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An International Approach to New Curriculum Development in Engineering Management

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ABSTRACT
Quality curriculum development requires a global approach. Communication advances, particularly in information technology, have escalated the sharing of ideas in curriculum approaches and content. At the same time, these advances have altered the nature of engineering management. This research focuses on the development and enhancement of a curriculum in engineering management at the Masters level. It addresses the different levels of international engagement in evolving a dynamic curriculum. Approaches such as dual degrees, joint degrees, co-badged degrees, and joint module development are examined. Both development and delivery of curriculum are explored. The constraints posed by funding and time as well as different national requirements are identified. Conclusions are drawn regarding the best approach, given time and monetary restrictions.

Keywords: curriculum development, engineering standards, postgraduate engineering education, engineering management, international collaboration.

BACKGROUND
Universities across the world are becoming more concerned with addressing an international agenda. This is a natural response to globalization that is impacting industry, consumption patterns, culture and communication. Every university wants to improve the education it provides and the research it conducts. The inclusion of an internationalization strategy is the most effective way to utilize this global connectivity to improve the university’s performance.

Postgraduate programs designed to produce Masters and Doctoral graduates are in the best position to address internationalization. This is the milieu where advanced courses are developed and taught and where students engage with academic staff to conduct research. Postgraduate studies are increasing in proportion at universities across South Africa. Globally, universities are being rated based on their research production. The Department of Higher Education and Training (DHET) in South Africa recognizes the importance of postgraduate education allocating funding to Masters and Doctoral students directly and through various additional sources including the National Research Foundation (NRF), Department of Trade and Industry (DTI), and the Sector Education and Training Authorities (SETAs). Postgraduate outputs provide universities with additional funds for each graduate and each recognized publication. The intent of these incentives is to provide much needed advanced skills. The added incentive for each university is the potential to improve their international ranking and rating. This in turn will make the university more attractive to top students, lecturers and researchers. The higher quality postgraduate students, lecturers and researchers will be more productive contributing toward further increased quality.

International connectivity plays an important role in this effort to improve quality education. Universities around the world are recognizing that diversity in students and staff adds to the cultural, technological and pedagogical depth and quality of the university. All major universities have organized or take part in international student exchange programs and encourage their students to spend time abroad to get an international experience. Many major universities make special efforts to attract foreign researchers as visitors and ongoing research collaborators. There is an opportunity to engage international professors in curriculum development and course
delivery at the postgraduate level that will lead to enriching the curriculum and pedagogy of South African universities. This opportunity has been enhanced by the availability of instructional technologies and increased bandwidth that make possible real time online delivery of complex material. This paper examines the potential of online delivery across continents, blended courses and the utilization of international lecturers to improve the diversity and quality of offerings in postgraduate engineering management. International lecturers and researchers can contribute in different ways. They can serve as visiting instructors and come to South Africa and teach for a full term or for a block course. They can provide online lectures as part of a course or for a complete module. Lastly they can provide course material and pedagogical practices that will be used by South African instructors.

THE WASHINGTON ACCORD

The Washington Accord provided a framework for mutual recognition of engineering graduates across a number of countries since 1989. South Africa is part of this accord, which includes 23 nations as members (including five G8 and eleven G20 nations). The three countries with the largest number of universities - China, India and the USA are all signatories. The Washington Accord provides a framework for Graduate Attributes for engineers. The 12 elements of the framework are:

1) Engineering knowledge;  2) Problem analysis;  3) Design/development of solutions;
4) Investigation;  5) Modern tool usage;  6) The engineer in society;
7) Environment and sustainability;  8) Ethics;  9) Individual and teamwork;
10) Communications;  11) Life-long learning  12) Project management and finance.

There are attributes associated with each of these elements that are highlighted in the accord (International Engineering Alliance, 2018). These elements and attributes provide the standard for all engineering programs across national boundaries that adhere to the Washington Accord. The Accord forms the basis for continuity in content and pedagogy for all member institutions’ undergraduate and postgraduate engineering programs.

SOUTH AFRICAN STANDARDS

The Department of Higher Education and Training (DHET) sets the standards for all of South Africa’s postgraduate degrees. DHET works closely with the Engineering Council of South Africa (ECSA) in determining the standards for engineering programs and graduates. Since South Africa is a signatory of the Washington Accord, South African engineering standards are in line with the 12 elements of that accord. ECSA has eleven exit criteria that cover the Washington Accord elements (Appendix A). Modules of each degree-granting program are regularly accessed to determine which of these exit criteria each module covers and to attain a balanced approach to address all exit criteria effectively across the program.

