum Agency of SA, the Namibian Renewable Energy and Energy Efficiency Institute, etc.

The adequate policy development requires two areas of action: 1) technological advancement related to the physical construction of modern facilities; 2) development of infrastructure services as a foundation for technology. The second area of action addresses the government efforts to stimulate potential for economic growth by increasing the supply of highly qualified human resources able to provide appropriate services, such as technical maintenance, investment, and project management. In this respect, education in engineering will play a key role in supporting Africa’s future technological innovation. Improving higher education in science and engineering will position universities at the centre of local development generating skills locally in response to local challenges and demands. (UNESCO, 2010)

III. PROBLEM STATEMENT – THE NEED TO INCREASE THE NUMBER OF WELL-QUALIFIED ENGINEERING PROFESSIONALS IN THE ENERGY SECTOR

Educating well-qualified engineering professionals is an essential factor for achieving a sustainable advancement in overcoming the energy challenge in South Africa and Namibia. This is where the region faces demanding challenges. The Engineering Council of South Africa (ECSA) has published the results of an international benchmark of an average population per engineer showing that South Africa lags behind other developing countries. The shortage of engineering practitioners is evident in the number of competent engineers available for ongoing projects (ESCA, 2010). In 2015, the difficulty in filling job vacancies has significantly increased compared to the previous year, according to the Manpower South Africa’s tenth annual Talent Shortage Survey. A major reason according to 47% of the interviewed employers is the lack of technical competencies, 30% of them mentioned the lack of industry-specific qualifications or certifications (Manpower, 2015).

Although the country is severely under-engineered, the unemployment in South Africa remains one of the highest in the world (World Bank, 2014). The mismatch of market-required skills is responsible for high level of unemployment among the youth (Manpower, 2015). For this reason, African countries, such as South Africa and Namibia, must find ways to combine the needs of the labour market with formal education. It remains a responsibility of the higher education institutions to address these challenges at tertiary level. On the university level, the proportion of engineers in Africa is the lowest worldwide (ESCA, 2010). Education in technical fields is expensive and the skills required are scarce. African universities should therefore seek cooperation with the public and private sectors, in addition to international HEIs, to provide high quality technical education on the tertiary level.

In the midst of the acute energy challenges, the trend in the technical universities is to continue rigidly offering conventional engineering programmes. Yet there is an industrial demand for graduates who can tackle the energy challenges. A new educational offering dedicated to energy is essential, structured in a way that addresses modern approaches, technologies and standards.

IV. PEESA – COMBINING REGIONAL SOLUTIONS AND INTERNATIONAL QUALITY ASSURANCE IN ENGINEERING EDUCATION

In order to respond to the challenges in the energy sector and to address the skills shortages and human capital gaps of qualified engineering professionals in the sector, the PEESA project was developed by an international higher education consortium. The project is funded by the European Union, in the scope of EDULINK II Programme, and implemented by the ACP Secretariat. The goal of PEESA is to
develop engineering Master programmes within the framework of these challenges. PEESA will support the participating African universities to develop high-level postgraduate programmes in engineering that meet the needs of the respective African regions, and will contribute towards building academic capacity. These programmes will offer a mix of taught part and research options that focus on the specific regional energy resources in light of their specific societal needs. This will range from natural to renewable resources with an emphasis on the technologies, processes and standards for efficient energy use and resource management. This includes the conventional energy production sectors (such as oil, gas and coal), as well as renewable sectors (such as solar, wind and biofuels). (Project documentation)

PEESA focuses on ensuring national and regional quality assurance standards for the envisaged programmes. It will also align quality requirements between European and African national standards. One outcome of PEESA is the development of guidelines for the design of engineering curricula that includes requirements for learning outcomes at Master’s level used within the Bologna Process (e.g. in a framework for Qualifications for European Higher Education Area and European Qualification Framework), criteria for accreditation of engineering programmes (Master’s level), and a comparison of the government education standards in South Africa and Namibia. It will further describe a methodology for engineering curriculum design, including allocation of credits in accordance with EUR-ACE Framework and federal standards of the respective African countries. Such harmonised structures and systems will improve mobility and facilitate higher education cooperation in Africa itself (through mobility schemes such as Nyerere), as well as between Africa and Europe and other parts of the world (through programmes such as ERASMUS). This, in turn, will support sustainable development and the gradual integration of the ACP countries into the EU HEI sector. (Project documentation)

In order to create relevant curriculum and teaching programme adapted both to the needs of the African higher education institutions and at the same time compatible with the European Quality Standards for engineering education, a collaboration at intra-regional and international level was necessary. The PEESA international consortium consists of seven partners and one associate partner. The partner universities from Germany are the Universities of Applied Sciences Wismar (HSW), Jena (FHJ) and Flensburg (FHF). Due to the long-term cooperation with the African partner institutions HSW, FHJ and FHF were able to analyse the regional situation and the conditions for establishing a post-graduate programme. In addition, they support the programme by sharing their experience in curricula and content development of engineering programmes, as well as sharing their expertise for elaboration of Guidelines in accordance with Bologna principles and European Quality Standards. As a lead partner, HSW is responsible for the strategic and financial management of the project.

Three of the six existing universities of technology in South Africa are partners of the PEESA project: Cape Peninsula University of Technology (CPUT), Vaal University of Technology (VUT) and the Tshwane University of Technology (TUT). They offer mainly career-oriented study programmes with a strong applied focus. The new programmes they will develop in the scope of PEESA will create and apply new knowledge in the field of energy efficiency and will contribute to the regional development in South Africa. The Polytechnic of Namibia (PON) is the project partner, who brings an expertise in renewable energy. PON is represented by the Renewable Energy and Energy Efficiency Institute. PoN’s participation in this project is of great importance for linkage with national governmental bodies and for dissemination of project outcomes throughout the Namibia.

The PEESA project is supported by the European Network for Accreditation of Engineering Education, which is actively involved in the development of the Guidelines. ENAEE will provide the project with its experts in evaluation of the quality of engineering programmes and will be responsible for organization of evaluation programmes developed against the EUR-ACE Standards.

The PEESA programme pursues the overall objective to ensure that the African partner universities have advanced curricula for the area of Energy Efficiency according to the European quality standards for engineering education. In particular, the PEESA project has the following objectives:

- to develop a methodology for engineering curriculum design based on the alignment of EU
quality Standards with national educational standards requirements to structure of programmes and graduates’ competences

- to develop/update a master engineering programme at CPUT, PON, VUT, TUT according to EU quality requirements
- to implement the master engineering programme at CPUT, PON, VUT and TUT
- to develop and implement a "train the trainer" online programme on master/PhD level for preparation of future teachers
- development/updating and implementing of a quality assurance system aligned to EU quality standards

Beside the students as main stakeholders, the project targets the teachers at African technical universities. The project has developed and will implement an appropriate teacher training programme in the form of a distance learning course. This will contribute to providing regional solutions for teacher shortages and so support ACP HEIs to compete globally. The final beneficiaries of PEESA are African and Africa-located companies, technical universities and African national quality agencies. A task force on energy efficiency, consisting of representatives of policy and industry, was already involved in the preparation of the project.

V. ESTIMATED OUTCOMES AND PROJECTED IMPACT

PEESA provides solutions on how to integrate innovative energy technology into efficient methodologies in the energy sector in Africa, building on the expertise and experience of the European partners. The impact of the project according to the target groups can be described as follows:

- Future teachers of the master programme: academic staff (a total of 20) will be targeted for curriculum development and training using modern and innovative approaches. It educates teachers on the value of work-oriented learning as a new paradigm.
- HEI management of the respective universities: at least two executive management staff from each partner will benefit from the experience of managing trans-national consortia-based projects. In addition, two further support staff will gain experience in quality assurance and curriculum development practice in an EU-Africa context.
- Students participating in the new master programme: the graduates from the planned qualification will enter the oil & gas, solar energy, wind energy, mining, and coal electricity sectors, amongst many others.
- Regional Enterprises: the project will provide emerging energy sectors in both countries with the necessary skills development platform. Longer-term development partnerships will therefore develop between the learning programmes and agencies tasked with promoting these sectors. The aim is to provide better higher education for delivering more qualified staff for innovative companies in the respective region of Africa. With the skills and knowledge of the graduates companies are more successful and competitive in global businesses.
- Project partners: project partners have complementary experience and the collaboration activity of sharing best practices.
- Wider academic and governmental community: emerging African government development policy on energy access to rural and marginalised communities will require innovative platforms that lead to additional longer-term partnerships with assigned agencies. Because of its research and innovation components, a postgraduate programme would be able to exploit opportunities for rural development, localisation and improved renewable energy mixes.

(Project documentation)

The estimated direct results of the PEESA project are:

- 4 new master programme on Energy Efficiency
- Guideline on engineering programme design
- Curriculum and syllabus development
- Engineering faculty training
- Evaluation of programmes against EUR-ACE Standards
- Implementation and promotion of programmes at 4 African technical universities

The PEESA project will provide development support on three levels – national, regional and Intra ACP – based on the development strategy agreed
between the consortium partners. In doing so, it responds to a number of key development issues:

- stimulating potential for economic growth by increasing the number of highly qualified professionals available in ACP countries;
- improving the quality of higher education provided locally in ACP countries;
- emphasising the importance of building ACP HEI capacity by promoting both cooperation between ACP HEI and between ACP and European HEI;
- stressing the importance of promoting intercultural dialogue and understanding between European and ACP countries.

The Project will provide emerging energy sectors in both countries with the necessary skills development platform. Longer-term development partnerships will therefore develop between the learning programmes and agencies tasked with promoting these sectors. (Project documentation)

VI. CONCLUSIONS AND OUTLOOK

This paper aimed to underline the role of higher education institutions in economic and social development at regional level, addressing global issues such as the sustainable energy supply in Southern Africa. In this light, technical universities are seen as the facilitators of a change process by transforming engineering education, curricula and teaching methods to emphasize relevance and applying a problem-solving approach to respond to locally conditioned industry needs (UNESCO, 2010).

Projects like PEESA foreground excellence in standards of higher education as a catalyst in transforming engineering education. The involved stakeholders and the supporters of the PEESA programme are convinced of the potential of the new programmes to deliver a significant contribution in addressing the skills shortage in the energy sector. PEESA’s implementation team is pleased with the progress made up to date, taking into consideration that a faster implementation will require significantly more resources. A major constraint for the project implementation turned out to be the long accreditation process in South Africa and Namibia, which will delay the final evaluation of the new Master programmes against the EUR-ACE criteria. Nevertheless, the good dialog between the policy-makers and decision-takers in the faculties and the national accreditation agencies could ensure an amiable solution, so that the project will be timely implemented.

The significant achievement of PEESA and contribution to engineering education is the harmonisation of the Quality Assurance Standards between South Africa, Namibia and Europe. The harmonised structures and systems will improve mobility and facilitate higher education cooperation in Africa itself, as well as between Africa and Europe. This will support sustainable development and the gradual integration of the southern African countries into the European higher education sector.

To leverage the achievements of the last three years of collaboration, the consortium is looking to expand its network and to internationalise the approach to other technology universities in Sub-Saharan Africa.

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INTERCONNECTED CAR AND BIG DATA –
THE PAVEMENT OF THE ACADEMIC AWARENESS FUTURE

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Abstract: Organizations from automotive industry and IT companies alike thrive to achieve the autonomous car concept; some search for the big breakthrough, while others choose the incremental path. Massive data processing must be performed in order to ensure the interconnectivity of ECUs inside car and interconnectivity between cars; Big Data approaches becoming mandatory for the future. Universities must make the first steps in order to become pioneers into this field; encourage student to innovate and get involved together with experts of the industry. The Academics - Industry interaction was explored during the research by generating a model of Autonomous Car Development Spiral (ACDS), a model in which the academic involvement is the key of promoting self-driving car awareness. The paper is presenting case studies of Interconnected-Cars / Big Data approaches inside well known companies and it’s exploring the model of achieving the Interconnected Car alongside with the academic awareness.

Keywords: autonomous vehicle, academic awareness, Big Data, automotive industry, interconnected car.

I. INTRODUCTION

Businesses of different nature are developing into a new era that is customer oriented and sustained by big data. Big Data (“Big Data” will be referred on this paper as simply BD) flow is generated by the rapid expansion of social media, the outburst of mobile devices, millions of networked sensors connected through internet all around the world; all resulting into a large volume of available data, that can offer development and innovation opportunities. There is a great deal of data coming from the vehicle, from the sensors and processors that are part of it. All data generated by the car components and data from communication between vehicles and other external ECUs like Smartphone, must be processed in order to enhance the future of interconnected vehicle. Going forward on this path, after pulling the information in and storing it in a way that allows it
to provide real-time value; connected cars are becoming intelligent entities, in the same way that computers were at the beginning of internet. To understand the massive processed data, an example is presented: more than 480 terabytes of data were collected by the OEMs in 2013 from the intercommunication of more than 26 million connected cars. The projections based on increased connected car sales and development of sensors will result a value of 11.1 petabytes (1 petabyte is equal to 1000 terabytes) by 2020[1]. The flow of data from IC (“Interconnected Car” will be referred on this paper as simply IC) is also suffering a dramatic increase: approximately “30 terabytes of data will be collected each day from the 152 million connected cars on the road in 2020, or about 350 megabytes per second, compared to about 15 megabytes per second in 2013”[1].

Industry experts consider BD a key element of the IC ecosystem, offering the potential for significant annual savings as well as new revenue streams [2]. Data connected by intelligent cars consist of: vehicle speed, braking pressure, wiper speed, transmission control systems, air bags status, geospatial and environmental conditions, tire pressure and detected objects by ADAS (Advance Driver Assistant Systems) modules paired with decisions. There is a fear of adoption new technologies, especially in the field of self-driving vehicles, people are not willing to let control out of their focus [3], and this is happening because of the lack of information starting with the academic phase. They should be the promoters of these concepts and drive passion in the eyes of students for continuous involved inside this work.

The purpose of the paper is to present an overview of the IC concept among industry and encourage the academic environment to educate the critical mass necessary for adopting this automotive innovation. The paper consists of two main chapters: in first are reviewed the approaches of IC / BD inside automotive industry while the latter presents a model (Autonomous car development spiral - ACDS) of achieving the valiant goal of big automotive OEMs, the “Interconnected Car”. ACDS and Big Data must be combined in order to pave the way for the IC, all this being performed with the involvement of the academic sector.

II. CASE STUDIES – BIG DATA AND INTERCONNECTED CAR

Next are presented four working and on-going initiatives where Big Data & Interconnected Car are applied into the automotive industry: a Big Data platform from a 3rd party supplier, a well-known IT-technology company (but new entry in the automotive field) IC concept, a renowned automaker process shift towards Big Data and the largest automaker seller (starting from 2nd quarter of 2015) concerns regarding this issues.

III. CASE STUDY: IBM

IBM developed a complete Big Data platform, devised to help organizations on gaining insight from BD by conveying “enterprise-class data management and advanced analytics” [11]. The platform supports impromptu data discovery, exploration and unstructured inquiry as well as structured, iterative tasks to revamp business insight disregarding of the Volume, Velocity, Variety, or Veracity of data. IBM realized an integrated solution (IBM PureData™ System for Analytics, powered) by gathering telematics data, pooling it with information about a vehicle’s environment, analyzing it and relaying it back to the driver through cloud-based applications. By doing so, Big Data and analytics can advance the concept of connected vehicles and provide greater opportunities to promote safe driving and enhance driver experience [11].

The integrated solution is offering an optimized architecture for the handling of data; providing a structured way of correlation between vehicle information and information regarding the environment in which the vehicle is operated at a certain moment in time. More and more sensors installed by the car manufacturers or devices used by drivers are connecting with data from the infrastructure in which the car is running and with the environment. The sensors will provide data regarding the infrastructure and environment at short and long range through Radar, Camera and LiDAR technologies. The infrastructure can be characterized by the road signs, pedestrian crossing, and location (railways, highways) composing the “Intelligent City”. The environment that can have an influence on the data from the car consists of the temperature, weather, traffic load, accidents, unexpected events or any other data that appears or not useful. The architecture
provided by IBM should provide analytic results to business insights and also reduce storage and maintenance costs.

IV. CASE STUDY: GOOGLE
Google, the well-known multinational technology company specialized in Internet-related services and products initiated a BD oriented program to fuel the software empowered Google's autonomous cars, called Google Chauffeur [12]. This self-driving car is a perfect example of Big Data creator: the sensors needed to facilitate the car to drive alone generate nearly 1 Gigabyte every second, that equals approximately 2 Petabyte of data per car, per year (considering that the average American drive 600 hours per year)[13].

These cars can detect objects thrown on the ground and knows when a person or another car might appear from a corner, all thanks to BD processing by highly efficient algorithms; now only the high costs of the sensors are proving to be an obstacle. Intelligent, autonomous cars are being developed with interconnectivity capabilities, and as a result of this, the automobiles are gradually turning into “highly efficient data harvesting devices” [14].

Other companies, both in automotive industry or not (like Apple Inc.), are also working on self-driving cars prototypes and millions are poured into this field every day, Mobileye (a technology company that develops vision-based advanced driver assistance systems) just raised a stunning $ 400 million to develop self-driving cars [13].

Even if now Google is the current global leader in the field of data analytics expertise in the Connected Car space; Chinese e-commerce giant, Alibaba Group, stated its intent to take full advantage of BD and computing capabilities in the automotive space, focusing not just on delivering customized in-car infotainment but goes on further to cloud computing and predictive data analysis [15].

The future of BD in the automotive industry will develop even more: IHS estimates that 480 terabytes of data was collected by vehicle manufacturers in the year 2013 from 26 million connected cars and the industry will collect 11.1 Petabytes of data from connected vehicle by the year 2020 data [16].

V. CASE STUDY: FORD MOTOR COMPANY
As most automakers struggle at some point in this challenging business, so did Ford in 2006, when it reported the largest annual loss in company history of $12.7 billion[5] and evaluate that profitability will return only in 2009[6]. Nonetheless in the second quarter of 2007, Ford shocked Wall Street by announcing a $750 million profit and eventually finishing the year with a smaller, $2.7 billion loss (largely associated to the finance reorganization at Volvo).

In the same time, Ford newly appointed CEO, Alan Mulally, started its initiative on Big Data mining by establishing a department of 200 Big Data analytics experts from a broad spectrum of discipline, assigned to centers of excellence. With the slogan "Data will set you free", since 2007 these experts have contributed to urgent strategic and tactical turnaround decisions, working on projects that decided issues impacting the clients, the suppliers and 3rd party dealers: such as which brands and models to discontinue, how to source parts and materials, where to build certain vehicles, and how to enable dealers to maintain their inventories to improve sales [7].

Even if most notable to Ford reconstruction was the fact that the USA economy regained momentum and also the fact that on June 2, 2008, Ford sold its Jaguar and Land Rover division to Tata Motors for $2.3 billion, none can argue that Big data mining and usage did not have an effect in Ford recovery. These conduct generated Ford a $2.7 billion profit in the whole 2009 fiscal year, the company's first full-year profit since 2005[8] and eventually in 2012 Ford's corporate bonds were finally upgraded from junk to investment grade (higher than BB) again because of “sustainable, lasting improvements”[9].

Data analytics is a key competitive tool for all carmakers, who are evaluating data on customers, production capabilities and vehicles to predict demand and put an edge on their own offerings; Ford has successfully amassed and combined customer feedback, and extracted all the in-house data to anticipate what outstanding, new technological features will make their cars enticing.

According to Gartner automotive analyst and strategic advisor, Thilo Koslowski, Ford is focusing its analytic efforts on customer preferences (an area where it seems to surpass the competitors starting with the monitoring of social media streams to data on what it has already built and sold or what has sold in the context of what was available in inventory at the time of the sale [7].