South Africa (SA) places priority on hiring the most qualified academics from a global pool of talent. DHET (2017: 24) is explicit ‘Higher Education Institutions must develop institutional policies or strategies on internationalisation of higher education.’ These plans are designed to attract foreign-born researchers, lecturers and professors with a particular mandate to engage in knowledge transfer and capacity building activities (DHET, 2017: 29). This knowledge transfer takes advantage of the international connections of these foreign-born academics. It is intentional to build on these connections to enhance the internationalization efforts at the universities. Capacity building focuses on training and developing more South African researchers and lecturers.

‘South African higher education institutions face increasing numbers of requests for joint offerings of academic programmes (DHET, 2017: 33)’. To facilitate the growth in these relationships (DHET, 2017) has defined four types of collaborations. Type-1 are co-badged degrees, where the degree-awarding higher education institution takes responsibility for the...
courses (MOOCs); 3) cultivating innovative talent; and 4) promoting generalized blended learning approaches needed in the current Fourth Industrial Revolution. They highlight four advances in teaching –embracing 1) Wearables-Assisted Teaching, Learning and Training; and 2) massive open online courses (MOOCs); 3) cultivating innovative talent; and 4) promoting generalized blended learning.

EUROPEAN STANDARDS

Currently, most of Europe remains outside the Washington Accord. They share standards and an accreditation process that is similar yet different from the Washington Accord. The European Network for Engineering Accreditation (ENAEE) authorized the European accredited engineer label to 1800 engineering programs in more than 300 universities in 28 countries between 2006 and 2015 (EUR-ACE, 2015). The framework specifies required outcomes at the Bachelor and Masters degree level along eight learning areas:

1) Knowledge and understanding;  4) Investigations;  7) Communication & Team-working
2) Engineering Analysis;  5) Engineering Practice;  8) Lifelong Learning.
3) Engineering Design;  6) Making Judgments;

These learning areas are largely in line with the 12 elements of the Washington Accord framework. Elements in the Washington Accord that are not explicit learning areas in the European standard, such as ethics, modern tool usage and the engineer in society, can be seen as cross-cutting elements that are covered in the various learning areas. ENAEE places a strong emphasis on ‘making judgments’ by elevating this to a separate learning area. In the Washington Accord, making judgments can be viewed as a cross-cutting dimension and is covered in the various elements of the Accord framework.

CURRICULUM DEVELOPMENT

Curriculum development must address the fast paced changes in technology, as well as the need for social relevance in curriculum content. For science and engineering curriculum, various efforts aimed at including appropriate technology across curricula has been documented (Trimble, 2013a, Trimble 2013b). Trimble & Keeling (2014) examine the issue of a socially relevant curricula development in the field of computing. Similar processes can be used in other science and engineering disciplines. The socially relevant approach gives priority to technology that empowers people and communities. The key focus is addressing the basic needs of communities – food security, water, energy, shelter, health, transportation, communication and education. This can be done with an appropriate technology approach. Appropriate technology also addresses cultural cognition, economic sustainability and ecological balance.

This current study recognizes the importance of critical thinking and system thinking as foundational approaches needed in the current Fourth Industrial Revolution. Xing & Marwala (2018) recognizes that university curriculum needs to address teaching, service and research utilizing the advances of the Fourth Industrial Revolution. They highlight four advances in teaching –embracing 1) Wearables-Assisted Teaching, Learning and Training; and 2) massive open online courses (MOOCs); 3) cultivating innovative talent; and 4) promoting generalized blended learning.
Wearables that allow augmented reality will inevitably become part of the long-range educational transformation. MOOCs will continue to see their primary utilization from users independent of degree granting experiences. Top universities globally have used MOOCs to extend their market and establish their brand. The Washington Accord, European and South African standards share a concern for developing innovation skills as expressed in key elements such as investigation, design and analysis. The combination of using modern computer-based tools and internationalizing the curriculum offers the opportunity to promote blended learning taking advantage of African-European partnerships.

A number of global trends have been identified that should impact the development of a program on Engineering Management. Large corporations and other mega-institutions are increasing their scale, scope and profits (Chang, 2016). Chang (2016: 456) goes on to indicate ‘several trends that affect the global business markets: (1) innovation (in products, services, and business models), (2) free flow of information, (3) expanded access to talent, (4) availability of cheap labor, (5) increase in low-cost competitors, and (6) reduction of trade barriers.’ Universities must use these facts as a basis for determining the local and national impact of globalization. The determined impacts should drive the continuous assessment and revision of the Engineering Management curriculum. There are trends not related to globalization that impact an economy. These trends are also considered in developing and refining the Engineering Management program. Chang (2016) identifies ‘underlying threads among these trends as effectiveness (customer and environment), efficiency (internal structure and cooperation activities), and integration (one-stop consolidation’.

Information, computer and communication technologies are playing an increasingly significant role in engineering management. Computer Aided Project Management, Management Information Systems, Decision Support Systems, E-commerce, E-Governance and E-Enterprises are key contributors to this development (Gupta, 2018). Combined, these trends provide valuable insight on how to revise existing modules, develop new modules and identify student research projects that will lead to dissertations and publications.

**COURSE DELIVERY**

The current course delivery of the structured Masters of Engineering Management at Tshwane University of Technology (TUT) is primarily lectures, discussion and teamwork sessions with all students in a single classroom. Some online assignments are organized through myTUTor, the TUT version of the Blackboard course management software. The current plan is to make more of the course content available online with video recorded lectures and videos of various supporting materials. Increasing the online teamwork of students between class sessions is also part of the current plan. This plan will take us to a blended course approach in all the modules of the Structured Engineering program. TUT is using Camtasia to create video lectures, tutorials and presentations to supplement the classroom activities. Camtasia features include screen recording, drag and drop functions and video editing. This allows robust video production. As the university develops its collective expertise in using Camtasia and similar software, the blended offerings will improve in quality and expand in quantity. The Masters of Engineering Management program is starting the blended offerings with the core courses – Research Methodology and Engineering Data Analysis. The process will proceed to other required course modules and then electives. This approach to developing blended programs using software requires financial resources and training. Currently few instructors are familiar with the advanced features of myTutor and an even smaller number have used Camtasia. TUT has dedicated staff to assist instructors and students in using MyTutor and all students and teaching staff have accounts on MyTutor. Plans are underway to provide access to and training for Camtasia. There are a number of free online tutorials to assist with self training, such as (Techsmith, 2018). The Faculty of Engineering and the Built Environment has made a commitment to training staff in advanced computer-based course delivery tools as part of a long range plan to provide more modules and programs in a blended format. This is important since most of our students in structured Masters programs are working students.
SELECTION OF APPROACH

The approach addresses both course delivery issues and curricula content development, and will be determined by the time and financial constraints and the program goals. Table 1 examines alternatives for different timelines for well-funded projects, while Table 2 corresponds to projects with limited funds. Appendix A provides a listing of the modules in the current offering of Engineering Management at TUT. The three rightmost columns indicate potential electives that could be added to the program. These three have been discussed within the Industrial Engineering Department, which hosts the Engineering Management program. The addition of these modules would reflect a potential new program with limited funding as indicated in Table 2.

### Table 1: Well Funded Curriculum Development Options

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<th>Time Constraint</th>
<th>Program goal</th>
<th>Recommended approach</th>
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<tr>
<td>&lt; 1 year</td>
<td>New modules</td>
<td>Involve European partners with SA partners in developing new modules. These could be added to Engineering Management program as electives. All partners make extensive use of Camtasia</td>
</tr>
<tr>
<td>1-2 years</td>
<td>Limited New program</td>
<td>Involve European and SA partners in developing new Engineering management program by enhancing our existing program. At least 50% are new modules or revised modules. Extensive use of Camtasia. Both partners will contribute to developing new modules. Program will be accredited by Europe and South Africa</td>
</tr>
<tr>
<td>3-5 years</td>
<td>Full New Program</td>
<td>Involve European and SA partners in developing new Engineering Management program by enhancing existing program. At least 50% are new modules. Extensive use of Camtasia. Both partners will contribute to developing new modules. Program will be accredited by Europe and South Africa. Program will be co-badged or dual-degree between European partners and SA University.</td>
</tr>
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The current Engineering Management program fulfills the EUR-ACE learning requirements and the ESCA Qualification Exit level requirements. The ESCA requirement is the SA standard in line with the Washington Accord. Appendix A indicates the standards provided by each of the modules in the program, including the proposed new electives.