Michael Cavaretta, PhD, technical leader of Predictive Analytics for Ford Research and
Advanced Engineering in Dearborn, Michigan notes the importance of domain knowledge, specifically when making changes in the manufacturing plant and underlines that it’s necessary “to talk with people who have 20 years of experience” [10] in order to better combine data with intuition. Other prefer different approach on using Big Data: from the customer oriented need to the self-driving car or to managing intellectual capital, big data will be an mandatory tool of usage for organization in automotive industry (from tier 3 suppliers to the most unknown OEMs).

VI. CASE STUDY: VOLKWSAGEN

Volkswagen company agrees with the use of BD in the IC but enhances the need of security and protection; according to Dr. Martin Winterkorn, chairman of VW Group, “integration time of vehicles into information technology (IT) infrastructures need to be accelerated, but data protection infringements remain a risk” [17]. Hackers could use the infotainment system as a gateway to safety-critical domains of the vehicles ECUs architectures, therefore a voluntary commitment of the whole industry is needed to ensure standardization. Winterkorn highlights the need of cooperation between the automotive, IT industry, together with politicians and academics in order to surpass the financial burden of this innovation, “VW Croup was investing around €3,8billion a year in IT and, in 2013 total R&D spend was €10.2 billions” [17]. On the 36th International Conference of Data Protection and Privacy Commissioners interested parties were urged “to exercise great care, and act in compliance with applicable data protection legislation, when sharing or publishing, identifiable, data sets [18].

VII. INTERCONNECTED CAR

SAE organization unveiled in 2014 the J3016 standard on “Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems”. The key elements that need to be concluded are not necessarily regarding the current stage that car development is right now and are more oriented on the stages of near future; this being the initiative of interconnected cars and automated driving. The stages of autonomous vehicle by SAE J3016 are presented in table below.

<table>
<thead>
<tr>
<th>Level</th>
<th>Connected system role</th>
<th>Human driver role</th>
</tr>
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<tbody>
<tr>
<td>No automation</td>
<td>May provide warnings but no direct contact between driving activities and system.</td>
<td>Monitors driving and execute the driving activities like: steering, acceleration, braking.</td>
</tr>
<tr>
<td>Driver assistance</td>
<td>Can be deactivated in certain conditions and immediate driver takeover is needed.</td>
<td>Monitors driving environment and determines the activation or deactivation of ADAS systems. Executes either longitudinal (acceleration, braking) or lateral (steering) dynamic driving tasks. Also the driver is able to take over immediately when required.</td>
</tr>
<tr>
<td>Partial automation</td>
<td>One or more ADAS systems of steering and acceleration / deceleration will give assistance to driver using information from environment.</td>
<td>Same role as in Driver assistance with the difference that is not needed to execute longitudinal (acceleration, braking) or lateral (steering) dynamic driving tasks.</td>
</tr>
<tr>
<td>Conditional automation</td>
<td>Automated driving performance with the expectation that human driver will respond appropriately to a intervention request.</td>
<td>Determines when activation of automated driving system is appropriate and may request the deactivation of system. On deactivation request the driver shall take off with lead time.</td>
</tr>
<tr>
<td>High Automation</td>
<td>Minimal risk condition if the human driver does not take over on request.</td>
<td>Same role as in Conditional automation but some applications in this category may not entail a human driver.</td>
</tr>
<tr>
<td>Full Automation</td>
<td>Full time performance under all roadway and environmental conditions without human interface.</td>
<td>No role.</td>
</tr>
</tbody>
</table>

Table 1. The levels of autonomous vehicle by SAE J3016 [Source 4, 19]
VIII. MODEL OF IC – INCREMENTAL APPROACH

There are two ways of achieving technologic breakthroughs in the automotive field: the leap to fully automated car chosen by IT companies, Google and Apple (that, without prior experience in this domain, thrive to reach the goal of an unmanned vehicle by 2020) and the incremental approach of experienced automotive OEMs (Audi, BMW, Daimler, Ford, Bosch, Continental), described prior in the SAE J3016 standard.

The human race has a natural fear of adopting new, ground-breaking technologies, especially ones that force them to let go the personal control of their means of transportation to unknown sources. In order to achieve a critical mass that will allow general Public Acceptance, modest and continuous steps must be performed (ACDS model), following the incremental approach. The role of Academics is to train future engineers in this field and also create awareness regarding the need of IC for future owners.

Currently all big OEMs and automotive organizations are entering a race of developing the autonomous vehicle, the lately news from year 2015 is the following:

- Audi presents in Shanghai the A7 self-driving car on the CES (Customer Electronic Show);
- Bosch explained that in order to fulfill the autonomous drive vision a lot of effort needs to be invested into the infrastructure;
- UK became the best location for developing the self-driving cars; no geographical limitation on tests, no special licenses or no additional insurance needed;
- More and more countries are allowing and encouraging the self-driving development;
- It’s allowed to test the self-driving cars on the A9 highway from Germany;
- Google’s car experienced 1 million miles of automated driving with no incidents from the car faults;
- Daimler started tests on autonomous driving truck in US;
- Ford announced its Smart-Mobility-Agenda which means that the OEM wants to invest in new services like autonomous driving, connecting car and car sharing;
- IBM and Continental are working to make the concept of autonomous driving a reality.

The next generation of autonomous cars will not only receive data, but also transmit vital information (velocity, coordinates, and deceleration) to the cloud, to process and analyze data with high computing power in a safe environment. The sensor and the communication directions that will enable this are shown in Figure 2.

**Figure 2. Interconnected car vision**

The approximate ranges at this stage of development for the main technologies are:

- Long range radar, Far Range less than ~200m, Near Range more than 40m
- Camera covers around 70m
- Surround view (mainly used for low-speed parking purpose) at 5m
- Short range radar field of view distance is 15-20m
- Static LiDAR (Light Detection and Ranging), the remote-sensing technology involving lasers is up to 30m

As presented in the paper until now, the concerns in this area are extremely serious and advanced; the main competitors from the automotive market being very concerned regarding these issues. One of the major problems that will arise, common to new products with high levels of embedded technology, is the acceptance of the potential market. Are we prepared to let go of one of the main concerns and pleasures of the past few decades to the advanced technological systems? Pretty hard to believe, even if the Science Fiction predicted long time ago such means of transportation.

The current trend in modern marketing, and in the same time, its greatest challenge is determining new
needs for the target population. The appearance and inoculation of these new needs on the market together with the publishing of messages with the purpose to determine the awareness of this unidentified need so far make marketing approaches to change radically. Thus, from this point of view, this is where the interface between advanced research in the automotive market competitors and academic awareness may become the hub for communication to the market.

The aspects of the problem are multiple and over Autonomous car development spiral (ACDS) the academic awareness may be located in different stages.

Figure 3. ACDS Model – Stages of development

For the training of such specialized engineers, the challenge is set at a high level; bringing in front of the academic field the transformation path from the Concept Generation to the Industrialization & Standardization stage, by technological and constructive point of view.

Knowledge of the concepts and identifying innovative technology elements will have a major impact on students from the mechanical, electrical or artificial intelligence profiles. Certain aspects can populate the syllabus of many technical disciplines and the simulation in laboratory conditions can empower the graduates to create and transmit that initial market need in order to establish a minimum first awareness.

Advanced research in the IC field may also be supported by these two important pillars: business and academic environment. Each of these stakeholders would follow individual goals in this kind of project; business environment by implementing concepts that can provide major financial performance in the medium and long term, and academics by stimulating research and obtaining grant funding.

In this way, we have a clear definition of the first and last stage of the "Autonomous car development spiral" (figure 3), where the Academic involvement is a must: Concept Generation and Public Acceptance by the market.

The success in the introduction of a new product depends on coordination and synchronization in time. An entry on the market too late leads to a compelling loss of opportunity, while being too early or unprepared, may surprise unprepared potential and unreceptive distribution channel parties. This is why finding the right input window (strategic window of opportunity - Abell 1978) is of vital importance. This implies that companies must be prepared to exploit any new market entry window, like the autonomous / IC concept.

Moreover, long-term performance of a company's success depends not only on timing and concentration while introducing a new product, but more importantly, as suggested by Lewis S. Edelheit from General Electrics, success depends on planning across multiple generations and associated products (eg. sensors needed by the autonomous cars, needed trainings, consumables) over time.

Mahajan and Muller notes that "determining the optimum time input is particularly important for superotechnologized products, where the successful introduction of each generation of a product puts the company in a position to analyze the customer impact on demand of previous generation and vice versa ".

The incremental development of the concept triggers the need of special energy and a rigorous timing. Starting initiative actions is an element that must finish in a narrow time window, but respecting the time frame will generate sustained competitive advantage (opposed to latter adopters). Our proposal concerns the establishment of a comprehensive market study, with resources used both in business and academic field, to identify, relevant and objectively, the optimal time to introduce the marketing concept and identify the problems that may occur in the market, together with the needed messages to be transmitted towards the market.

Gomory [20] emphasizes the cyclical nature of product development and the need for companies to prepare in order to align with current and future market needs and technological development. The
same author demonstrates that the cyclical development, or introducing a new product at the same time with the start of working on a new product, is vital if companies are to remain competitive and that such efforts are guided by the concept of "life cycle of a product". Uncertainty in knowing the needs, segmentation and market dynamics is a time-based function, as well as financial efficiency. For this reasons, long-term performance companies must satisfy these conditions during whole operation time. Company's expediency is a function dependent on the absorption capacity and the utilization of resources, while the market responsiveness is again a time-dependent function, on the existence and availability of interdependent / complementary products and services. To conclude we state that long-term performance of companies is a function dependent on the timing / synchronization of the company's expediency and market responsiveness.

Industrialization & standardization stage involves identifying potential solution of collaboration with suppliers and can generate substantial cost reduction processes. Even if this new technology is considered generally a disruptive / untailored one, solutions towards standardization of relevant benchmarks can be identified, in order to reduce production costs substantially. The role of project and design management is critical in this stage; and the association with the academic scholars can offer viable technical solutions that can be used to introduce the concept. Incremental development will pave the marketing trends and render Interconnected Car a worthwhile monetized innovation, following the organizations need of well-founded and innovative business models like ACDS, to create value for the customer and foster continuous improvement.

For long-term success, organizations must shift the focus from the sampling of customer expectations to real-time, Big Data analysis of the whole preferences range. This will be in our grasp, done by the sensors provided in the IC (same approach as the vineyards in Napa already use to check the exact conditions of temperature and humidity of each growing grape), ensuring the proposed business model (ACDS) to develop as a living organism based on customer and academics feedback.

IX. CONCLUSION AND FURTHER APPLICABLE WORK
Gathering and mining of Big Data is an essential part of the Interconnected Car initiative. It can be learned from the successful approaches of the big OEMs or from their mistakes. The general public is not yet prepared to handle such a crucial change like the self-driving car. Both the market need and cultural acceptance must be introduced into the people daily life one step at a time. The academics involvement regarding self-driving will enhance these necessary steps by inoculating those needs in the potential market, raising the awareness of future customers and growing the scholars' interest.

The Autonomous Car Development Spiral (ACDS) is creating a bridge for solving multiple problems of the self-driving initiative, ranging from the concept generation to public acceptance; the academic sector can ensure that this fundamentally new technology and product will find a nurtured field to grow on and could also offer viable technical solutions that can be developed by automotive producers. Incremental development will pave the marketing trends and render Interconnected Car a worthwhile monetized innovation, following the organizations need of well-founded and innovative business models like ACDS, to create value for the customer and foster continuous improvement.

For long-term success, organizations must shift the focus from the sampling of customer expectations to real-time, Big Data analysis of the whole preferences range. This will be in our grasp, done by the sensors provided in the IC (same approach as the vineyards in Napa already use to check the exact conditions of temperature and humidity of each growing grape), ensuring the proposed business model (ACDS) to develop as a living organism based on customer and academics feedback.

A. References
Abstract: The purpose of the article is to show how engineering schools and business schools can benefit from using a regional approach in a globalized world of education, science and business. In order to tailor make services to the needs of the students and the business community research can be the main activity of engineering schools and business schools, having a critical eye on changes in demographics, pollution and urbanization. At undergraduate programs philosophical approaches building on broad approaches from science will be important, using Kant and chaos theory as references. Graduate programs can to a greater extent use applied approaches suited to the needs of the business world, again building on insights from Kant and chaos theory. We suggest that a regional model is used as the basis for organizing engineering and business schools in an efficient and effective manner, Technological knowledge, with a focus on routines, can be the regarded as the main driver for changing existing practices. Change in routines can have effects on leadership traits and value creation processes.

Keywords: Economic decline in Europe, regionalization, globalization, engineering schools and business schools, research approach, Kant, chaos theory.
Graduate programs can benefit from serving the engineering and business community by focusing on the use of existing knowledge. Graduate programs can prepare students for a professional career, using applied research approaches and using executive experiences as benchmarks.

Chaos theory. The emerging conceptualization of reality is based on complex, dynamic, non-linear and unpredictable systems, often referred to as chaotic systems. Chaos describes a situation where a system is dislodged from its steady state condition by triggering events. It involves regrouping of elements of a given system. From which a new order eventually emerges (Fitzgerald and Eijnatten, 1998).

Complexity is related to the number and types of relations in a system (Rescher, 1998, 1). In case of a high degree of complexity, system behaviors will easily be perceived as being chaotic. The performance of a system is hard to explain based on how the various parts operate. From the moment of increased complexity in a system, subsequent expansion has a tendency to follow, i.e. complexity feeds on itself (Rescher, 1998, 6).

An edge of chaos exists when a system is in tenuous equilibrium. An analogy is borrowed from Waldrop (1992) explaining a pile of sand heaped on a table to the limit capacity. It implies a readiness for change, or “an edge of chaos” states in which the adhesive friction between the sand and grains are taxed to the limit of tolerability.

It is when a system is in a state of chaos that it is most vulnerable to the butterfly effect, which states to small causes can have large effects (Lorentz, 1963). This metaphor explains that a butterfly in Amazon can, of course theoretically, cause a swelling ripple that, in turn, can lead to a gigantic dust storm in Texas.

An interpretive approach is regarded as suitable for the investigation of complex and poorly understood phenomena (Dixon et al, 2007) since such an approach implies that the researcher’s task is to “make sense of local actors’ activities” (Soulsby and Clark, 2007, 1426). Thus, the important criterion for assessing interpretive data analysis is its ability to provide reasonable insights into phenomena that demand deeper understandings. Empirical findings illustrate, rather than validate, the theories they reflect (Astley and Zammuto, 1992).

IV. THE USE OF STORY TELLING

Since regionalization and the use of research linking regionalization to the globalized world an inductive approach was chosen. Our choice fell on storytelling when deciding our research approach. Storytelling as a cultural presentation and as a sociological text emerges from many traditions, but nowhere more strongly illustrated than in oral history and folklore (Claydinin and Connelly, 1999). Story telling is an important of the construction of meaning and understanding in social situations (Boje, 1991; Brown, 1990; Weick, 1995). Organizational storytelling serves to establish
common values and strengthen the identity within organizations (Brown, 1990; Kreps, 1990). People construct meaning about their lives through the stories they tell (Ramer, 1997). Stories can act to enhance the organization’s ability to navigate through difficulty (Boje, 1991; Peters and Austin, 1985, Neuhauser, 1993). Storytelling is powerful in organizational settings, where “stories act as a vehicle through which members can offer definitions and explanations of their work life” (Brown and Kreps, 1993, p. 49). Stories present conceptual boundaries for members to think through and make sense of events that have occurred (Brown and Kreps, 1993; Weick, 1995).

The purpose of stories in organizations is primarily twofold (Neuhauser, 1993; Pondy, 1993): grounding (clarifying key values) and instruction (demonstrating how things are done in a setting). Critical viewpoints challenge the notion that stories can be explained in individual ways. Instead, multiple voices and multiple realities must be considered (e.g. Berger and Luckmann, 1967). Boje et al (1999) caution about the hegemonic aspects of storytelling research, as narrators, by definition, privilege particular fragments of stories. Consequently, researching stories in organizations must be carefully being undertaken to present many voices.

V. RESEARCH (AND ECONOMIC GROWTH) THROUGH REGIONALISATION

The economic geography of the post-industrialized world is characterized by fundamental processes of restructuring, an increased mobility of capital and a pursuit for new economic growth activities, particularly in the service sector. Traditional means of investing, conducting marketing ad work within political networks have undergone dramatic changes. In recent years, the service sector has become more important worldwide, for example when it comes to consumer preferences, wealth mobility and location mobility (Hudson, 1995). The same argument holds in the educational sector.

Europe faces a situation where markets have become highly competitive and turbulent, and are constantly changing. Market conditions move from being simple and complex, from stable to dynamic, and from being tame to being hostile (Neu and Brown, 2005). Economic turbulence linked to accelerating internationalization, continuous improvements of technologies and deregulations of markets have profound impacts on firm’s competition. As new business regimes emerge, managers are realizing that the basis of the competitive advantage is found in the customer base, that is among the students and the business community including the scientific community.

Economists and environmental analysts ascribe these changes to transformations of the economic infrastructure. A metamorphosis leads to a replacement of manufacturing resources with knowledge as a driving force of economic growth. Capital, labor and property, in other words the economist’s traditional factors of production, are still important, but become less crucial as sources of value creation (Leonard-Barton, 1995; Nonaka and Takeuchi, 1995; Grant, 1996a, Grant, 1996b). Knowledge can be regarded as operant resources that often are dynamic, invisible and intangible (Constantin and Lusch, 1994; Vargo and Lusch, 2004).

In order to achieve economic growth we have constructed a conceptual model that we believe is tailor-make for regional development for engineering schools and business schools in Europe.

Technical routines. Based on data from secondary sources, our findings suggest that change in routines through the use of technological knowledge is the main change agent in transformation processes, being more radical than simply stating that technology simply can make organizational practices more effective (Barney, 1986, Orlikowski, 1993, 2000; Szulanski, 2000).

When routines change as a result of the use of technology, it has often been argued that the effects are greatest when professionals work closely together (Orlikowski, 1993). This also involves learning different role (Orlikowski, 2000), making numerous small adjustments to facilitate technology implementation.

Our findings so far in the research project support such viewpoints, however in a more practical way than often highlighted in the business literature. Personal relationships are critical to get things done in Senegal. Such relationships can serve as points of resolving conflicts, discussing future developments, guiding interactions, and enhancing information flows.
Leadership. In Senegal it is reason to believe that business leaders have higher profiles than ever before. The business world is experiencing enormous changes calling for a need for strategizing the leadership role. Leaders can hold a particular cognitive framework about a technology that is likely to affect leaders perception of the meaning and the implication of a given technology (Edmondson, 1999). Technology implementation often requires experimentation, using trial and error as means to find satisfactorily solutions (Thomke 1998). Thus, psychological safety by taking risk without fear of material or reputation harm can facilitate collective learning in technology implementation processes (Orlikowski, 2000).

Value creation. The process of creative destruction, facilitated by episodic witches in technical regimes, was positioned by Schumpeter (1942) to be the key endogenous driver of economic growth. Recently, several studies have linked measures of regional entrepreneurial activity to regional economic growth (e.g. Audretsch and Fritsch, 2002; Acs and Armington, 2004).

VI. TOWARDS THE BUSINESS FEDERATION IN REGIONS IN EUROPE

Increased turbulence and increased need for changed have led to increased complexity, both internally and externally, at engineering schools and business schools in Europe. It is of vital importance that firms identify and explore business opportunities by taking an entrepreneurial strategic posture, building on strong performance incentives. Being entrepreneurial allows a firm to be responsive to lucrative market opportunities. An entrepreneurial strategic posture can give advantages by responding quickly to business opportunities at the same time as firms can be able to repress business threats. Being agile evolves staying nimble and flexible, open to new evidence, ready to reassess past choices and change direction as business opportunities are explored and exploited.

Handy (1992, 1994) expends the nature of contradictions that managers face to issues related to power and control. He adds that a major challenge for modern businesses is to try to achieve the advantages of large firms as well as small one. Handy is of the opinion that the federalist concept, applied in a business context, is particularly appropriate to deal with managerial contradictions. A company that seeks growth can emphasize an organizational model that tries to solve the dilemma of operating locally within an international network. The dilemma should be in accordance with the times we live in. We wish to be a part of a strong entity at the same time as we prefer a high degree of autonomy in our professional lives. Within the business federation it is not top management that delegates to local units but rather local units that give top management the permission to handle certain tasks because they are handled more efficient at the top, for example when introducing corporate support services. The center does not direct or control, but rather advices, coordinates and influences, being well aware that initiatives generally come from the local levels.

A number of management thinkers and researchers advocate a process of renewal of corporations which inevitably will lead them to behave in accordance with federalist principles (Simon et al, 1950; Drucker, 1954; March and Simon, 1958; Provan, 1983; Barlett and Ghoshal, 1988; Bartlett and Ghoshal, 1995; Handy, 1992; Handy, 1994; Syvertsen, 2000). However, these authors only provide a partial understanding of the importance of federalist behavior. We describe federalist behavior though the use of a building block system consisting of autonomy at local levels, the extent to which local offices share resources, ownership of resources at local levels, lack for hierarchical control of local units, and how corporate services can be used. The building block system represents a guide for how to hold businesses within Senegal together.

Autonomy. It is often assumed that autonomy can promote entrepreneurial activities. This argument can also be used in studies of the business federation since autonomy can influence entrepreneurial processes. The relationship between autonomy and performance is assumed to be positive since local levels may serve clients in a better way than the corporate level can. We believe that this argument will hold in studies of businesses within regions in Senegal. Traditionally the society has been based on agriculture with a strong degree of autonomy for each farm.

Ownership. It is believed that ownership over traditional means of production and intangible resources such as knowledge will have a positive
effect on economic growth within regions in Senegal. Giving women a high degree of responsibility will lead to economic growth according to our reasoning (see for example initiatives in micro finance leading to regional growth in selected areas of Africa, to mention just one example).

Resource sharing/interdependence. Firms face challenges in providing local offices with access to limited resources without duplicating costs. This requires specialization and coordinated efforts among local offices as individuals and companies are constantly moving toward more tailor make solutions. A positive relationship between resource sharing and economic performance can be expected. Control mechanisms. Social means of control, consisting of ideology, culture and sanctions, can regulate behaviors at local levels within the business federation. By ideology we mean integrated set of beliefs that unite a firm so that members are ensured basic knowledge on how a firm is supposed to work. Culture can be regarded as cognitive mindsets, manifested through behaviors and language. Sanctions can involve that group members punish colleagues who violate goals, norms and values, ranging from gossips and rumors to ostracism and sabotage (Ferlie and Pettigrew, 1996). Social means of control are supposed to have a positive effect on performance.

VII. CONCLUSIONS AND RECOMMENDATIONS

We illustrate how engineering schools and business schools can use a regional approach in a globalized world. We show that technology and leadership can have an influence on value creation. We regard technology as the main change agent. A focus on technology can also have a positive effect on communication among actors in the business community and in the public sector.

At first stage businesses within regions will probably use knowledge on a trial-and-error basis using technology to change routines. In the longer run changes in routines are assumed to lead to strategic change maybe leading to economic growth certain European regions where engineering and business schools can play important roles,

More research is necessary to find out more about how actors can co-operate in networks, paying attention to routines. A global focus means that intangible resources become more important moving to a broader approach involving more that economic parameters, Value creation should also have a broad approach involving social as will as economic parameters.

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GENDER INEQUITY IN ENGINEERING AND BUSINESS EDUCATION – SOME IMPLICATIONS FOR HANDLING CHALLENGES FROM AN AGING POPULATION. THE NORWEGIAN CASE

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Abstract: The article looks upon society’s challenges from an aging population. The international development in care services is that elderly care, in institutions and in home help services, are done by private companies on contract from public authorities. Such services are more and more taken care of by for-profit agents and technological inventions are implemented in the services. This calls upon curricula in engineering and business education to focus on the special needs of care services for older people. EU is also coping with this challenge, and cross-country comparisons are therefore included. The article concludes that gender innovativeness is unnoticed in society and not supported. The implication is that gender innovativeness remains poorly utilized in care services to the detriment of a sector that needs optimal use of all resources. It concludes that curricula in engineering and business education should have stronger focus on the needs of such know-hows in elderly care.

Keywords: Engineering and business education, aging population, innovative gender, human resources.

I. INTRODUCTION (HEADING 1)

This article deals with aging societies’ need for women in engineering and business education. For simplicity reasons the label “science education” is used when appropriate. Norway is used as case, and in some occasions compared with the EU and certain EU-countries.

Statistics from EU make projections of the proportion of persons aged 65 (age when they are generally economically inactive) and the projected number of persons aged between 15 and 64. The result is called projected old-age dependency ratio and is measured in percent. In Norway it increases from 25% in 2015 till 30% in 2030 (Eurostat 2015a). Many of these will need care services. European Union (28 countries), faces a similar situation. The dependency rate increases from 29% to 39% in the same period (Eurostat 2015a).

It seems obvious that that situation requires increased capacity in relevant education. In addition to that, however, it calls for more men to be educated in relevant professions. For example, a study by Ose and Bungum (2014) demonstrates that men in Norway are working in technological professions and a great proportion of women are working in care professions. Most EU countries are in a similar situation.

The article assumes that it is such a thing as “innovative gender” in social and economic policy. The concept innovative gender is a concept used in an ongoing project entitled “Innovative gender as a new source of progress”. The project runs from 2013 to 2016 with Jagiellonian University, Krakow, as project promoter. The project summary reads: “Learning about special aspects of female and male innovativeness could result in finding new sources of progress and competitive advantages, also through elimination of the existing barriers. The project
objective is to identify and measure the concept of innovative gender.” (EEA). Even though this concept per today is more like a black box than a fully developed concept, the article argues that a higher proportion of men in care services could make results as quoted above. The article concentrates on gender inequity in science education as a hindrance for handling the challenges from an ageing population. To our knowledge, such focus on gender inequity has been disregarded in the Norwegian academic and political debate up till now.

II. METHODS
Initially the intention was to explore gender profiles based on education background of professionals in care services. But because public statistics differed in ways of categorizing data it was difficult to find reliable data. Education statistics turned out to be easier at hand. Therefore the focus of the study changed from care services to higher education programs. I argue that gender profiles in education represent good forecasts of which part of the labor market students eventually enter.

One part of the data consists of government documents on higher education. These are three different kinds: Official Norwegian Reports (NOUs) are produced by committees and working groups constituted by the Ministry. They often form the basis of a bill or white paper and are put forward to the Storting (Parliament) as Government document (Meld. St., or Melding til Stortinget) [Message to the Storting]. Reports and plans are generally produced by external researchers or committees, and encompass reports, analyses and documentation presented to the ministry.

An extensive body of documents of these three kinds on higher education is available at the government website government.no. The present study draws primarily on seven documents covering the years 2006, 2011, 2012 and 2014. The latest one is from the present (i.e. 2015) blue-green government (center-right) of Erna Solberg, the three former are from the red-green (center-left) government of Jens Stoltenberg. An underway report on gender equity in 2014 issued by the red-green government of Stoltenberg deals with the government’s goals. One of 9 chapters deals with education. Here the word men is listed 18 times, women 2 times, boys 15 times and girls 11 times (Barne-, likestillings- og inkluderingsdepartementet [Ministry of Children, Equality and Social Inclusion].2014). A look at the overview of all measures about gender inequity, 86 altogether (pp. 3-9), unveils 7 measures regarding education. A common denominator is to motivate men and women to choose higher education programs that are untraditional in a gender perspective. When specific education programs are mentioned - two measures totally – science education is not mentioned ((preschool teacher, teacher and child Welfare education (barnevern) are the two)).

A report on the status of equity (i.e. all kinds of equity not only gender) from Kunnskapsdepartementet [Ministry of Education...
and Research] in 2014 mentions the word men 29 times and women 14 times. This snapshot of Norwegian education politics on gender equity indicates that it has been and still is high on the agenda, but signs of the community’s need of a better gender balance in science education are absent. Are these results in accordance with education statistics also? The next subsection consists of statistics that gives some input to an answer.

Figure 1. Finished more than four year university education, 2008 – 2013, men and Women. (Absolute numbers).

Figure 1 demonstrates that women have been the dominant gender in higher education (all sorts) every year since 2008.

How is the picture when one looks at education programs separately? The next figure, figure 2, shows dispersion of men and women on nine education programs for the year 2012/2013. We confine the analysis by looking at the two dark blue columns, which represent natural-sciences, craft-trades and engineering sciences, and the two light blue columns, which represent care professions. Figure 2 shows a considerably greater proportion of men attending the natural sciences in contrast to women. Business administration has actually a slightly higher proportion of women than men. The opposite situation holds for the group of education where science belongs, where men dominate. Men are represented in natural science education about twice as much as women, while women are represented in care professions about four times more than men.

Figure 2. Completed university education in Norway. Gender and study programs. 2012/2013.

Can one observe a similar trend when one looks at higher education programs over several years? The next figure, figure 3, contributes to an answer to that. The y-axis displays increase or decrease in proportions of women in various higher education study programs in the period 2006-2012.

Figure 3 demonstrates that the proportion of women in programs dominated by men, i.e. economy/administration, natural science/technology; fishery and agriculture, have increased, while it has decreased in two of the programs dominated by women; i.e. humanities and teacher education. At the same time, it has continued to increase in the program most dominated by women; health and care [Norwegian: Helse og sosial].

Has it been any increase in gender balance attending science education? From documents referred to above one should expect so. The most reliable data covering this topic is published by Samordna Opptak [Coordinated Student admission, (a government agency)]. Unfortunately its data are not grouped in similar categories over the years. Never the less, comparisons are made as shown in the next figure. Science education is grouped by the author in the category Technological higher education. It shows results from the author’s calculations. The tall blue column represents life sciences and the small blue technological higher education in 2005. The tall red column represents life sciences and the small blue represents technological higher education in 2015. The blue columns are median values calculated from a number of studies, listed in Samordna Opptak in its 2005 issue, which are labelled health education and technological education respectively. In contrast to
the blue columns, the red columns are derived directly from the data as they occur in the 2015 report from Samordna Opptak.

Figure 4. Proportion of women in life sciences* and technological higher education programs. 2005 and 2015. Norway.

Given the differences between 2005 and 2015, one can conclude that women in both years constitute a remarkable lower proportion (more than 30% women) of students in technological education than men. In fact the figure displays a small decrease. Health education displays the opposite trend; women are more than one third of the students both years.

Results from Norway should be placed in a cross-country setting to assess whether its composition of men and women in science education is unusual. A document issued 2010 by the European Commission addressed to the European parliament, the Council, the European economic and social committee and the Committee of the regions, deals with EU-strategy for equality (not “equity”. Author’s comment) between women and men 2010-2015. It points out how essential it is to promote non-discriminatory gender roles in all areas of life and lists education as one area. Gender-related inequalities that affect boys/men (European Commission, 2010, part 6.1.) are mentioned explicitly. Obviously, it is considered to be a European challenge and not only has something the Norwegian government had high on its agenda.

How, then, does a map of gender inequity in higher education in Europe look today? A snapshot is displayed in figure 5. It shows proportions of women in various science studies. Norway and Poland are among the seven nations with the highest proportion of women in science studies (dark green color).

Figure 5 has a disadvantage because it encompasses a group of studies that may be quite different in their combination of men and women. A later study should control for this. In the meantime I put forward a figure presenting proportions of male students in health and welfare studies in 2003 and 2012, figure 7. The columns are results of own computations based on Eurostat c data and KNOEMA1.

Norway and Poland present an unchanged situation over the years; around 25 percent were men, although a tiny decrease is visible for Norway. What appears as the most visible contrast is that men are a bigger group both in Poland and EU 28 than in Norway. It demonstrates that gender inequity is higher in Norway than rest of Europe.

This pilot study demonstrates that men are underrepresented in higher education in traditional female higher education programs in Norway. What came as a surprise was that no substantial change has occurred during the last decade or so. During the finishing stage of this study, a leaflet from Nordic information on gender (NIKK, 2014) was published. The title “Male perspectives on gender equality” nourishes expectations that one might find focus there on men as a means for society to get optimal use of its human resources. But, no such sign is unveiled. As usual, it deals with the unfavorable situation of men such as fathers, their health, their overrepresentation in prison and marginalization.

Furthermore, the study has demonstrated that Norway lags behind Europe. This may come as a surprise for some, but not for people familiar with gender research. The “paradox of gender equity” as it is called in Norway [No: likestillingsparadokset] (Smette & Hegna, 2010)] confirms a common picture of Norway as a country with high world ranking on gender equity in general (see for example World Economic Forum’s Global Gender Gap Index) and a sharp gender division in higher education.

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1 Eurostat affords in several instances data that can be developed for researcher’s own purpose by using KNOEMA, a data dissemination engine.
IV. CONCLUSIONS AND RECOMMENDATIONS

This pilot study demonstrates that the Norwegian government has been coping with gender inequity in higher education for at least a decade with practically no result. Evidently, the society needs optimal use of all human resources in order to handle the challenges from an aging population, and even more so in the future. To the best of this author’s knowledge, the lack of men in care professions is a disregarded topic in academic discussions in Norway.

A strong political focus on women’s inequity in society might have reduced politicians’ ability to acknowledge the need for getting a more balanced gender representation in business- and engineering studies.

This is a pilot study that eventually shall develop into a broader investigation.

A. References

5. Eurostat 201..c.
6. Eurostat 201..d.
Industry assigned student projects –
A case of a Norwegian university college

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Faculty of Engineering
Fredrikstad, Norway
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Abstract:
Real problem based teaching method is a widely used for many higher education institutions. A nature approach is closely collaboration with local industries or business partners in teaching, but most of all, crediting industry assigned student projects into regular study curriculum. This paper presents a case statistics overview of Østfold University College’s bachelor thesis projects over last 10 years, with heavily industry assigned part for most student projects. The case shows divided trends: One is a sustainable collaboration with few large size industrial partners rather involved more than one student project over the year, while major part of the industrial partners, mainly SMEs assigned only 1-2 projects, simply coming and go mechanism. The question is which one is best for education purpose and student learning.

Keywords: Industry assigned student project, real problem based teaching, sustainable industry and higher education collaboration, Bachelor thesis projects.

I. INTRODUCTION
The attempting and competing on education quality, including higher education quality has never been stopped. Many education institutions are targeting their education programs directly toward profession job matching or job creating (Mulder and Pasman, 2011). Focus on the real world becomes a popular slogan but also into the regular study curriculum (Lim. et. 2012) Industry assigned student project is a good example of such approach. The crucial issue is how and what is the best model?

Østfold University College (OUC) is a professional focused higher education institution graduated mainly engineers, nurses, bookkeepers, etc. With a location in southeast of Norway and most density population, industry restructuring, it is even more important for OUC to adopt real problem based teaching methods into practices. The industry and local business communities need Day1 engineers, nurses or bookkeepers to the job tasks right after their graduations.

OUC, Faculty of Engineering has an advantage and a long tradition to collaborate with local industrial partners. There are 22 000 companies in Østfold county, all with easy access thus less than 2 hours driving distance each other. Most are SMEs, means flat organization structure and easy communication internal for companies.

OUC, Faculty of Engineering (OUC-FE) has over 20 years used the industry collaboration as the main sources for student bachelor project assignments. There are annually 30-40 bachelor thesis projects assigned and over 70% are from the industries. The students are grouped in 3-4 and they picked up the industrial assignments by their interests combined their professional backgrounds. Then they make a survey, an analysis, a design or a concept or prototype for the assignment upon the real problem the assigned company sketched for them. The students will obtain real experiences by doing these.

II. THE RESEARCH QUESTIONS MODELS
However, there shall be research questions to examine this category of collaboration in a systematic way. There are stories of both sides: In some cases the companies are good contributors to the student project assignments with clearly defined assignments and mentors/coach assigned, while other cases the students can experience lack of real
interests and unwillingness to engage in academic coach or discussions from the company, as a result, students are leftover for the company.

The key research question might be: Can we find a sustainable model for industry collaboration? What mechanism can we summarize for such model? Are all the companies equally interested, engaged or assigned for OUC-FE student projects?

OUC-FE has over 20 years’ data statistics for final bachelor thesis projects, noticeable for assignments from or by industrial partners, called industrial project assignments, plus OUC-FE own academic assignments, called academic project assignments.

III. THE DATA COLLECTING AND FINDINGS

The data collecting was dated in 2006-2014 and there are totally 1060 students did their bachelor thesis projects during the period. Most cases there are 3-4 students into one project group, thus one project assignment, often assigned by one company.

Table 1 shows the total industrial assigned project for the whole period and frequency classes by project assigned times. 167 companies contributed 293 student projects. However, most (129) only

<table>
<thead>
<tr>
<th>Participation Company</th>
<th>Number of companies</th>
<th>%</th>
<th>Number of project</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned only 1 time</td>
<td>129</td>
<td>77,25 %</td>
<td>128</td>
<td>43,69 %</td>
</tr>
<tr>
<td>Assigned 2-4 times</td>
<td>24</td>
<td>14,37 %</td>
<td>54</td>
<td>18,43 %</td>
</tr>
<tr>
<td>Actively Assigned 4 times and more</td>
<td>14</td>
<td>8,38 %</td>
<td>111</td>
<td>37,88 %</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>100,00 %</td>
<td>293</td>
<td>100,00 %</td>
</tr>
</tbody>
</table>

Table 1: Total student projects over companies

14 companies contributed more than 4 times, while 24 companies contributed moderate 2-4 times to the student project assignments. We can conclude most companies are coming and going attitudes for this kind of collaboration.

<table>
<thead>
<tr>
<th>Company</th>
<th>Number of Project</th>
<th>% on the most active organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borregaard</td>
<td>5</td>
<td>4,50 %</td>
</tr>
<tr>
<td>Contiga AS</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>COWI AS</td>
<td>11</td>
<td>9,91 %</td>
</tr>
<tr>
<td>Fredrikstad Energinett AS</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>Fredrikstad kommune</td>
<td>6</td>
<td>5,41 %</td>
</tr>
<tr>
<td>Hjellnes Consult AS</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>OUC</td>
<td>26</td>
<td>23,42 %</td>
</tr>
<tr>
<td>IFE – Institutt Energiteknikk</td>
<td>5</td>
<td>4,50 %</td>
</tr>
<tr>
<td>Multiconsult</td>
<td>9</td>
<td>8,11 %</td>
</tr>
<tr>
<td>Nexans</td>
<td>13</td>
<td>11,71 %</td>
</tr>
<tr>
<td>Norske Skog Saugbrugs</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>Omega Elkraft</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>SEAS AS</td>
<td>4</td>
<td>3,60 %</td>
</tr>
<tr>
<td>Statens vegvesen</td>
<td>12</td>
<td>10,81 %</td>
</tr>
<tr>
<td>Sous-Total</td>
<td>111</td>
<td>100,00 %</td>
</tr>
<tr>
<td>Total</td>
<td>293</td>
<td>100,00 %</td>
</tr>
</tbody>
</table>

Table 2: Company statistics for student projects

Table 2 shows a company statistics for student projects for major engaged companies. These are the major student project contributors assigned at least 4 times or more for the student projects.

Still, OUC with 26 student projects is the largest single contributor for the student projects, means OUC academic student projects exceed any company contribution solely.

The nature of contributed companies is diversified and variable, showing the diversification of Østfold industry, from chemical industry Borregaard, engineering consulting COWI, applied research institution IFE, to municipal community government Fredrikstad commune, etc. a wide range of business contributes student project diversifying.

Table 3 shows the annual statistics for student projects. It is variable from a company to another. However, total annual student projects have an increasing developing trend, except 2014 when OUC dominated the statistics by 9 projects.

It is nature for a company to contribute student projects continually over few years, as we can see
Most companies are providing projects continually more than one year since the starting. This finding indicates a fact that once collaboration starts, it is relatively easy to follow up and continue further steps. In fact, the majority of companies on the list are mostly large companies with over 500 employers, and this might explain the sustainable collaboration with them.