### Table 2: Limited Funds Curriculum Development Options

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<th>Program goal</th>
<th>Recommended approach</th>
</tr>
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<tbody>
<tr>
<td>&lt; 1 year</td>
<td>Revised modules</td>
<td>Involve European partners with SA partners in updating existing modules in Engineering management. Main collaboration will be through online meetings using Skype or similar tools and focus on core modules</td>
</tr>
<tr>
<td>1-2 years</td>
<td>Limited New program</td>
<td>Involve European and SA partners in developing new Engineering Management track by enhancing existing program to use at least 50% of existing modules. Both partners will contribute to developing new modules</td>
</tr>
<tr>
<td>3-5 years</td>
<td>Full New program</td>
<td>Involve European and SA partners in developing new Engineering Management track by enhancing existing program to use at least 50% of new modules. Both partners will contribute to developing new modules. Program will be accredited by Europe and South Africa</td>
</tr>
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Georgia Institute of Technology (Georgia Tech) was selected as a benchmark for related structured masters in engineering programs because it is ranked as the top postgraduate program in industrial/manufacturing and systems engineering in the USA (US News, 2018). The Industrial and Systems Engineering (ISyE) Department offers eight different structured Masters in engineering. GaTech (2018) indicates its Masters in Industrial Engineering program consists of 30 credit hours (ten modules) with core courses in manufacturing, warehousing, and supply chain systems, as well as methodology courses such as simulation, optimization, and probabilistic models. Students can choose 3 elective modules from areas such as operations research, statistics, management and mechanical engineering. IsyE’s Supply Chain Management Masters requires eight classroom modules and a fulltime three month internship that serves as two capstone modules. The six additional structured Masters offered are in: Analytics, Health Systems, Quantitative and Computational Finance, Operations Research, Statistics, and Computational Science & Engineering. All of these six are multi-disciplinary options. Students may take modules in Business, Health, Computing or Mathematics depending on the option. This range of options at the Masters level is a strength of the Georgia Institute of Technology program and plays a significant role in their top ranking. Over the years they have increased the range of options and the number of elective modules available to students.

Module development of both core and elective modules can be organized as a collaboration between SA and European partners. This will involve an exchange of course materials used by European and SA instructors. Discussions on lecture material; student group and individual exercises and assignments; testing regimens; tutorials and audio and video supplements will lead to the development of enhanced modules. This collaboration must identify new materials relevant to the module and new developments in instructional technology that can be used.

CONCLUSIONS

Learning from best practices of the leading example in Industrial Engineering, it is necessary to expand the number of postgraduate modules, and to conduct collaborative continuing assessment on already existing modules. The selection of new electives must reflect the SA demands as well as global dynamics. TUT wants to position itself to meet student, industry and government demands in expanding its Engineering Management curricula.

TUT currently has limited funding for curricula development for different options in Engineering Management. It is necessary to take advantage of international partners in further developing this structured masters program. The low cost option of using Skype meetings to discuss and direct the program development and Camtasia to develop robust online material is the best option. This is best accomplished with an active collaboration with international partners.

All the existing modules have been organized to address both the EUR-ACE and SA learning standards and exit criteria for Masters students (see Appendix A). As existing modules are revised and new electives are developed, they must be aligned with the eight learning areas of EUR-ACE and the twelve framework elements of the Washington Accord. This positions TUT to apply for accreditation with both the Council of Higher Education (CHE) and our European partners through ASIIN (ASIIN, 2018). Unlike the Georgia Tech programs, TUT requires 50% of the credits to come from a major research project, referred to as a mini-dissertation. This is a significant research undertaking that usually takes one-year fulltime to complete.

The highest level of international collaboration in the Engineering Management program engages academic staff partners working together with students on their mini-dissertation. This generally requires SA and European staff to have an agenda for research collaboration. This joint research agenda can be the source of research projects that lead to mini-dissertations for the students. While students will graduate and move on, the SA European research collaboration can continue on a long-range basis. Building on this ongoing research, TUT can explore the options of Dual degrees and Co-Branded degrees as defined in (DHET, 2017). This long-range opportunity
has the potential of generating more funding through international collaborations focusing on research and allowing for student and staff exchanges.
ACKNOWLEDGEMENT

We would like to acknowledge the PEESA III organization at TUT, our sister Universities of Technology in South Africa and our European University partners for support throughout the project.