Another issue is discussing is grades A-best, B-good, C-average, D-weak, E-poor, distribution over the student projects. Table 4 shows overviews of student project number of each grade over each company assignment. Early studies claimed the company assigned student project might get better grades than university academic projects. We can have a close look to our data.

Generally, grades are concentrated within A, B, C, especially B and C, independent assignments. No one even gets E. There might be a critical question for how grading was considered and evaluated according to national standards, which are:

- A- Excellent;
- B- Very good;
- C- Good;
- D- Weak or missing major element;
- E- Just passed minimum requirement.

So the evaluation might tend to in favour of good grades generally speaking. On the other hand, the majority of students pay more attention for their bachelor thesis no matter where their assignments come from, so this might lift up the general grades for this category of evaluations.

### Table 3: Annual statistics for student projects

<table>
<thead>
<tr>
<th>Company</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Total</th>
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<td>5</td>
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<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>COWI AS</td>
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<td>2</td>
<td>3</td>
<td>2</td>
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<td>11</td>
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<td>1</td>
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<td>1</td>
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<td>1</td>
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<tr>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Høgskolen i Østfold</td>
<td>3</td>
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<td>1</td>
<td>2</td>
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<td>4</td>
<td>9</td>
<td>26</td>
<td></td>
</tr>
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<td>IFE – Institutt Energiteknikk</td>
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<td>1</td>
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<td></td>
<td>1</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiconsult</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>9</td>
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<td>Norske Skog Saugbrugs</td>
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<td>4</td>
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<td>13</td>
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<td></td>
</tr>
<tr>
<td>Omega Elkraft</td>
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<td></td>
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<td>SEAS AS</td>
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<td></td>
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<td></td>
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<td></td>
<td>4</td>
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<td>Statens vegvesen</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>12</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>20</td>
<td>111</td>
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</table>

### Table 4: Grades distribution over student projects

<table>
<thead>
<tr>
<th>Company</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Total</th>
</tr>
</thead>
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</tr>
<tr>
<td>Contiga AS</td>
<td>2</td>
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<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>COWI AS</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
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<td>10</td>
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<td>Multiconsult</td>
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<td></td>
<td></td>
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<tr>
<td>Norske Skog Saugbrugs</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Omega Elkraft</td>
<td></td>
<td></td>
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<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>SEAS AS</td>
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<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Statens vegvesen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>51</td>
<td>40</td>
<td>6</td>
<td>0</td>
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</tbody>
</table>

| %                | 12.61 | 45.95 | 36.04 | 5.41 | 0.00 | 100.00 |

Table 3: Annual statistics for student projects

This finding indicates a fact that once collaboration starts, it is relatively easy to follow up and continue further steps. In fact, the majority of companies on the list are mostly large companies with over 500 employers, and this might explain the sustainable collaboration with them.

Table 4: Grades distribution over student projects

For the best grad A, there are only one A for academic project, out of 26 in total for academic and out of 14 A. For this category, the company or industry assigned projects get clear major number of A. Concluding performs better than academic projects. For poor grad D, there are 5 academic projects out of 26 in total, and out of 6 in total D, clearly, the industry assigned did also better than academic student projects. For B – Good and C – average grades, academic student projects are the dominated part, means B, C are concentrated mostly within academic student projects.

We can summarize this category of findings as a trend that industry assigned student projects has a better
performance than academic student projects within grades A and D, but academic student projects have more grades B and C.

Table 5: Industry assigned student projects over different study disciplines

<table>
<thead>
<tr>
<th>Company</th>
<th>CE</th>
<th>IP</th>
<th>EE</th>
<th>ME</th>
<th>DE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borregaard</td>
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<td>5</td>
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<tr>
<td>Contiga AS</td>
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</tr>
<tr>
<td>COWI AS</td>
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<td>Energinet</td>
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</tr>
<tr>
<td>Høgskolen i Østfold</td>
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<td>2</td>
<td>12</td>
<td>4</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>IFE – Institutt</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Energiteknikk</td>
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<tr>
<td>Multiconsult</td>
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</tr>
<tr>
<td>Nexans</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Norske Skog Saugbrugs</td>
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<td>1</td>
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</tr>
<tr>
<td>Omega Elkraft</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEAS AS</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statens vegvesen</td>
<td>12</td>
<td>9</td>
<td>33</td>
<td>10</td>
<td>9</td>
<td>111</td>
</tr>
</tbody>
</table>

Table 5 shows industry assigned student projects over different engineering related study disciplines. As CE for Civil engineering, IP for Innovation and project management, CE for chemical engineering, EE for electronics engineering, ME for mechanic engineering, DE for design engineering.

According to this statistics, CE, EE, ME are the most active study programs that collaborate actively with industry assigned student projects. CE, EE, ME is also the classic engineering disciplines, which are heavily represented by local companies in Østfold.

- Sustainable industry collaboration relies on large size companies whom might have more resources and manpower to follow up and continue collaboration often request after first student project.
- The few major large size companies dominate the assignments for the student projects. This is good for stability and continual collaboration, but not good for project diversification.
- Industry assigned student projects have better performance than academic projects in grades of A, D categories. But majority of academic student projects gets B, C.
- The classic engineering discipline such as CE, EE, ME has more industry assigned student projects than other disciplines. This phenomenon might indicate a local industry profile with needs of restructuring but still remaining a classic industry structure.

For further research, it is recommended to compare wider data sources, national or international so the conclusions can be checked and challenged by other independent data sources.

V. ACKNOWLEDGEMENT

The author expresses appreciation for data rewriting and collecting conducted by the exchange student Marie Furet during her apprenticeship at OUC. Appreciation also goes to OUC administration that provided data sources.

A. References
THE STUDY ON PITFALLS OF CHINESE UNIVERSITIES’ ENTREPRENEURSHIP EDUCATION AND THE WAY OUT

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Sun lixin  
Shijiazhuang University of Economics,  
Shijiazhuang, Hebei  
China

Abstract: From the beginning of 21st century when Chinese universities started entrepreneurship education, it has gone through more than twenty years of exploration, and now it carries out in full swing and gradually forms the education boom. However, the small proportion of student starting businesses and low percentage of success are the indisputable facts. Chinese universities entrepreneurship education problems the author arguing are as follows: simply open education courses lack of education system, carry out the more pure entrepreneurship competitions lack of inner links with their majors, and develop low level of venture incubations lack of science and technology. It is the reasons that no clear educational orientation leads to dislocation in practice, single education model, simply copying other school model and arranging the education as a kind of reform also cause to the fragmentation of education. Thus universities should build flexible entrepreneurship education based on their cultural, regional and industry background, teacher competencies, student backgrounds, and other elements. Meanwhile, dominated by ‘the entrepreneurial spirit’, create the entrepreneurial atmosphere, change the concept of entrepreneurship education, perfect the system, implement all-round education, comprehensively promote the educational reform, and encourage the teachers to actively carry out the entrepreneurship education. In a word, only comprehend the connotation of entrepreneurship education, and practically according to own culture and professional characteristics, carry out the education comprehensively and systematically is the way for Chinese universities, while that is also the essence of higher education.

Keywords: Educational Orientation, Entrepreneurship Education, Professional Education, Characteristics of Universities.

I. INTRODUCTION
Entrepreneurship Education in Chinese universities began in the 20th century. It has now fully expanded, and has gradually formed a boom among Colleges and Universities after phases including the launch of a certain universities (Tsinghua University Entrepreneurship Plan Competition 1997), the experiment of a few universities (Ministry of Education announced nine colleges and universities as the pilot in 2002), and the development into large-scale (in 2012, 28 colleges and universities directly under the Ministry of Education and 30 under different provinces and cities began a pilot stage). Currently, entrepreneurship education has got great attention of Chinese colleges and universities and even the whole society, and is showing a strong momentum of development. Particularly, since May 2015, when the Chinese government promulgated the "Opinions of the General office of State Council on Deepening the Reform of Higher Education Innovation and Entrepreneurship in Colleges and Universities", entrepreneurship education in Chinese universities has entered a rapid development period. However, after the past two decades’ reform and exploration of entrepreneurship education in Chinese universities, there is an indisputable fact that only a very small proportion of students start college or university entrepreneurship, and the success rate is low. The data of Xinmin Evening News shows that the success rate of current college students
entrepreneurship is less than 10%\(^1\). Weak foundation, late start, and lack of supporting are part of the contributing factors, but the root causes, the author argues, are the misunderstanding or bias in understanding and the simplification of the operation. Therefore, changing concepts, accurately understanding the connotation of entrepreneurship education and the practical implementation of innovation and entrepreneurship education according to their own cultural and professional characteristics of universities will build the way out for Chinese universities, and are also the essence of higher education.

II. PROBLEMS IN CHINESE COLLEGES AND UNIVERSITIES ENTREPRENEURSHIP EDUCATION

II.1. Simply offering curriculums in innovation and entrepreneurship education, lacking systematic thoughts in entrepreneurship education

Most universities do not organize teachers and students to study and take an in-depth research in entrepreneurship education, and thus teachers and students are not able to get an accurate understanding of the essential meaning of entrepreneurship education. Instead, in order to meet the educational requirements of the government agencies, universities only offer entrepreneurship education curriculums in certain majors, or set up elective courses of entrepreneurship in universities, or set up pilot class. There are neither clear educational goals and teaching programs, nor supporting training measures and conditions in these courses. And the selection or preparation of teaching materials also has relation to students’ major, and thus there did not form an entrepreneurship education ideology in combination of students’ majors. In addition, most teachers engaged in entrepreneurship education are non-professional administration staff. They not only lack the expertise but also have not received any formal training. Also they don’t have any entrepreneurial experience themselves. The theory based education, of course, will lead to unsatisfying effects.

II.2 Carrying out entrepreneurial competition for competition, lacking the internal relation with the students’ majors

In the organization of entrepreneurship competition, most colleges and universities organize teams through propaganda from student administration. Students spontaneously assemble their team, not according to their specialty or long-term relative research accumulation, but only temporarily binding social hot topics. Planning and research processes don’t focus on practical application of the project itself, but on accommodating the competition rules and format requirements. The goal is to win the competition rather than the quality of the outcome, and thus the outcome is left unattended and few achievements are put in practice. For example, since 2007, winning the provincial and ministerial level or above entrepreneurship competition projects has reached 56 in our school, including 10 national award, but only 3 have formed the entity.

II.3 Low-level entrepreneurship incubator and low technology in students’ entrepreneurship projects.

Entrepreneurship is not equal to the creation of employment, nor is it simply equal to start a business. Entrepreneurship is an innovation of career driven by creation. In order to adapt to the trend of entrepreneurship education, currently the vast majority of colleges and universities not only have carried out entrepreneurship education and training, but also have created conditions for entrepreneurship incubator. However, a considerable number of entrepreneurial projects are not of high level, with a lack of scientific and technological content. Website business, restaurants, brokerage, retail, carrier, etc. have accounted for a considerable proportion. This is contrary to the goal of higher education, and particularly the original intention of entrepreneurship education. In 2015, according to a data of Zhaopin, there are total 7.49 million college graduates in our country, more than 220000 in 2014, including students with entrepreneurial intention increased from 3.2% in 2014 to 6.4%. However, in venture project, the most popular is not technology, finance and other high-tech projects, but the ‘Send Out’, and in the survey, there are more than 60% college students believe that if they venture, it will be their first choice.

\(^1\) Xinmin Evening News.2014.12.20
http://news.ifeng.com/a/20141220/42761251_0.shtml
Entrepreneurship education is not only about teaching entrepreneurship knowledge and developing entrepreneurship skills, more importantly, it is to develop entrepreneurial spirit within students, and make them think and solve problems like entrepreneurs. It’s like learning pedagogy purpose is not to become educators, but to think like an educator. Entrepreneurial spirit is the essence of entrepreneurship education and the rational pursuit of personnel training; entrepreneurship as a positive ideas and mental state, is supposed to be the core of entrepreneurship education; Entrepreneurship education should take the cultivation of entrepreneurial spirit as the leading. However, at present, many colleges and universities in China lack a clear and profound understanding of the entrepreneurship education, and there is a great misunderstanding, which leads to the emergence of various problems in the process of entrepreneurship education.

### III.1 Unclear positioning of entrepreneurship education results in dislocation of entrepreneurship education in practice.

First of all, there is not a clear positioning of entrepreneurship education. Entrepreneurship education is equaled to creating a business and employment, and entrepreneurial educational effects become the focus. Understanding of entrepreneurship education should have two levels: the first is to guide and encourage small fraction of capable university graduates to embark on the road of entrepreneurship and develop new economic growth points; the second is to have most people stay energetic in their careers and achieve better development, and thus create greater value in their respective positions. But currently in universities, there is either universal encouragement of student entrepreneurship or simply entrepreneurial spirit promotion; there are no actual actions to support the entrepreneurial ability of some capable students to develop entrepreneurship.

Secondly, this dislocation is also reflected in the value tendency of utilitarianism in entrepreneurship education. Entrepreneurship education is not managed from the original source, and is not linked to knowledge and practice. Entrepreneurship education is seen as ‘Entrepreneur Training Class’, and accomplishments are located as various ‘Student Startups’, to realize the dream of the birth of numerous bosses.

This utilitarian entrepreneurship education, will not be able to meet the high-tech industry symbolized ‘Entrepreneurial Revolution Needs’.

Thirdly, the object of entrepreneurship education lacks universality. There is a strong elite mark on entrepreneurship education. The focus is on the impressive achievements of few students, whereas most students are not able to participate in. This does not allow entrepreneurship education to properly function, and thus lose its core value.

### III.2 Limited methods in entrepreneurship education and lacking research on the systematic entrepreneurship education system

Although there is more and more emphasis on innovation and entrepreneurship education in colleges and universities, a considerable number of universities simply copy the practices of others. They only set up curriculums of innovation and entrepreneurship in the form of elective courses, but it’s not reflected in the university curriculum system. Not only the education system of innovation and entrepreneurship education is imperfect, also the education does not rise to the level of academic disciplines and stays only in the initial stage. Course are simple, teaching methods are not diversified, entrepreneurship and students’ majors are out of line, and course content and practice are hardly related. Schools are only mechanically educating students the entrepreneurial knowledge and skills; students just simply learn the program and path to start a business, but have not really established the concept of entrepreneurship and entrepreneurial spirit, and also have not grasped the innovation-driven long-term development ideas.

### III.3 Treating the entrepreneurship education as an education reform arrangement, resulting in fragmentation of entrepreneurship education.

Although entrepreneurship education in Chinese universities began to flourish, but the school does not create a good atmosphere of entrepreneurship education. The status of entrepreneurship education has not been understood and supported by staff and students. Neither has entrepreneurship education been added into the school education system, nor has
it been co-promoted by all the administrative staff and teachers. Instead, it acts as second class led by the student management department to improve the employment rate. Teachers and staff who have relevant experiences conduct lectures, reports, and entrepreneurship competitions. Teachers act in their own, do not communicate with each other, specialized course teachers are unable to cooperate and support from a professional point of view. This has led to fragmentation of entrepreneurship education – unclear educational objective, simple education contents, identical education methods, and ineffective education.

IV. ‘ENTREPRENEURSHIP SPIRIT’ AS THE LEADING PROPOSAL

IV.1 Create an entrepreneurial atmosphere and change the concept of entrepreneurship education. Entrepreneurship Education in Chinese Colleges and universities are still in the initial exploratory stage. There is no mature model for reference and promotion and it has not gained widespread attention and concern. In fact, there’s actually a need to create an entrepreneurial atmosphere to form a force, so as to encourage universities to seek innovation in the competition, and provide convenient conditions and suitable for the cultivation of university entrepreneurship environment. Started from entrepreneurship competition, entrepreneurship education our country is engraved with the elite education from the beginning. Entrepreneurship institutions established by universities, no matter whether "innovation laboratory" and "student entrepreneurs club", or "Kechuang Center" and "21st Century Talent School", all belong to elite institutions. Entrepreneurship education outset most students at the door at the beginning and most students can only stand by. Therefore the concept of entrepreneurship education must be changed. Entrepreneurship education is not elite education, but for all. At the same time, entrepreneurship education is not equaled to employment education, and it’s not employment guidance education. Entrepreneurship education is not only to cultivate the boss, but also to cultivate the boss with the quality of the talent. Training the pioneering spirit of the people is the ultimate pursuit of entrepreneurship education.

IV.2 Improve entrepreneurship education system, implement the entrepreneurship education full spectrum

Entrepreneurship education is a systematic project which runs through the whole process and every step of talent development. The first is to integrate entrepreneurial ideas and methods into professional education to enrich and improve students' knowledge structure, so that the students can better adapt to future innovative society and achieve self-development. The second is to explore a way of entrepreneurship education that suits the school, and to promote the comprehensive development of entrepreneurship education from various levels including the development model, curriculum development, teacher training, teaching reform, and practice camp construction. The third is to handle the relations between entrepreneurship courses and professional courses properly. The innovation and entrepreneurship curriculum system should be in line with the professional curriculum system to achieve complementary effects, rather than disjointed and unconnected. Innovation and entrepreneurship education should be based on professional education; we should integrate the entrepreneurship courses into the entire talent development program, establish scientific and rational entrepreneurship education curriculum, offer courses related to entrepreneurship under academic background in professional education, to combine the spirit of entrepreneurship education with the cultural classes, professional basic courses and specialized courses; we should have entrepreneurship concept penetrated into the teaching process, build expertise in entrepreneurship awareness, and develop basic entrepreneurial skills necessary, so that entrepreneurship courses have professional curriculum as a basis and platform. In addition, we should properly handle the relation between entrepreneurship practices and professional practice to make them effectively convergent. We should refer to successful experience of entrepreneurship education at home and abroad, but we should pay more attention to remain the local culture, the school’s professional fields and school characteristics rather than simply copying. Thus, the
entrepreneurship education system with own characteristics will be formed.

IV.3 Promote the educational reform comprehensively and encourage professional teachers to actively carry out entrepreneurship education.

One of the major challenges in the development of entrepreneurship education in Chinese colleges and universities is the lack of professional teachers and the recognition and support of the teachers in other disciplines.

If the design and development of curriculum determines the range and the way of their mutual integration and mutual penetration between entrepreneurship education and professional education, then, the degree of their mutual integration will depend on the recognition and support from the teachers. From the current actual development of entrepreneurship education, the professional teachers in other disciplines lack the recognition of entrepreneurship education, and also there’s a lack of support for the integration of entrepreneurship education into professional education initiative. Many professional teachers do not have an in-depth understanding of the connotation of entrepreneurship education, and also have doubts about the integration of entrepreneurship education into professional education. Therefore, universities need to provide support in the transformation of professional teacher’s entrepreneurship education awareness, and to support and encourage professional teachers to explore other aspects of entrepreneurship education. First, as to the curriculum development and design, attention shall be paid to the development of entrepreneurship education curriculum, the number of entrepreneurship education curriculum shall be increased, and its coverage shall be expanded to allow more students to choose entrepreneurship courses that meet their own needs. Second, vigorously promote the development of the entrepreneurship courses in professional classes, try to integrate the contents of entrepreneurship education into the curriculum system, and encourage professional teachers to offer elective courses of entrepreneurship education so as to strengthen entrepreneurship education’s influence throughout the whole school. Thirdly, encourage professional teachers to add in content of entrepreneurship education in the teaching process of professional courses. Last but also the most important is to strengthen the training of teachers, conduct training for all teachers, and thus improve the awareness and skills of all the staff, and ensure the realization of all of the above objectives.

V. CONCLUSIONS AND RECOMMENDATIONS

To conclude, it is an indisputable fact that entrepreneurship education in Chinese colleges and universities has been carried out vigorously. There are achievements but also problems. We should acknowledge achievements, realize opportunities for improvement, and continuously seek for rational solutions and increase effects of entrepreneurship education, and eventually develop highly capable talents who possess entrepreneurial spirit and skills, stick to entrepreneurial concepts, and actively participate in entrepreneurship practices.

A. References

1. Xinmin Evening News.2014.12.20
   http://news.ifeng.com/a/20141220/42761251_0.shtml.
STRENGTHS AND WEAKNESSES OF INNOVATION-DRIVEN ENTREPRENEURSHIP IN SLOVAKIA

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Abstract:
The topics of innovation driven entrepreneurship have not been sufficiently covered in the Slovak entrepreneurship literature. The aim of this paper is an analysis of key factors of development of innovation-driven entrepreneurship in Slovakia. The results of the analysis will serve as a base for an outline of measures to strengthen the innovation and startup ecosystem in Slovakia.

Keywords: Entrepreneurship, innovation, high-growth enterprise, gazelle, ecosystem.

I. INTRODUCTION (HEADING 1)
In an innovation-driven entrepreneurship are the R&D results of enterprise translated in its products and services, whereby activities of all enterprise units are systematically improved as well. This is an important source of competitiveness, export performance and employment growth that has been underdeveloped and lacked appropriate support in Slovakia for a long time.

II. INNOVATION-DRIVEN ENTREPRENEURSHIP
One of the most well-known definitions of entrepreneurship by Joseph Schumpeter: „Entrepreneurship is making new combinations of products, processes, organisation and markets.“ It considers both incremental and more radical innovation as an inherent essence of entrepreneurship. Steven Walsh makes a distinction between disruptive and sustaining innovations, where in disruptive innovations the knowledge base changes radically, while in the case of sustaining innovations a relatively small change occurs in the knowledge base. In Walsh’s terms, radical and incremental innovation are related to change in user behaviour. ‘Radical’ means a completely different consumer/user behaviour to a product. Peter Drucker also stressed co relation between entrepreneurship and innovation when referring to Schumpeter. “…the entrepreneur upsets and disorganizes”. As Joseph Schumpeter formulated it, his task is "creative destruction…The entrepreneur always searches for change, responds to it, and exploits it as an opportunity.” (Drucker, 1985).” According to the Innovation Policy Platform, a joint initiative developed by the OECD and the World Bank innovative entrepreneurship1 is an intersection of three areas: innovative businesses, young and high-growth businesses, and SMEs. B. Aulet is more specific and sees the following distinguishing features of innovation-driven entrepreneurship (IDE): it is based on some sort of innovation with potential competitive advantage, focused on global/regional markets, diverse ownership base including external capital providers, it creates jobs that do not have to be performed locally, it starts with loss period but if successful achieves exponential growth. Its opposite is described as SME entrepreneurship that is not necessarily based on an innovation, focusing on regional/local markets, most often family business with little or none external

1 https://www.innovationpolicyplatform.org/content/smes-and-innovative-entrepreneurship
capital, creating jobs performed locally and growing slower at linear rate (Aulet, 2013).
The Slovak literature on entrepreneurship and innovation discusses mostly innovation types, innovation process and its management, innovation financing or innovative SME’s but the IDE is hardly explored more deeply. The main reasons of this may be the relative new and immature Slovak national innovation system and strategy (built only since 2007), underdeveloped R&D and innovation financing, weak linkages between academy and businesses and protection and commercialisation of intellectual property rights as well. However, in the neighbouring Czech Republic with more generous R&D and innovation financing and advanced innovation infrastructure the term is much more used and discussed. There has been very active the Association of Innovative Entrepreneurship in Czech Republic since 1993. Its vicechairman P. Švejda defined IDE as a set of entrepreneurial activities focusing on systematic realisation of innovations. As a rule it is an SME implementing an innovation project (Švejda, 2007, p.85).

In this paper is the IDE understood as efficient collaboration of highly motivated and skilled human resources in harmonising of corporate functions (links of value chain) based on systematic innovations of company products, processes and systems aiming at increasing the customer value. Its key driver are highly motivated and skilled employees working under conditions of corporate culture of excellent performance, optimal professional and personal development and participative leadership.

III. HIGH-GROWTH ENTERPRISES AND GAZELLES

Typical phenomena of IDE are high-growth enterprises, especially so-called gazelles and their share among the companies in an economy. Their role in job creation is particularly interesting for policy makers. High-growth enterprises are enterprises with average annualised growth in employees (or turnover) greater than 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period. Medium-growth enterprises are enterprises with average annualised growth in employees between 10% and 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period.

The share of high-growth enterprises ranges between 2% and 6% for most countries, with higher shares (between 5% and 15%) when measured on a turnover basis.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of enterprises</th>
<th>Number of employees</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>383</td>
<td>20 653</td>
<td>2013</td>
</tr>
<tr>
<td>Slovenia</td>
<td>560</td>
<td>32 651</td>
<td>2013</td>
</tr>
<tr>
<td>Estonia</td>
<td>593</td>
<td>41 584</td>
<td>2013</td>
</tr>
<tr>
<td>Latvia</td>
<td>985</td>
<td>68 032</td>
<td>2012</td>
</tr>
<tr>
<td>Romania</td>
<td>1 300</td>
<td>180 160</td>
<td>2013</td>
</tr>
<tr>
<td>Slovakia</td>
<td>1 438</td>
<td>154 368</td>
<td>2013</td>
</tr>
<tr>
<td>Ireland</td>
<td>1 765</td>
<td>130 458</td>
<td>2013</td>
</tr>
<tr>
<td>Finland</td>
<td>2 074</td>
<td>160 907</td>
<td>2013</td>
</tr>
<tr>
<td>Denmark</td>
<td>2 112</td>
<td>141 344</td>
<td>2012</td>
</tr>
<tr>
<td>Lithuania</td>
<td>2 123</td>
<td>144 058</td>
<td>2013</td>
</tr>
<tr>
<td>Belgium</td>
<td>2 446</td>
<td>153 790</td>
<td>2013</td>
</tr>
<tr>
<td>Norway</td>
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<td>152 108</td>
<td>2013</td>
</tr>
<tr>
<td>Austria</td>
<td>2 718</td>
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<td>2013</td>
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<tr>
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<td>203 245</td>
<td>2013</td>
</tr>
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<td>2013</td>
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<td>3 180</td>
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<td>2013</td>
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<td>6 802</td>
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<td>9 162</td>
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<tr>
<td>United States</td>
<td>36 585</td>
<td>8 065 208</td>
<td>2012</td>
</tr>
</tbody>
</table>

Fig. 1 Medium and high-growth enterprises: number of enterprises and employment, total business economy in 2013. Note: Data for New Zealand, Israel, Canada, Brazil, United States refer to >20% growth enterprises. For the rest of countries it is >10% growth.

Gazelles are a subgroup of high-growth enterprises comprising high-growth enterprises born five years or less before the end of the three-year observation period. They are enterprises which have been employers for a period of up to five years, with average annualised growth in employees (or in turnover) greater than 20% a year over a three-year period and with ten or more employees at the beginning of the observation period. The share of gazelles is expressed as a percentage of the population of enterprises with ten or more employees (OECD, 2013, p. 62).

In a majority of countries, less than 1% (or even less than 0.5%) of the enterprises with ten or more employees are gazelles when the growth measure is based on employment; the share is slightly higher for gazelles as measured by turnover growth. In all
countries is observed the prevalence of high growth enterprises in the service sector (measured by employment and turnover) compared to the manufacturing sector (OECD, 2015).

The data on gazelles in Slovakia in 2012 compared to its neighbour countries appear to be surprisingly favourable for both evaluation criteria considering the Slovak entrepreneurship and innovation environment. However, the period 2010 - 2012 is characterised by economic growth and rising labour productivity. Gazelles prevail in the service sector as well.

IV. INNOVATION ENVIRONMENT IN SLOVAKIA

The structure of enterprise by their size in Slovakia differs from that in the EU in the share of micro and small enterprises.

It is also estimated by the European Commission, that only 50% of European startups survive the first five years. This leads to lower number and share of high-growth enterprises as defined above.

A clear weakness of the Slovak SME’s on their way to high-growth enterprises has been their low share in exports in the long run. In 2013 this share made 29.4% of the total value of exports. Thus they have been considerably lagging behind the export performance of the SME’s in the EU 25, whose average share in the total 2013 exports achieved 45.2%. In the year-to-year comparison the share of microenterprises in exports declined sharply to 11.3% while the shares of small enterprises moderately rose to 6.3% and medium-size enterprises to 11.8%.

The data on gazelles in Slovakia in 2012 compared to its neighbour countries appear to be surprisingly high-growth enterprises as defined above.

<table>
<thead>
<tr>
<th>Country</th>
<th>Sectors</th>
<th>2008</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td>Czech Republic</td>
<td>Industry</td>
<td>0.73</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>Services</td>
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<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
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<td>Hungary</td>
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<td>Services</td>
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<td></td>
<td>Construction</td>
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<td>Services</td>
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<tr>
<td></td>
<td>Construction</td>
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</table>

Fig. 2 Gazelles' share in percentages, measured by employment growth (>20%), by main sector (adjusted excerpt, OECD, 2015, p. 74)

<table>
<thead>
<tr>
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<th>2012</th>
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<td>Construction</td>
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<tr>
<td>Estonia</td>
<td>Industry</td>
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<td>1.32</td>
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<td>Construction</td>
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<tr>
<td>Hungary</td>
<td>Industry</td>
<td>1.58</td>
<td>0.79</td>
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<tr>
<td></td>
<td>Services</td>
<td>1.40</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
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<td>0.83</td>
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</tr>
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<td></td>
<td>Construction</td>
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</tr>
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</tr>
<tr>
<td></td>
<td>Construction</td>
<td>0.72</td>
<td>#N/A</td>
</tr>
</tbody>
</table>

Fig. 3 Gazelles’ share in percentages, measured by turnover growth (>20%), by main sector (adjusted excerpt, OECD, 2015, p. 75)
The development of innovation activities of Slovak enterprises in the industry and service sectors is stated in the tables above. The medium-size enterprises and a portion of small enterprises stand a chance to develop into high-growth enterprises depending on the quality of their management and staff, industry or service sector and favourable market and regulatory conditions.

The status of innovation environment in Slovakia and its results is reflected in the Innovation Union Scoreboard 2015. Slovakia is one of the weaker members of the group of 13 countries - modest innovators topped by Estonia and Czech Republic. Its innovation performance increased from 31% of the average Summary Innovation Index (SII) for the EU in 2007 to a peak of 69% in 2012 and current decrease to 64% in 2014. It performs below the EU average SII in all SII dimensions except for Human resources (113% of the EU average) and also for most indicators. Among the relative strengths of Slovakia in terms of indicators are Sales share of new innovations (158%), Exports of medium and high-tech products (120%) contributing to the level of 81% of the EU average in the Economic effects of innovations. Further strengths are New doctorate graduates (133%), and International scientific co-publications (118%). The highest growth in terms of indicators is observed for Community trademarks (18%), Non-EU doctorate students (14%) and Exports of knowledge-intensive services (9.2%). On the other hand among the relative weaknesses are License and patent revenues from abroad (-1%), PCT patent applications (13%), Public-private scientific co-publications (27%) and R&D expenditures in the business sector (29%). A strong performance decline is observed in License and patent revenues from abroad (-38%) and in Non-R&D innovation expenditures (-8.8%) (European Commission, 2015)

In the Global Competitiveness Report 2014-2015 (using 2013 data) is Slovakia included among the Innovation-driven countries again, ranking 75 out of 144 countries based on the evaluation of 12 dimensions of the Global Competitiveness Index (GCI). It is an improvement compared to the GCI 2013-2014 (rank 78, but a decline compared to the GCI 2012-2013 (rank 71). The Slovak GCI ranking in Innovation and sophistication factors is more favourable (rank 73) thanks to a positive development of dimension "Business sophistication" (rank 65). However, the GCI dimension "Innovation" with the rank 78 indicates a weakness and most of its indicators are even lower. This is definitely a field to be improved, especially in the indicators Government procurement of advanced tech products (rank 117), Innovation capacities (rank 89), University-industry collaboration (rank 84) and company spending on R&D (rank 84). The only favourable indicator development shows the Quality of scientific research institutions (rank 65) (Schwab, 2014).

Slovakia has been lagging behind in the intensity of innovation activities of enterprises, R&D and innovation expenditures, in technology transfer and utilisation of cooperation potential of research and industry, patent activities, and use of venture capital. The cooperation between the institutions of research, education and industry in creation and commercialisation of new products, processes and services has been insufficient. Therefore after successful implementation of the first ever national innovation system as a part of National Innovation Strategy for period 2007-2013 followed the elaboration of the more focused Research and Innovation Strategy for Smart Specialization of Slovak Republic for the period 2014-2020 in line with the requirements of the EU (passed by the Slovak government in 2014). However, among the policy measures in this document the IDE and its conditions were not explicitly discussed (MH SR, 2014).

V. ANALYSIS OF INNOVATION-DRIVEN ENTREPRENEURSHIP IN SLOVAKIA

The entrepreneurship ecosystem by D. Isenberg consists of tens of specific elements that are grouped for convenience into six general domains: a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture-friendly markets for products, and a range of institutional and infrastructural supports (Isenberg, 2011). The element “Culture” comprises: a) Societal norms, e.g. tolerance of risk, mistakes, failure, social status of entrepreneur, wealth creation, ambition and drive, innovation, creativity and experimentation; b) Success stories, e.g. visible success, wealth creation for founders, international reputation. The element “Policies and leadership” includes: a) Government, e.g. institutions providing investments and support, financial support for R&D, startups..., regulatory framework and incentives (tax benefits), research institutions, venture-friendly legislation (bankruptcy, contract enforcement, property rights and labour laws); b) Leadership, e.g.
unequivocal support, social legitimacy, entrepreneurship strategy. The element "Finance" comprises various forms of financial capital, e.g. microloans, angel investors, friends and family, zero-stage venture capital, venture capital funds, private equity, public capital markets and debt financing. The element "Human capital" includes: a) Labour, e.g. skilled and unskilled employees, serial entrepreneurs; b) Educational institutions providing general degrees (professional and academic) or specific entrepreneurship training. The element "Markets" comprises: a) Early customers, e.g. early adopters for proof-of-concept, expertise in productising, reference customer, first reviews, distribution channels; b) Networks, e.g. entrepreneur’s networks, diaspora networks, multinational networks. The element "Supports" includes: a) Infrastructure, e.g. telecommunications, transport and logistics, energy, zones, incubation centres and clusters; b) Support professions, e.g. legal and accounting services, investment bankers, technical experts, advisors; c) Non-government institutions, e.g. entrepreneurship promotion in non-profit, business plan contests, conferences, entrepreneurship-friendly associations.

The framework described above may be used for analysis of startup ecosystem or innovation ecosystem as well. Here it will be used in the analysis of strengths and weaknesses of innovation-driven entrepreneurship in Slovakia as follows:

1 Element Culture
- **Strengths:**
  Growing entrepreneurial mindset among the young generation;
  Increasing interest in success stories;
  Growth of startup culture and number of startups;
  Growing respect for high-growth companies that gained an international reputation (e.g. ESET company);
  Opennes to domestic/international collaboration in innovations;

- **Weaknesses:**
  Low tolerance of of risk and failure;
  Quite negative social image of entrepreneurs;
  Low support of creativity and experimentation in education system and business life;
  Ambiguous attitudes of public to wealth creation (envy instead of motivation);

2 Element Policies and leadership
- **Strengths:**
  Established organisations for SME support and support of young entrepreneurs;
  Established institutional intermediaries for innovation support;
  Latest (2015) regulatory support system for startups, including tax benefits;
  Ease of doing business (rank 37 out of 189 in 2014)\(^2\) with prospects of further simplification;

- **Weaknesses:**
  Rare government statements of wholehearted support of entrepreneurship;
  Low efficiency enforcement of property rights and contracts;
  High level of corruption and bureaucracy (Schwab 2015);
  Fast changes in business legislation;
  Limited tax benefits for innovating enterprises;
  Rigid labour legislation;
  Insufficient number of serial entrepreneurs;

3 Element Finance
- **Strengths:**
  Availability of soft microcredits and guarantees for entrepreneurs;
  Entrepreneurship trainings and workshops by incubators and coworking centres;
  Growing interest in domestic and foreign crowd financing;
  New financing and funding facilities for innovations (Jeremie facility, Innovation and Technology Fund)

- **Weaknesses:**
  Limited access to angel investments and venture capital;
  Limited sources of early stage financing for enterprises;
  Insufficient resources for innovation financing in SME’s and high innovation cost to equity ratio (MH SR, 2014);
  No public capital market for company exits;
  Low level of R&D expenditures by enterprises;
  Preference of innovation purchase to own R&D by large companies;
  Too strong orientation of enterprises on innovation financing through the EU programmes;

\(^2\) http://data.worldbank.org/indicator/IC.BUS.EASE.XQ/countries
4 Element Human Capital

**Strengths:**
- Sufficient capacity of skilled labour, especially in the ICT sector;
- Systematic development of entrepreneurial mindset at the level of secondary schools by non-profit organisations (e.g., Junior Achievement, Young Entrepreneurs of Slovakia);
- Growing number of mentors with business/entrepreneurship experience;
- Growing interest of start-upers in experience in foreign entrepreneurship hubs (e.g., Y-Combinator in Silicon Valley, O2 Wayra accelerator);
- Growing number of international and domestic entrepreneurship events (e.g., Startup Weekend, Global Entrepreneurship Week);
- Contests for awards of the best Slovak entrepreneur (male and female), for the best Slovak company innovation, Creative Young Entrepreneur by Junior Chamber International;
- Growing number of Community trademarks (EC, 2015);

**Weaknesses:**
- Insufficient offers of entrepreneurship study programmes at universities (Zajko, 2013);
- Insufficient capacities to innovate in SME’s;
- Attractive job offers by large Slovak or foreign enterprises for young professionals (especially for graduates and PhD’s in the ICT);
- Low number of patent applications (184 in 2013).

5 Element Markets

**Strengths:**
- Pressure for high-growth companies to go for global markets;

**Weaknesses:**
- Limited domestic market of the small and open economy;
- Uncertain demand for innovated products and services (MH SR 2014);
- Low usage of information and research results from academic sector by industry;
- Low international focus of Slovak SME’s;
- Slow growth of high technology exports (10% in 2013).

Unsatisfactory payment discipline of Slovak companies (one third of invoices are overdue 5), possible secondary insolvencies of enterprises;

6 Element Supports

**Strengths:**
- Growing number of business plan contests and entrepreneurship awards (past five years);
- High level of Internet penetration (80% in 2014) and growing mobile broadband penetration (50.1% in 2013);
- Network of entrepreneurship (e.g., Slovak Business Agency and RPIC centres) and innovation (BIC’s) support;

**Weaknesses:**
- Insufficient number of technology incubators and accelerators;
- Slow growth in fixed broadband subscriptions (21.84% in 2014);
- Low level of services of the emerging technology transfer offices of universities;
- Low state support of technology transfer from universities to industry;
- Underdeveloped business clustering.

VI. CONCLUSIONS AND RECOMMENDATIONS

The potential innovation-driven enterprises need different support programmes ad measures than the SMEs without an innovation focus. Therefore the leaders from government, business and civil society in Slovakia should focus, connect and partner and take steps to improve conditions for innovative enterprises at the prestart, start and expansion stages considering strengths and weaknesses in all key elements of entrepreneurial ecosystem instead of fragmented and partial improvements of its individual elements with political impact only. They could draw on the hints stated in the life cycle approach to fostering innovation-driven entrepreneurship (World Economic Forum, 2014). In terms of this approach focusing means stating more explicit criteria that can help enterprise stakeholders identify and invest in momentum-building entrepreneurship initiatives. Connecting means creation of better and new connections across countries, sectors and programmes in line with the

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3 http://data.worldbank.org/indicator/IP.PAT.RESD
4 High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery (measured as % of manufactured exports).
http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS
5 http://www.podnikam.webnoviny.sk/peniaze/peniaze-investicie/platobna-disciplina-slovensku-najlepsia/35934
6 Internet users (per 100 people) by World Bank. http://data.worldbank.org/indicator/IT.NET.USER.P2
criteria above in order to overcome challenges of fragmented domestic and European markets and entrepreneurial support services. A more transparent, inclusive and Europe-wide database and network of initiatives would greatly assist in promoting innovation-driven entrepreneurship. Finally, partnering means building enabling network to encourage and support stakeholders to collaborate and partner across initiatives, regions, organization types and sectors to achieve scale and momentum for new ventures and ideas (World Economic Forum, 2014, p.5-6).

References


12. Slovak Business Agency, Bratislava


SUPPORT AND STIMULATION TOOLS FOR INNOVATION-DRIVEN ENTERPRISES IN THE COUNTRIES OF EUROPEAN LEADING INNOVATORS

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Slovak Republic
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Abstract:
The support and stimulation of innovation in the European enterprises, especially in SMEs, on the part of the EU and its individual member countries as well is a typical feature of the current economic development. Inspite of this the EU catches up with the lead of the USA, Japan and South Korea slowly only. One of the reasons may be the differences in the innovation environment and lower efficiency of the European innovation-driven enterprises due to the focus of their support. The paper gives an analysis of the institutions and tools for innovation support and stimulation in the European innovation leaders Sweden, Denmark and Finland and formulates recommendations for the moderate innovators, specifically Slovakia.

Keywords: Innovation, support and stimulation tools, innovation leader, high-growth enterprise.

I. INTRODUCTION

The support and stimulation of innovation in the European enterprises, especially in SMEs, on the part of the EU and its individual member countries as well is a typical feature of the current economic development. In spite of this the EU catches up with the lead of the USA, Japan and South Korea slowly only as shown in the Fig. 1 below.

![Fig. 1 Global innovation performance measured in 2012 (European Commission, 2015, p. 34)](image)

Average performance is measured by means of a composite indicator building on data for 12 indicators ranging from a minimum performance of 0 to a maximum performance of 1. The three global top innovators are outperform the EU particularly in indicators of R&D expenditures in the business sector, Public-private co-publications and PCT patents, but also in Share of population having completed tertiary education. Innovation performance for the EU has been improving at a higher rate (2.4%) than that for the US (1.0%) and Japan (1.7%) but at lower rate than South Korea (4.8%) and China (3.6%) (European Commission, 2015).

Tools for support and stimulation of corporate innovations and collaboration in it include programmes, financial schemes, moral and tax incentives, educational and networking tools, that are as a rule implemented by means of specialised institutions (predominantly funded by state). In the following parts of this paper will be given definition of innovation driven enterprise and analysis of tools and institutions for innovation support and innovation in Sweden, Denmark and Finland – European innovation leaders as measured by eight dimensions of the Summary Innovation Index (SII) 2015.
These most innovative countries perform best on all dimensions: from research and innovation inputs, through business innovation activities up to innovation outputs and economic effects. It reflects their balanced national research and innovation systems (Fig. 3), since they also show the smallest variances in their performance across all eight innovation dimensions of the SII.

<table>
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<tr>
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<td>0.542</td>
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<td>0.682</td>
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</tr>
</tbody>
</table>

Fig. 2 Innovation performance (measured by the SII) of the current innovation leaders in the EU 28 in the period 2008-2014 (European Commission, 2015)

Note: SE-Sweden, DK-Denmark, FI-Finland

These most innovative countries perform best on all dimensions: from research and innovation inputs, through business innovation activities up to innovation outputs and economic effects. It reflects their balanced national research and innovation systems (Fig. 3), since they also show the smallest variances in their performance across all eight innovation dimensions of the SII.

<table>
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<td>0.581</td>
<td>0.668</td>
<td>0.856</td>
<td>0.560</td>
<td>0.594</td>
</tr>
</tbody>
</table>

Fig. 3 Innovation performance of the current innovation leaders in the EU 28 (in SII dimensions) in 2014 (European Commission, 2015)

Notes: SE-Sweden, DK-Denmark, FI-Finland.


II. INNOVATION-DRIVEN ENTERPRISE

The potential innovation-driven enterprises (IDE) need different support programmes and measures than SMEs without an innovation focus. In this paper IDE comprises efficient collaboration of highly motivated and skilled human resources in harmonising of corporate functions (links of value chain) based on systematic innovations of company products, processes and systems aiming at increasing the customer value. Its key driver are highly motivated and skilled employees working under conditions of corporate culture of excellent performance, optimal professional and personal development and participative leadership. It is desirable that the successful IDE turn into high-growth or medium-growth enterprises bringing multiple positive effects for the economy of a country and a region. According to the OECD high-growth enterprises are enterprises with average annualised growth in employees (or turnover) greater than 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period. Medium-growth enterprises are enterprises with average annualised growth in employees between 10% and 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period (OECD, 2013, p. 62).

Tools for support and stimulation of corporate innovations and collaboration in innovation include programmes, financial schemes, moral and tax incentives, educational and networking tools, that are as a rule executed by means of specialized institutions (predominantly funded by state). In the following parts of this paper will be given analysis of such tools and institutions in the Sweden, Denmark and Finland.

III. GAZELLES IN THE NORDIC COUNTRIES

The favourable framework conditions for entrepreneurship that were gradually developed in the Nordic countries have led to many startups. The Nordic entrepreneurial culture is now closer to the entrepreneurial culture of the best-performing countries. Some of these startups developed into young high-growth companies – gazelles1. Young Nordic gazelles have a considerable impact on job creation in relation to their number. In the Nordic region, a total of 602 gazelles created 29 588 new jobs during the period of 2006-2009. For instance, in Finland 92 gazelles alone created 7 617 new jobs. Evidently, an average Finnish gazelle creates significantly more jobs compared to gazelles in the other Nordic countries. Most gazelles are in service industries. This is the case in all the Nordic countries, but most pronounced in Denmark where almost nine share of gazelles is expressed as a percentage of the population of enterprises with ten or more employees (OECD, 2013, p. 62).

1 Gazelles are enterprises which have been employers for a period of up to five years, with average annualised growth in employees (or in turnover) greater than 20% a year over a three-year period and with ten or more employees at the beginning of the observation period. The
out of ten gazelles is in service industries. Denmark is also the country with the highest proportion of gazelles in knowledge intensive services.

<table>
<thead>
<tr>
<th></th>
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<th>Denmark</th>
<th>Finland</th>
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<tr>
<td>Number of gazelles</td>
<td>206</td>
<td>84</td>
<td>92</td>
</tr>
<tr>
<td>Initial employment by gazelles</td>
<td>5 048</td>
<td>2 140</td>
<td>4 359</td>
</tr>
<tr>
<td>Final employment by gazelles</td>
<td>13 495</td>
<td>4 940</td>
<td>11 977</td>
</tr>
<tr>
<td>New jobs created by gazelles</td>
<td>8 447</td>
<td>2 800</td>
<td>7 617</td>
</tr>
</tbody>
</table>

Fig. Job creation in gazelles in Sweden, Denmark and Finland in the period 2006-2009 (Norden, 2013, p. 14, adjusted)

When the absolute number of gazelles is small it is even more important that those that exist are able to become successful in terms of generating jobs and growth. However, not many of the Nordic gazelles become really big players. The vast majority of Nordic gazelles remains under 50 employees at the end of their growth period and therefore grow from „small to small”. Gazelles grow more successfully in Finland. Whereas 47% of Finnish gazelles reach more than 50 employees, this is only 25% in Sweden and 20% in Denmark. Even less of the Nordic gazelles ever reach 100 employees, but still more in Finland compared with the rest of the Nordic countries (Norden, 2013, p. 12).

IV. SUPPORT AND STIMULATION TOOLS FOR INNOVATION-DRIVEN ENTERPRISES IN SWEDEN

Sweden is one of a few OECD member countries that does not use fiscal stimuli for R&D. Instead it prefers provision of funding to enterprises and R&D institutions within purpose-bound programmes (focussed on specific sectors of economy and technologies) realized by agencies and foundations, with whom these recipients enter into partnerships and consortia. The Swedish government agency for innovation systems VINNOVA with budget of 2.7 b SEK (290 m €) in 2014 is the most important innovation intermediary. It has representations in Stockholm and Brussels. It provides about 30% of funding to enterprises and about 60% of funding to R&D institutions (mainly to universities: 44% in 2014) via programmes on the co-funding base. Co-funding leads to more than doubling of the total amount of funding. VINNOVA acts as a national contact point of EUREKA and Eurostars programmes. Some of the programmes involve funding of research important for renewal of Swedish industry. In other cases they involve enterprises applying for funds for their development projects. Some of the programmes require actors to merge to jointly manage large and long-term projects. The programmes target actors in society who are important for Sweden’s innovativeness, such as knowledge-intensive companies, universities, colleges, research institutes and actors within the public sector.

At present the VINNOVA programmes focus on innovation support in the following three areas: 1) Strategically important knowledge areas (e.g. Future health and Health care, Transport and environment, Services and ICT, Production and Work life) 2) Strengthening of innovativeness of specific groups (Public sector, Innovative SME’s, Knowledge triangle and Strong innovation environments), 3) Cross-border cooperation (e.g. innovations driven by societal challenges, partnership programmes, EU and international collaboration).

Among the first group of programmes are of interest above all the following: Innovations for future health, Strategic means of transport, Entrepreneurship and innovations, Innovation procurement and Product strategies.

Among the second group of programmes are of interest above all the following: Support of innovative SME’s (e.g. Research and growth; Support of high-tech start ups within the VINNU and also directing enterprises to participation in EUREKA and Eurostars programmes; Knowledge triangle is orientated to boosting of collaboration of enterprises and R&D institutions, including universities (e.g. in programme Verification for growth (risk evaluation of research-orientated enterprises); Strong innovation environments support building of the VINN centres of excellence (17 applied research centres), Berzelii centres of excellence (4 centres of fundamental research centres), programmes Institute excellence centres, Excellent industry branches and also Regional growth and clustering.


Among the second group of programmes are of interest above all the following 4: Innovations motivated by societal challenges (with innovation user participation, interdisciplinary collaboration on solving these issues) and partnership programmes (Partnerships in research of strategic means of transport or aviation engineering).

**Innovation Bridge Ltd.** is a state company (7 regional offices and 5 subsidiaries) with budget of 135 m. SEK (14.5 m. €) in support of seed funding of companies, provision of "soft" loans to enterprises and equity investing and in support of incubators.

**Almi Business Partner, Ltd.** is a non-profit public company (21 regional representations in Sweden) with mixed ownership (51% equity belongs state, 49% to regional authorities), which provides "soft" loans to innovative enterprises in the initial development stage or in the growth stage.

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### V. SUPPORT AND STIMULATION TOOLS FOR INNOVATION-DRIVEN ENTERPRISES IN DENMARK

Denmark is one of six countries of the world spending on R&D more than 3% of GDP a year. It has strong science and research base with several world class universities (3 among top 100 universities of ARWU ranking). In 2006 the universities were restructured so that majority of public research was integrated in them that helped increase their international reputation. In science publications Denmark ranks third among the OECD states. In 2014 the Forbes magazine proclaimed Denmark to be the best state in the world for entrepreneurship that was confirmed by the evaluation of the World Bank in 2015.

Danish innovation policy has been characterised by substantially lower level of coordination in the long term than the Swedish or Finnish ones. However, in the past two years this has changed in favour of stronger coordination and global focus. The science, research and innovation policies are directed by the restructured **Ministry of Higher Education and Science** (earlier Ministry for Science, Innovations and Technologies) by means of the **Danish Agency for Science, Technology and Innovations**. In 2014 three specialised agencies for R&D funding merged into the Danish Innovation Fund with annual budget of 215 m € for grants for strategic applied research and experimental development, technologies and innovations.

Another two specialized institutions are: Danish Council for Independent Research with annual budget of 175 m € for grants for independent research, Danish National Research with annual budget of 55 m € for grants for fundamental research and centres of excellence. For basic funding of university research is reserved 1,200 m € per year that may be increased depending on the quality of outputs. Private institutions (Novo Nordisk, Carlsberg and Lundberg) contribute to research financing by an average annual amount of 250 m €.

In 2012 Danish government passed the first Danish innovation strategy „**Denmark– Nation of Solutions**“. It does not focus on technology areas but above all on social changes: 1) Innovations motivated by social challenges, 2) Higher transformation of knowledge into values, 3) Education as a means of boosting innovation capacity. For these three topics were formulated 27 initiatives aiming at. Starting up demand for new solutions in society and thus demand-driven innovations. Strategy leans on a dialogue among enterprises, institutions and experts on Danish innovation potential and shall simplify and foster closer collaboration between public and private sector in innovations. The target is to achieve by 2020 in R&D indices and share of the highly educated employees in private sector the top positions within the OECD.

Among the most important means of Ministry of Higher Education and Science belong programmes and tools such as innovation vouchers, innovation consortia for knowledge transfer to enterprises and open funds for funding and new collaboration forms, Danish innovation networks (20 networks, communication forums for industry and public education institutions), knowledge pilot schemes (subsidies to development project of enterprises), projects of industrial studies of PhD students (3-years projects with state funding), innovation agents for knowledge transfer to small enterprises, incubators of innovation-driven enterprise. The common denominator of all of them is fostering and development of collaboration among enterprises and knowledge institutions and improving competencies of enterprises.

**Danish Innovation Centre (DIC)** 5 was established in. 2006 through joint initiatives of Ministry of Foreign Affairs and Ministry for Innovation.

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5 Via: [http://www.icdk.dk/](http://www.icdk.dk/)
Science, Technology and Innovations as a part of globalisation strategy of the Danish government aiming at transformation of Denmark into a leading knowledge economy by 2016. The first DIC representation was opened in Palo Alto in Silicon Valley, currently such centres operate also in Munich, Sao Paulo, Delhi, Seoul, Shanghai and Tokyo in order to boost collaboration of Danish enterprises, investors, universities and R&D institutions with their counterparts in their countries of residence using the following tools: Innovation and entrepreneurship camp, Programme Inovation-driven growth, Programme Innovation pack, and Programme of scientific and technology survey.

**Innovation and entrepreneurship camp** deals with SME’s interesting in learning international entrepreneurship and innovation environments in the cities where the DIC has subsidiaries. The Camp is organised for 5 SME’s as a minimum and must be managed by external coordinator. It takes 3 to 5 days for participants to get the required counselling and professional contacts. The agenda of the event includes: Introduction to ecosystem, Meetings and networking with potential partners, Access to international knowledge and research, Evaluation of business model/technology of participant, Possibility of pitching the business idea to potential partners and Possibility of key competencies improvement. The approved entitled participants (entrepreneurs and SME’s with less than 100 employees and annual turnover to 150 m DKK (1 119,4 thsd €) can qualify for a subsidy from the Commercial Council up to 70% of the participation cost.

**Programme Inovation-driven growth** is a two-phase innovation programme for SME’s with growth ambitions in locations where the DIC has subsidiaries. Participants get assistance in responding to such global business opportunities (technology evaluation and directions on the road to a new market). The approved entitled participants are technologically-intensive SME’s with less than 100 employees and annual turnover to 150 m DKK (1 119,4 thsd €). In the first phase (free of charge) is evaluated the business model of participant and set out the road to the new market/markets. In the second phase (paid by company at basic hourly rate) is supported implementation of the road of enterprise to a new market. The Danish Ministry of External Affairs provides to a SME subsidy covering 35% of the total cost of the 2nd phase (for 35 to 100 project hours).

**Programme Innovation pack** is for the SME’s with ambition to penetrate foreign markets in the locations where the DIC has subsidiaries. It is a tailored pack of consulting services for a SME (35 to 100 consulting hours at the basic rate for project hour. It includes meetings, networking and seminars with key actors, access to international knowledge and research, evaluation of business model and technology. The entitled participants are technologically-intensive SME’s with less than 100 employees and annual turnover to 150 m DKK (1 119,4 thsd €). The Commercial council may subsidise the cost of the pack up to 35% of its total cost.

**Programme of scientific and technology survey** is for the technology-intensive SME’s interested in contact with a leading international entrepreneur and innovation environment in cities where the DIC has subsidiaries. Programme is for 4 to 10 SME’s with similar interests in market survey. The entitled participants are technologically-intensive SME’s with less than 100 employees and annual turnover to 375 m. DKK (5 025 thsd €). The price of the programme (11 813 DKK, i.e. 1 583 € per participant) is to be borne by participants.

**Danish Ministry of Higher Education and Science** developed within the Innovation Strategy of Denmark (2012) a support scheme for innovation-driven entrepreneurship for university graduates “Start Up Graduate”. It is selective and for students with a business idea, which they intend to realize in their own knowledge-intensive innovative company and improve their entrepreneurial competencies. The selected students are entitled for a financial and consulting support related to this purpose from the Danish Agency for Science, Technology and Innovations (DASTI) for one year since 2014.

VI. SUPPORT AND STIMULATION TOOLS FOR INNOVATION-DRIVEN ENTERPRISES IN FINLAND

Finland puts considerable stress not only on the support of R&D of new technologies but also on the foresight, technology forecasting – research of new technological and related social and economic trends and risks in the longer term time horizon (5 years and more). Its continuation is technology evaluation and forecasting

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4Foresight serves as a base for formulation of regional, branch or national science and technology policy. It is focused on identification and planning broader
trends, opportunities and challenges. The National Foresight Network\(^7\) was set up for this purpose with the aim to estimate strategic challenges, risks and opportunities in Finland and in the world, which will be considered in directions, objectives and structure of research, technology and innovation policies. An important project was, e.g. the Project FinnSight 2015, where participated Finnish Academy and innovation agency Tekes. The aim was to evaluate change factors, that influenced Finnish entrepreneurial environment, industry and society, identify future challenges in innovation and research for the competitiveness of enterprises.. The project Cleantech Finland (Finnish innovation fund SITRA, 2007)\(^8\) was targeted at prospects of clean technologies development\(^9\) and elaboration of National programme of Environmental Entrepreneurship in order to make Finland world leader in this field\(^10\).

Finland belongs among the countries well known for the importance of the public sector in innovation development, application and implementation. In 2010 there was formulated in the document „Innovation policy managed by demand and users“ an action plan for innovation promotion and implementation in public procurement in order to improve conditions in public procurement of innovations. It requires, e.g. that purchase solutions may not exist in the market or their outcome will be a new way of problem solution or need satisfaction. The National Innovation Strategy of Finland accentuates implementation of user-led innovations and demand-driven innovations (market needs to address environmental and social issues, climatic changes, population aging, public services, etc.). Strategic conception Internationalisation of Finnish education, research and innovations for period 2010-2015 responded to low international focus of Finnish innovation system and lead to establishment of Finnish innovation centres abroad (FinNode) as a new model of creating partnerships in R&D, entrepreneurship, innovations, entrepreneurship and marketing. Their aim is to promote Finnish enterprises, attract foreign investors to Finland, strenthen knowledge flows to Finland and vice versa, assist Finnish enterprises in penetration foreign markets, get higher visibility of Finnish innovations, present Finland as an attractive R&D destination and support mobility among universities and researchers. They are established established in the USA (Silicon Valley), Russia, China, Japan and India as a collaboration of several public entities: TEKES, Finpro, VTT, Sitra and Finnish Academy. Finland is another OECD member that did not use fiscal incentives for R&D. However, for the period 2013 - 2015 it temporarily introduced for SME’s and start up investors tax benefits for R&D.

Finland has a well developed institutional network for support of science, R&D and innovations: Finnish innovation fund SITRA, the largest multidisciplinary research organisation in the Northern Europe VTT Centre of Technology Research, Strategic centres for science, technology and innovations (SHOK), Finnish Academy, specialised state company Finverra and the most important of them – the innovation agency TEKES. TEKES deals with project funding of enterprises (with co-funding up to 50% of project costs for SME’s and up to 65% - 75% for large enterprises) in line with the following strategy: 1/3 of funds is for the young SME’s (less than 5 years in business, up to 500 employees) with a growth potencial\(^11\), Another 1/3 is for support of internationalisation of established SME’s\(^12\) and SME’s with a research project or pilot development and testing of innovation. The remaining 1/3 is for the large enterprises (more than 500 employees) with export potencial, that plan to substantially innovate their businesses (with a research project or pilot development and testing of innovation).\(^13\)

Funding is carried out according to differenciated rules: nearly 40% of funds is for customer iniciatives, about 20% of funds is for the research in the Strategic centres for science and technologies, about 25% serves for funding of TEKES.

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\(^10\) Currently there successfully operates a network of enterprises and experts in global environmental entrepreneurship in Finland (2013 outcomes: 50 thsd jobs, combined turnover of 25.8 b €, more than 1/3 of R&D funding, 5% growth and more than 1% share in the world market of clean technologies).


\(^12\) More: http://letsgrow.fi/en/

\(^13\) More: http://www.tekes.fi/en/funding/companies/piloting/

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\(^7\) www.foresight.fi

\(^8\) http://www.cleantechfinland.com/content/about-cleantech-finland

\(^9\)Clean technologies include products, services, processes and systems resulting in lower negative impact on environment than for their alternatives. They bring added value to customers through reduction of direct or indirect consequences on environment.

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programmes and remaining 15% is for other strategic topics.

Six Strategic centres for science and technologies (SHOK) operate as cooperation platforms for long term intensive collaboration of enterprises and top research institutions. In the period 2008–2012, nearly 500 enterprises and 30 research organisations collaborated in this way. TEKES provided for these research programmes 373 m € and enterprises co-funded 40% of project costs.

TEKES provides funding for Programme of procurement of consulting and innovation support services for SME’s with the aim of boosting development of business activities of enterprises using external innovation services. These services are involved especially with commercialisation of new products, creation of innovation methods, market studies and research, protection of intellectual property, knowledge and technology transfer, trainings, etc.

TEKES offers to enterprises and research institutions funding for participation in 11 TEKES research programmes for the period 2014-2019 on specific topics and sectors, e.g. Electric vehicle systems, Creation of immaterial values, Industrial Internet as revolution in business, Innovative cities, Innovations in health and social care, Intelligent procurement.

In collaboration with organisations Finnverra and Finpro TEKES fosters development of globalisation of Finnish enterprise through the SME network Team Finland via several programmes, e.g. Team Finland – Future Watch, Team Finland – Export, Fudan iLab, VIGO, Finland Let’s Grow and others.

Programme Fudan iLab (period 2014 -2016) is focused on young innovative enterprises that can test doing their business in the Chinese market with TEKES and MBA students from the prestigious Fudan School of Management in China. It is a chance for the Finnish enterprises to gather practical marketing experience, develop business strategies and solve real business challenges. They can also gain a subsidy for their R&D and innovation projects.

Vigo programme is a business accelerator programme for young innovative enterprises with global focus and growth potential. It interlocks innovative business ideas, business professionals with international experience and public and private funds. The aim is to foster quality start ups, help find funding and venture capital (VC), improve VC market in Finland and attract the VC there.

Foundation for Finnish inventions serves as „one-stop-shop“ in protection of intellectual property rights offering services in invention evaluation, guidance and assistance on patent protection of invention, workshops on prototype creation, legal issues and marketing assistance. Foundation also supports inventors with grants amounting from 2,000 € to 200,000 € depending on the project size.

VII. CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of foreign support tools for innovation-driven enterprises the following tools may be recommended for testing and implementation in the Slovak business environment:

- programmes of selective entrepreneurship support in the areas of strategic specialisation of country using results of comprehensive foresight and technologically forecasting in Slovakia and in the world;
- programmes fostering innovation-driven entrepreneurship, especially in the seed and start up phases of enterprises with high growth potential and global focus, e.g. incubation and acceleration programmes;
- programmes fostering innovation-driven entrepreneurship of established SME’s with global focus in the expansion phase of development;
- programmes boosting innovation partnerships between businesses and universities or among businesses, universities and local/regional authorities;
- programmes fostering use of intellectual property rights and their commercialisation, e.g. by means of knowledge and technology transfer centres;
- programmes fostering internationalisation of enterprise and penetration in the foreign markets (market surveys, building innovation centres for start ups in the strategic regions of the world, e.g. Silicon Valley, Berlin, London, Israel, China, Japan, South Korea );

16 http://www.vigo.fi/frontpage
- programmes on fostering SME’s with own R&D targeting on increasing share of entrepreneurship in high tech;
- programmes on strengthening national entrepreneurial mindset, e.g. inspired by the British campaign „Startup Britain“;
- programmes on reenforcement of regional/local entrepreneurial awareness, e.g. „Start up cities“ initiatives;
- national acceleration programme for Slovak start ups and attraction of start ups to Slovakia (inspiration from Chile, Canada, Silicon Valley, Berlin, London a other start up hubs);
- programmes on organisation of contests for high-tech start-up enterprises;
- consulting programmes on commercialisation of innovative products and customer acquisition;
- programmes for universities fostering creation of university start ups and start up incubators;
- mentoring start-up programmes and programmes for attraction of world talents and start upers to Slovakia;
- programmes fostering long strategic partnerships between universities and industry, e.g. inspired by the successful British Knowledge Transfer Partnerships;
- programme for national and international promotion of results of Slovak R&D and innovations;
- programme supporting potential VC investors and business angels for start up investments in Slovakia;
- programmes for organisation of national and international conferences, seminars, exhibitions with renowned entrepreneurship personalities, e.g. from companies Google, Amazon, Facebook, Microsoft, Toyota and others, as an inspiration may be mentioned the conference Web Summit v Dublin17;
- programmes on development of creativity and innovative thinking already at the level of primary and secondary schools.

There are considerable challenges in development of innovation-driven entrepreneurship in its support by local and regional authorities, which will require education and training in entrepreneurial mindset and acting on the part of employees of public administration institutions.

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17More: www.websummit.net, the biggest technology conference in Europe focusing on internet technologies with participation of world start ups, VC investors and renowned speakers.
Abstract: E-Business application is driven via interdisciplinary education including both business education as well as Information and Communication Technology education. The synergy between e-Business application and education is generated by educational research. Sampling as an element of the educational research has a two-fold role: sample size is interconnected with statistical analysis of the data and generalisation. Against this background, little attention has been given to an approach to sampling in educational research. The research question is as follows: what approach forms sampling in educational research? The aim of the research is to analyse scientific literature and work out an approach to sampling in educational research underpinning elaboration of a new research question for further studies in educational research. The present research involves a process of analysing the meaning of the key concepts “effectiveness”, “approach”, “sampling” and “principle”. In the empirical study, explorative research was employed. Interpretive research paradigm was used. The empirical study involved six experts from different countries in February 2013 – July 2014. The findings of the research allow drawing the conclusions on the elaborated approach to sampling in educational research. Directions of further research are proposed.

Keywords: E-Business application, empirical analysis, effectiveness, educational research, sampling.

I. INTRODUCTION

E-Business application is becoming a key priority for smart, sustainable and inclusive growth of the European Union as E-Business application plays a two-fold role in improving European performances related to employment, economic reform and social cohesion:

- on the one hand, Europe 2020 strategy highlights entrepreneurship and, consequently, E-Business application as one of the key factors of smart, sustainable and inclusive growth, and,
- on the other hand, E-Business application helps Europe’s citizens and businesses to get the most out of digital technologies as the digital economy is growing at more than ten times the rate of the rest of the economy.

E-Business application is driven via interdisciplinary education including both business education as well as Information and Communication Technology education as shown in Figure 1.

![Figure 1: Interdisciplinary education in E-Business application](image-url)

The synergy between e-Business application and interdisciplinary education is generated by educational research as demonstrated in Figure 2.
Educational research facilitates enrichment of such pedagogical and educational developments as organization of educational environment, curriculum design and implementation, enhancement of educational institution activities in terms of research, etc. in order to promote learners’ knowledge, competences and behavior aimed at ensuring new discoveries, innovations, etc. (Ahrens and Zaščerinska, 2014a). Success in carrying out educational research is generated by a couple of strategies. For evidence based educational research, one of the strategies is focused on sample analysis (Mayring, 2007).

The sample method is recognized as an effective way for empirical analysis within educational research. By effectiveness, aim achievement at a certain quality spending minimal time and energy (Žogla, 2001) as well as money is meant. In comparison to the population method, the sample method is effective as it reduces

- time spent to interview the respondents,
- money paid to employ people to make the interviews as well as for their trips to every respondent, and
- all sort of energy such as human, electrical, mechanical, etc. spent on data processing and analysis.

Traditionally, sampling refers to empirical studies of educational research. It should be noted that empirical studies as shown in Figure 3 are differentiated into quantitative, qualitative as well as hybrid/mixed studied.

Analysis of scientific literature reveals that, on the one hand, a number of terms such as sample, sampling, scientific sample, statistical sampling, sampling scheme, sampling plan, sample design, sampling procedures, sample size, etc. exist that indicate how a sample if shaped, and, on the other hand, despite the differences in the terms, sample remains the overall concept.

Within the present contribution, sampling focuses on obtaining a group of subjects who will be representative of the larger population or will provide specific information needed (McMillan, 1996). The goal is to select a sample that will adequately represent the population, so that what is described in the sample will also be true of the population (McMillan, 1996). It should be noted that, in educational research, the best procedure for selecting such a sample is to use probability sampling as non-probability sampling does not ensure the construction of a parameter for a population. Moreover, the primary distinction between the two domains is that the probability sampling study findings can be generalized to the target population while the non-probability sampling study findings can only be generalized to the institution where the sample was studied (Summers, 1991). The key characteristic of a probability sample is that each element in the population has a known probability of being included in the sample (Sweeney, 2013).

In educational research, sampling has attracted a lot of research efforts. In educational research, factors that influence sample size have been identified (Ahrens and Zaščerinska, 2014a) as well as a framework for selecting sample size has been proposed (Ahrens and Zaščerinska, 2014b). However, little attention has been given to an approach to sampling in educational research.

The research question is as follows: what approach shapes sampling in educational research? The aim of the research is to analyse scientific literature and work out an approach to sampling in educational research underpinning elaboration of a new research question for further studies. The present research involves a process of analysing the meaning of the key concepts “effectiveness”, “approach”, “sampling” and “principle”. Moreover, the study demonstrates how the key concepts are related to the idea of “approach to sampling”. The study presents how the steps of the process are related: approach → principle → approach to sampling in
educational research → empirical study within a multicultural environment → conclusions.

The methodological background of the present research is based on the System-Constructivist Theory. The System-Constructivist Theory is introduced as the New or Social Constructivism Pedagogical Theory. The System-Constructivist Theory and, consequently, System-Constructivist Approach to learning introduced by Reich (Reich, 2005) emphasizes that human being’s point of view depends on the subjective aspect (Maslo, 2007) as experience plays the central role in the knowledge construction process (Maslo, 2007). Therein, the subjective aspect of human being’s point of view is applicable to the present research, too.

The System-Constructivist Theory facilitates the application of interdisciplinary research within the present investigation as interdisciplinary research assists in synthesizing, connecting and blending ideas, data and information, methods, tools, concepts, and/or theories from two or more disciplines in order “to make whole” (Repko, 2012) or, in other words, a system entitled “approach to sampling in educational research”. Figure 4 adopted from Repko (Repko, 2012) presents how the process of interdisciplinary research is organized where ‘A’ means a scientific discipline, and ‘B’ – another scientific discipline.

![Figure 4: The process of interdisciplinary research by Repko (adopted from Repko, 2012)](image)

It should be noted that the present research is not limited to only two scientific disciplines but is based on a number of scientific disciplines such as agriculture, pedagogy, management, economics, psychology, environment, etc. In Phase 1 of the interdisciplinary research, an issue is separately explored by two or more scientific disciplines. In Phase 2, the same issue is examined by the synergetic point of view of these two or more scientific disciplines. In Phase 3, results of the analysis are interpreted.

II. THEORETICAL FRAMEWORK

Approach is a set of theoretical principles (Karapetjana, 2008). For the purposes of further theoretical analysis, it should be noted that, in the present contribution, education is part of pedagogy as illustrated in Figure 5.

![Figure 5: Inter-relationship between pedagogy and education](image)

In pedagogy and, consequently, in educational research, principle is identified as a certain viewpoint system and/or internal belief that determine person's attitude to the world, his/her behaviour’s norms and actions (Belickis, Blūma, Kočė, Markus, Skujinā and Šalme, 2000). Analysis of this definition of principle and complementing this principle for pedagogical purposes with the words individual combination in regard to a researcher leads to such a newly determined definition of principle as an individual combination of beliefs and assumptions that determine researcher's attitude to the world, his/her behaviour’s norms and actions or, in other words, sampling in educational research. Further on, complementing the principle definition formulated by Belickis, Blūma, Kočė, Markus, Skujinā and Šalme (Belickis, Blūma, Kočė, Markus, Skujinā and Šalme, 2000) for pedagogical purposes with the words shared combination in regard to a group of researchers leads to such a newly determined definition of principle as a shared combination of beliefs and assumptions that determine researchers' attitude to the world, their behaviour’s norms and activities or, in other words, sampling in educational research. Analysis of scientific literature allows structuring the principles of sampling in accordance with three types of empirical studies as delivered in Table 1.

| Table 1: Principles of sampling in different types of empirical studies |
|---------------------------|-----------------|-------------------|-------------------|
| Quantitative studies | Qualitative studies | Hybrid / mixed studies |
| Principle 1 - be a difference between the sample statistics and the true population mean, which is attributable to the selection of the units in “Accuracy” (increase sample size) with “cost” (decrease sample size), | The quantitative principle of representativeness and the qualitative principle of appropriateness (Morse, 1991) | |

The quantitative principle of representativeness and the qualitative principle of appropriateness (Morse, 1991)
It should be noted that the paradigm in educational research shifts towards hybrid/mixed empirical studies as the approach of mixed methods provides more precise results: qualitative methods explain the differences, and quantitative methods reveal the amount of differences (Hunter and Brewer, 2003). Therefore, only the principle of sampling in hybrid/mixed empirical studies identified by Morse (Morse, 1991) and Minkkinen (Minkkinen, 2008) are considered for further analysis. Analysis of the scientific papers authored by Morse (Morse, 1991) and Minkkinen (Minkkinen, 2008) reveals that the principles determined by Morse (Morse, 1991) and Minkkinen (Minkkinen, 2008) seem to be a combination of quantitative and qualitative principles worked out before. Against this background, principle is a condition of activity (Beļickis, Blūma, Koķe, Markus, Skujina and Šalme, 2000) or, in other words, sampling in educational research. A condition means a circumstance from which the implementation of a process, process or activity depends (Beļickis, Blūma, Koķe, Markus, Skujina and Šalme, 2000) or, in other words, sampling in educational research. In the present research sampling depends on the inter-relationships between sample size and statistical analysis of the data, sample size and generalization (Ahrens and Zaščerinska, 2014b).}

Table 2: Principles of sampling

<table>
<thead>
<tr>
<th>Circumstances</th>
<th>Principle of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the measurement phase, the parameters of measurement tools and scales are</td>
<td>Principle of sample appropriateness</td>
</tr>
<tr>
<td>kept fixed when used by sample’s further components or elements</td>
<td></td>
</tr>
<tr>
<td>In the data processing phase, the tests carried out on a given set of data</td>
<td>Principle of sample sufficiency</td>
</tr>
<tr>
<td>allow extracting the required information in an appropriate form such as</td>
<td></td>
</tr>
<tr>
<td>diagrams, reports, or tables</td>
<td></td>
</tr>
<tr>
<td>In the statistical analysis phase, the information extracted from the</td>
<td>Principle of sample confidence</td>
</tr>
<tr>
<td>obtained data processing ensures a possibility to make conclusions and</td>
<td></td>
</tr>
<tr>
<td>generalisations</td>
<td></td>
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<tr>
<td>In the analysis phase, sample’s further components or elements do not</td>
<td></td>
</tr>
<tr>
<td>change conclusions or generalisations drawn from the obtained data</td>
<td></td>
</tr>
<tr>
<td>(Kroplijs and Raščevska, 2004).</td>
<td></td>
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</tbody>
</table>

Table 3 presents the principles of sampling in the context of educational research.

Table 3: The principles of sampling in the context of educational research

<table>
<thead>
<tr>
<th>Principles</th>
<th>Principle of sample appropriateness</th>
<th>Principle of sample sufficiency</th>
<th>Principle of sample confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of the inter-relationships between sample size and statistical analysis of the data, sample size and generalization</td>
<td>Principle of sample appropriateness</td>
<td>Principle of sample sufficiency</td>
<td>Principle of sample confidence</td>
</tr>
</tbody>
</table>
III. EMPIRICAL RESEARCH

The present part of the contribution demonstrates the design of the empirical research, results of the empirical study and findings of the research. The design of the present empirical research comprises the purpose and question, sample and methodology of the present empirical study. The empirical study was aimed at evaluating the approach to sampling in educational research. The empirical research’s question was as follows: What is expert evaluation of the approach to sampling in educational research?

The present empirical study involved six experts from different countries in February 2013 – July 2014. All the respondents have been awarded PhD Degree in different scientific disciplines. As the respondents with different cultural backgrounds and diverse educational approaches were chosen, the sample was multicultural. Thus, the group (age, field of study and work, mother tongue, etc.) was heterogeneous. The sample of six experts involved two researchers in the field of educational research, Educational Research Association, "Freie Universität" (Free University), Berlin, Germany, a researcher in the field of educational research, Latvia University of Agriculture, Jelgava, Latvia, a researcher in the field of applied research in education, CAH - Vilentum University of Applied Sciences, Dronten, the Netherlands, two researchers in the field of e-business and telecommunications, Vienna University of Technology, Vienna, Austria. In order to save the information of the present research confidential, the respondents’ names and surnames were coded as follows: two researchers from Germany were given the codes of E1 (Expert 1) and E2 (Expert 2), a researcher from Latvia was pointed as E3 (Expert 3), a researcher from the Netherlands was considered as E4 (Expert 4), and two researchers from Austria were indicated as E5 (Expert 5) and E6 (Expert 6).

Interpretive research paradigm was used in the present empirical study. The interpretive paradigm aims to understand other cultures, from the inside through the use of ethnographic methods such as informal interviewing, participant observation and establishment of ethically sound relationships (Taylor and Medina, 2013). Exploratory research aimed at generating new questions and hypothesis was employed in the empirical study (Phillips, 2006). The exploratory methodology proceeds from exploration in Phase 1 through analysis in Phase 2 to hypothesis development in Phase 3. The qualitatively oriented empirical study allows the construction of only few cases (Mayring, 2004). The cases themselves are not of interest, only the conclusions and transfers we can draw from these respondents (Flyvbjerg, 2006). Selecting the cases for the case study comprises use of information-oriented sampling, as opposed to random sampling (Flyvbjerg, 2006). This is because an average case is often not the richest in information. In addition, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur (Flyvbjerg, 2006). Further on, the choice of experts was based on two criteria: recognized knowledge in the research topic and absence of conflict of interests (Lopez and Salmeron, 2011). The number of experts depends on the heterogeneity of the expert group: the greater the heterogeneity of the group, the fewer the number of experts (Okoli and Pawlovski, 2004). Thus, six is a good number of experts for the study (Lopez and Salmeron, 2011). Therein, the non-structured interviews comprised six experts who were researchers from different countries. All the six researchers had decisively contributed to their fields of research. All the six researchers had received extensive teaching experience thereby they were involved in educational research.

In order to evaluate the approach to sampling in educational research, non-structured interviews were carried out to search for the main categories of the research field (Kroplijs and Raščevka, 2004) or, in other words, evaluation of the approach to sampling in educational research.

Expert 1 thanked the authors for the interesting abstract submitted to the conference where Expert 1 was acting as a reviewer. Expert 2 underlined that the authors had tried to summarize a study and identify the main characteristics of this study. Expert 3 was interested in the continuation of the study. Expert 4 assumed that the factors play a key role in forming the sample size in educational research. Expert 5 stressed the use of the research results in other scientific disciplines, too. Expert 6 emphasized that the contribution submitted to the conference where Expert 6 was acting as a reviewer had been well done. Summarizing content analysis (Mayring, 2004) of the data reveals that experts positively evaluated the
approach to sampling in educational research.

IV. CONCLUSIONS AND RECOMMENDATIONS

The empirical findings of the research allow drawing the conclusions on experts’ positive evaluation of the approach to sampling in educational research. The following research question has been formulated: what is the methodology of sampling in educational research? The present research has limitations. The interconnections between effectiveness, approach, principle, conditions, circumstances, sample size, statistical analysis of the data and generalization have been set. Another limitation is the empirical study conducted by involving the experts only. Further research tends to focus on empirical studies to be carried out in other institutions. The search for relevant methods for evaluation of the approach to sampling in educational research is proposed. And a comparative research of different countries could be carried out, too.

References

FIVE CONSTANT VIRTUES AND ENTREPRENEURIAL ETHIC EDUCATION

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Abstract: Confucianism and its ethic, with a long history, are extensive and profound, with Five Constant Virtues being the core. Five Constant Virtues refer to the five ethic norms, that is, benevolence, righteousness, propriety, wisdom, and good faith, of which benevolence is the core. Benevolence does not only embody the thought of “benevolences loving others”, but also the dialectic thought of “being affectionate and filial”, “loyalty and forgiveness”, “being firm and gentle”, “stepping forward and backward”, and “Yin and Yang”. It is a dialectic way thinking of “dichotomy of one” and “unity of two”, and involves the profound wisdom of the relationship between heaven, earth and humanity. Five Constant Virtues offer great guidance for college students on shaping ethics and value orientation in their entrepreneurship. In fact, the Five Constant Virtues inter-generate and inter-restrain. The ethic basis of entrepreneurship is benevolence, which is rational and dialectic emotions, and a value system guided by “good and kindness” with a scientific understanding of humanity, market, environment, and shareholders. The construction of benevolence ethic can not only firm up entrepreneurial determination, confidence and perseverance, but also help to form good order, develop good relationships based on integrity, insist management principle of responsibility first, generate wisdom from benevolence, and shoulder the entrepreneurial responsibilities.

Keywords: Confucianism; Five Constant Virtues; entrepreneurship; ethic; education.

I. FIVE CONSTANT VIRTUES AND ENTREPRENEURIAL ETHIC

Benevolence, righteousness, propriety, wisdom, and good faith are Five Constant Virtues in Confucianism, which are the basic interpersonal ethic principles and norms, and the essence of Chinese traditional ethics. They were put forward in Spring Autumn and the Warring States Periods, and were shaped in Han Dynasty. Confucius thought “Three Virtues”, that is, “wisdom, benevolence, and bravery” were ethic norms. He said: “A man with wisdom is not in perplexity; a man with benevolence is not in worry; a man with bravery is not in fear”. Mencius developed “Three Virtues” into “Four Virtues”, that is, “benevolence, righteousness, propriety, and wisdom”. “Good faith” was put into it by Dong Zhongshu, the great master of Confucianism in Han Dynasty, which developed into five virtues, called “Five Constant Virtues”. In History of Former Han Dynasty, it mentioned: “Benevolence, righteousness, propriety, wisdom, and good faith are Five Constant Virtues that kings should learn, maintain, and follow.” Ban Gu, a literary man in Han Dynasty illustrated the meaning of “Five Constant Virtues” in his compiled book, General Principles from the White Tiger (Lodge), “What are Five Constant Virtues? They are benevolence, righteousness, propriety, wisdom, and good faith. Benevolence is to show mercy to all life, love humanity. Righteousness is proper, is to make proper decisions. Propriety is to carry it out, and carrying out Tao will lead to principle. Wisdom is knowledge and understanding, a person has particular opinion and good foresee, and he can know the principle from the daily things. Good faith is being integrated, concentrated, and unchangeable.” It seems that Five Constant Virtues only deal with interpersonal relationships, reflect the
principle of humanity, whereas, in essence, they also reflect the principle of nature, that is, “trinity of heaven, earth, and humanity”. The five virtues have their correlations in the Five Elements. Thus benevolence is correlated with Wood; righteousness with Metal; propriety with Fire; wisdom with Water; and good faith with Soil. The Five Elements inter-generate and inter-restrain each other, so do the Five Constant Virtues. “Benevolence → propriety → good faith → righteousness → wisdom → benevolence” is in the cycle of inter-generation. For example, a man with real benevolence not only observes the natural law of heaven and earth, loves self and others, but also knows propriety, and the rule of “benevolences loving others” so that he acts by the rule of propriety. With propriety, he is sure to be honest, really knows rituals, and what he does will win good faith. With good faith, he is sure to be righteous, and willing to shoulder family and social responsibilities. With righteousness, he will have wisdom, knows principle and law, and develops positive energy from wisdom. A man with real wisdom is sure to pursue inner benevolence. Their inter-generation can improve the symbiosis and harmony between human, between humanity, society, and nature. Diverging from Five Constant Virtues will lead to their inter-restraint, that is, imbenevolence → bad faith→ inwisdom→ impropriety → unrighteousness → imbenevolence. See figure 1.

![Diagram of the inter-generating and inter-restraining relationships between five virtues](image)

Figure 1 The inter-generating and inter-restraining (solid lines means inter-generating, dotted lines, inter-restraining)

In English, the two words, entrepreneurship and enterprise, with similar meanings, mean doing it. In 1934, the famous economist, Joseph Alois Schumpeter, first used the word, entrepreneurship, with modern meaning. He mentioned, “Doing a new association is called entrepreneurship, and those who do it are entrepreneurs”. In Mencius II, it is mentioned, “A gentleman lays the foundation of the inheritance, and hands down the beginning which he has made; does what may be continued by his successors”. For us, entrepreneurship does not only refer to the development and innovation of ways of thinking and behavior, but also the innovation in the education ideas and modes of entrepreneurial ethic, the key of which is the development and innovation on entrepreneurial ethic. Entrepreneurship is a process of creating material and spiritual wealth, also a process of entrepreneurship education and practice, and development and improvement of entrepreneurial ethic. Entrepreneurial ethic education in China should not just motivate the entrepreneur the desire for and the relentless pursuit of material wealth, but cultivate their character through education, so as to form a group of neo-Confucian businessmen. Therefore, Five Constant Virtues are ethic basis of entrepreneurship education. Entrepreneurship not only involves honest desire for material wealth, but also a sensible love, benevolence. Entrepreneurship is responsible not only for self behavior, but also a society, and can tell “must do it” from “mustn’t do it”, integrates entrepreneurship into a nation’s revival and prosperity, and world peace, which is righteousness. Entrepreneurship with benevolence and righteousness is great wisdom. Entrepreneurship should set up a system and develop a form, but also develop new ethic moral and climate, which is propriety. Entrepreneurship should be trusted, honest, just like the proverb going “Faith moves mountains”. Following Five Constant Virtues in practice will be great, be well influential in society, will produce positive energy, and bring about happiness to all creatures and societies. Therefore, a systemic study on the relationships between Five Constant Virtues and entrepreneurship is beneficial to understand the close relationship between ethic and entrepreneurship, to inherit traditional Chinese ethic culture, and develop value system, fortune view, and world view with Chinese characteristics.

II. THE BASIS OF ENTREPRENEURIAL ETHIC EDUCATION: BENEVOLENCE

II.1 The meaning of benevolence

Benevolence is the core idea of Confucian ethic, and the root of Confucianism, advanced first by Confucius as the theoretic basis of “propriety”. Confucius said: “A man with benevolence loves
others.” Mencius said: “A man with sympathy is benevolent.” Dong Zhongshu said: “The principle of benevolence is to love others, not just self”, and he also developed the idea: “A man with benevolence is to comfort others”. In Shuowen Jiezi, benevolence (仁) is to love, with the radical of human (人), and root of two (二). Benevolence is to love based on the good nature and sensibility. It is also a dialectic way of thinking of “dichotomy of one” and “unity of two”. The structure of the word indicates the relationships of two human, involving sovereign and subject, father and son, husband and wife, elder and younger brother/sister, and friends, as well as families, organizations, and nations. To properly deal with interpersonal relationships, a man should be faithful, that is, being frank and unreserved, he should be altruistic, that is, “Do not do to others what you do not wish yourself”; which requires a man to be considerate in practice.

II. Benevolence: the foundation of entrepreneurial ethic education in College

The saying “The benevolent is invincible” does not mean that the benevolent can defeat all the enemies, but that the benevolent has no enemy. With the economic and social background of new normal, public entrepreneurship and innovation is the new trend. Entrepreneurship demands a man to act with noble character, to find and develop the good of human nature. Mencius said: “Being benevolent will lead to prosperity, while not being benevolent decline.” In modern times, the ethic basis of entrepreneurship is benevolence. In the complicated entrepreneurship environment and management, benevolence is the kernel idea in dealing with complex relationships, and ethic rule in public entrepreneurship. Benevolence reflects the relationships of shareholders, and the symbiosis of heaven, earth, and humanity. Therefore, in public entrepreneurship, the symbiotic circle of loving self and others should be first constructed, which can lead the movement to positive development oriented with “humane values”. In entrepreneurship, growing the seed of benevolence will produce the cycle, and finally the fruit of benevolence.

In entrepreneurship activities among college students, in School of Business, SJZUE, guided by “the project of neo-Confucian businessman”, benevolence education is executed, and filial devotion for one’s relatives is advocated. The aim is to cultivate college students with filial piety so that they can love their parents, and respect the old and love the young. Thus, they can develop benevolence, and love their teachers, classmates, customers, and then love the incorporate, the nation. Cultivation of benevolence can improve the personality and character of college students so as to motivate their enthusiasm and perseverance in entrepreneurship.

III. THE RESPONSIBILITY OF ENTREPRENEURIAL ETHIC EDUCATION: RIGHTEOUSNESS

III.1 The meaning of righteousness

Righteousness is one of the moral norms of Confucianism. “Righteousness means appropriateness”, that is, the motive and behavior should conform to sense, rules and regulations. In Confucianism, righteousness refers to the behavior according with the essence of benevolence. It is the reflection of inner benevolence in practice. The righteousness involves literal meaning of “just, responsibility, or justice”. It is to pursue appropriateness, just, and justice, and take the responsibilities. Righteousness is also the moral bottom line. Confucius said: “A man of noble comprehends righteousness, a small man comprehends profit”. Mencius said: “The feeling of shame and dislike is the beginning of righteousness”. Dong Zhongshu said: “The principle of righteousness lies in rectifying self but not others”. Confucianism believed that “righteousness produce profit”, that “a man will consider righteousness in face of profit”, that “righteousness precedes profit”, and that “righteousness and profit are equally important”. Rectifying righteousness in Confucianism is to rectify one’s own righteousness. Rectifying is correcting, regulating and restraining, which requires insisting justice, rectifying one’s mind, that is, to have a positive motivation. Evil mind will be misleading. Dong Zhongshu said: “A human should have righteousness and desire material wealth (profit). Material wealth can nourish our body, while righteousness our mind. Mind is uneasy without righteousness, while body is uneasy without material wealth.”

III.2 Practising righteousness in entrepreneurship to execute social responsibilities

In modern operation and management, responsibility, power, and profit match with each other with responsibility as first. Principles and justice must be followed in making profit, which is both the presupposition and responsibility of entrepreneurship. Confucius said: “Being rich and having high position without righteousness is
nothing to me”. Confucius is often misunderstood for valuing righteousness other than profit, and even despising profit. In fact, what Confucius emphasized is that wealth, high position, success, and profit should be based on benevolence and righteousness. Entrepreneurship should not reject the pursuit of economic interests, however, pursuit of interests should be appropriate and legal, and seize the golden opportunities. In entrepreneurship, a man should follow the law of market, meet customer’s needs. He should also respect nature, and observe ethic norms. Strengthening entrepreneurship ethic education requires following the principle of just and justice. In addition, it also requires following the principle of benefiting all and harming none, rejecting such behavior as “forgetting righteousness when tempted by profit”, “seeking nothing but profit”, “profiting self at the expense of others”, and “killing others for money”. Entrepreneur should know his responsibility and duty, shoulder the social responsibility. Complementing social responsibility and duty can be helpful in setting up a just and justice image. Only if a man should act and think in one and same way in entrepreneurship, can he develop the good, set up the criteria of justice, and set an example in carrying social responsibility, so as to improve the positive development of entrepreneurship.

IV. THE NORM AND ORDER OF ENTREPRENEURIAL ETHIC EDUCATION: PROPRIETY

IV.1 The meaning of propriety

As the important ritual and norm of Confucianism, propriety involves all kinds of rituals, regulations and norms which play a role in regulating interpersonal relationships, and keeping social peace and harmony. Propriety is the external reflection of benevolence. Confucius said: “Is it helpful for a man to observe rituals without benevolence?” What Confucius said emphasizes the innate nature of propriety, that is, benevolence. Of the two virtues, propriety is the external reflection of benevolence. Therefore, Confucius put forward the inner state of mind and life pursuit, “denying self and returning to propriety”. Dong Zhongshu believed, “With both inner moral and external conditions, it can lead to propriety”. That is, external propriety should accord with the essence, benevolence, then one can be a man of noble, and can be successful in practice. Namely, propriety is the presupposition of acting and succeeding, which indicates having propriety first, and then being successful. Propriety also refers to ethics and order. Confucius said: “Without an acquaintance with the rules of propriety, it is impossible for the character to be established”. Propriety can bring about order, and propriety can make things in order, can make a man established based on the general ethics. A saying goes like this, “Without the compass and square, squares and circles could not form”. Propriety is not only norms for individual behavior, but also the order observed by a community. Propriety is the base of good order and system, and good order and system can play positive role in practice. Propriety also denotes respectfulness, endurance, faith and forgiveness, honesty, all of which reflect the inner good, benevolence.

IV.2 Entrepreneurship to benefit people on the base of propriety

Propriety, as the moral norm, is based on self-discipline, which requires following the laws, rules, and regulations, respecting benevolence, obeying order, and staying within one’s bounds. It doesn’t mean that a man should give in to bad business trend, disobey one’s good nature, or feign compliance, but that inner good should be motivated, and a new entrepreneurship trend should be formed. Enterprising in observing propriety and obeying order, and doing something new daily will be helpful to start a great cause beneficial to others and self. In entrepreneurship, propriety is the good order which reflects organizational rituals and system based on good value. It is the criteria and rituals that the entrepreneur must follow, and the principle and order where entrepreneurship is accepted, praised and encouraged. In public entrepreneurship, following propriety can help both entrepreneurship and social and economic eco-systems to realize symbiosis, co-existence, co-prosperity, and all win, and finally success.

V. STRATEGY OF ENTREPRENEURIAL ETHIC EDUCATION: WISDOM

V.1 The meaning of wisdom

Wisdom is important in Confucianism, involves intelligence, knowledge, and ability. In Shuowen Jiezi, it is defined: wisdom is the compound of “sun” ( 日), the radical, and “knowing”(知), the sound, which means knowledge, knowing, and willingness to learn. Mencius said: “The sense of right and wrong is the beginning of wisdom”. Wisdom is to understand. Without understanding benevolence, a man can’t really understand the way of being a man,
the logic of things, and the reason of things. Without understanding all those, how can a man be successful? Dong Zhongshu emphasized, “A man should be benevolent and wise”. That is, wisdom is based on benevolence, and coordination and unification of the two virtues can make a man really benevolent and wise. A man who is not benevolent or wise will do bad wantonly, which of course will do harm to society; a man who is wise but not benevolent can understand but will diverge from principle, or commit crime on purpose, or do nothing although he knows he should do. A man who is benevolent but not wise will do something bad with good intention because he doesn’t understand. Therefore, a man who is benevolent and wise can succeed in doing and being.

V.2 Entrepreneurship to success with benevolence and wisdom

With globalization and new normal, public entrepreneurship is sure to vitalize economy. However, entrepreneurship needs planning and strategy. Just like the saying goes, “Since ancient times, he who doesn’t contrive ten thousand years is not able to contrive a time; he who doesn’t make overall plan is not able to make a partial plan”. Entrepreneurship requires great ambition and strategy. In modern times, market competition focuses on strategy, whereas, the basis of strategic competition is on ethics. Strategy is the key issue in management, and the key of strategy is wisdom which is the basis to make tactics and strategy. Wisdom reflects man’s innate character, and benevolence is the base of wisdom. The true great wisdom rectifies self and influences others, that is, by rectifying self, and setting an example, a man can influence others, cultivate others. With benevolence, a man can consider others first, and he is benevolent and wise to activate others being active, and innovative. He will strive unremittingly, and his entrepreneurship will develop in a good way, and he will succeed.

VI. THE SOUL OF ENTREPRENEURIAL ETHIC EDUCATION: GOOD FAITH

VI.1 The meaning of good faith

Good faith is also important in Confucianism. Confucius said: “I do not know how a man without good faith is to get on”, and “Hold faithfulness and sincerity as first principles, and be moving continually to what is right—this is the way to exalt one’s virtue”. The philosopher Zeng said: “I daily examine myself on three points: whether, in transacting business for others, I may have been unfaithful; whether, in intercourse with friends, I may have been insincere; whether I may not have mastered and practiced the instructions of my teacher”. Zixia said: “His words should be sincere in getting on with his friends”. Youzi said: “When agreements are made according to what is right, what is spoken can be made good”. Mencius said: “Good faith is that one’s words accord with his intention”. In Shuowen Jiezi, good faith refers to honesty. The literal meaning of good faith is being true and sincere, that is, one’s words should be based on honesty. Mencius said: “Sincerity is the way of Heaven. To think how to be sincere is the way of man”. A philosopher, Zhou Dunyi said: “Honesty is the basis of Five Constant Virtues, the origin of all action”. Honesty is the cause, good faith is the effect. Dong Zhongshu believed, “Being a man should have good faith.” No good faith leads to no benevolence. Good faith is the presupposition of being a man and being benevolent. Good faith requires a man to speak honestly, and is responsible for his words. Keeping promise can be trusted and convincing.

VI.2 The basis of entrepreneurship symbiosis and sustainment: good faith

In modern times, good faith is the basic norm in being and doing. Globally, economy and society is based on good faith, without which economy and society can’t go smoothly. Good faith can decrease trading expense; otherwise, the cost of social trading will increase. Good faith is not only the foundation of being a man, but also the basis of entrepreneurship. Having good faith demands sincerity and honesty. Entrepreneurship will be rewarded and succeed when thinking more of others and potential customers, practising honesty and good faith, taking social responsibilities. Without good faith, it will bring about dishonesty, mutual deception, swindle, fooling people, which will increase potential crises and the cost in trading and defense for entrepreneur and shareholders, and finally shake the base of entrepreneurship. In globalization and informationization, entrepreneur and their activities should consider good faith the basis, and establish credibility so as to be trusted and promote entrepreneurship to develop smoothly.
VII. CONCLUSION

The studies on Five Constant Virtues and entrepreneurial ethic can lead to the conclusions as follows.

(1) Five Constant Virtues are the core ethic in China. In the new era of public entrepreneurship, constructing entrepreneurial ethic is very important. Studying the new connotation and meaning of Five Constant virtues is also the basis of public entrepreneurship.

(2) Five Constant Virtues are ethics that come from life and social practice, therefore, they should be combined with entrepreneurship. It requires the entrepreneur to learn and understand the intrinsic spirit of Five Constant Virtues, and develop, practice and carry out them.

(3) In the fierce competition, entrepreneur should practise and develop Five Constant Virtues, maintain ethic moral, draw on empathy, and consider others, properly deal with the relationships of entrepreneurship and shareholders, of entrepreneurship and market environment, maintain the entrepreneurship eco-system in good cycle, coordination, sustainability and symbiosis so as to realize symbiosis, co-prosperity and all-win of the public entrepreneurship.

A. References

9. Project: China Association of Higher Education "Eleventh Five-Year" educational research planning project “Research on NCB Cultivation Mode Based on Honesty and Integrity and Its Evaluation System” (No. 06AJI0240040) Directed by Zehua Miao.