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An International Approach to new Curriculum development in Engineering Management
John TRIMBLE, KMPOFU, JMUNDA
Appendix A Current and potential modules for Engineering Management Course at TUT

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* potential electives
Developing a Curriculum Guide for Masters’ Program in Industrial Engineering through a Learning Factory Approach

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ABSTRACT
A curriculum guide may be referred to as a leading document that outlines the material teaching staff need to cover. Many higher education institutions struggle to acquire an on-time record of graduating postgraduate students based on challenges relating to work pressure, family responsibility, lack of motivation, and lack of resources to support postgraduate studies amongst others. Factors influencing the development of an efficient curriculum guide are explored and a peer support model is proposed to support students on completing their studies on time or even faster than expected while maintaining the quality of expected outcomes. Analysis of the factors discovered through literature leads to the development of a curriculum guide for postgraduate students in an industrial engineering masters’ degree. Successful implementation of the curriculum guide will lead to more masters’ students graduating on time.

Keywords: student diversity, peer support model, curriculum guide

INTRODUCTION
A curriculum guide is a management tool that outlines the material educators need to cover. It is mainly used in the education domain, higher education institutions (HEI’s), schools of different levels as well as training centres. However, even though some studies on learning factories cover the aspects of curriculum guides, the topic is usually discussed in undergraduate studies. Accordingly, a carefully executed curriculum can lead to faster completion rate in the postgraduate studies.

A number of reasons can influence progressing into a master’s degree. In many cases, this encompasses individuals who have some level of work experience in their area of specialisation. This is mostly achieved when one attains a bachelor’s degree, does their graduate traineeship and thereafter works as a qualified professional. As time goes on the need to rise up the hierarchy of the organisation puts pressure for higher qualifications for individuals. Therefore, candidates opt for a postgraduate level study at a Masters or Doctoral level. Accordingly, a masters’ degree is a qualification that creates an impeccable space for participants to gain independence, skills and confidence as learners and creators of knowledge (Khalifa et al., 2018). This platform allows growth and proficiency in research development, professional and workplace expertise. The population group occupying this space is diverse and encompass new graduates, full time and part time workers, and those with extensive work experience. However, challenges pertaining to dragging of the qualification and low completion rates form the reality of many higher institutions of learning (Massyn, 2018).

Some of these challenges are a result of work pressure; deadlines and targets from industry for part time students, domestic related challenges as many participants at this level have families (Havenga and Sengane., 2018, Massyn. 2018, Stagg and Kimmins, 2014), and lack of motivation. Other challenges include; experiencing academic cultural shock, lack of preparedness to the postgraduate...
Developing a Curriculum Guide for Masters’ Program in Industrial Engineering through a Learning Factory Approach. Matilda Nkateko MAHESO, Khumbulani MPOFU

Studying, lack of resources to support postgraduate studies and lack of employer support (Macleod et al., 2018). Another reality is that participants come from different fields of expertise and the course content may not completely accommodate their needs.

This paper seeks to explore methods that will ensure record time completion of postgraduates’ candidates at a masters’ level through the learning factory paradigm. A curriculum guide is presented for the industrial engineering discipline as a stepping-stone to achieving this goal. The first part of the paper explores student diversity and the different reasons leading to pursuing a higher qualification. The second section takes a glimpse into managerial competencies as they play a big role when formulating the curriculum guide. The third section looks into other factors that should be considered when designing the curriculum and supporting functions to help accelerate the progression and graduation success rate. Finally, curriculum guide is presented for the industrial engineering discipline.

**STUDENT DIVERSITY**

Batterbury and Toscano. 2018, describe three types of students that can be found at a masters level. The first set of students possess extensive work experience and seek to change career paths, the second set of students are in their early development phases in the corporate world and pursue a postgraduate degree as form of validation to their status/expertise, while the third group progress through the masters’ degree directly from an undergraduate level (Nghia, 2018). The diversity is not only the case of experiential progression, but these students come from different backgrounds which include professional experience, socio-cultural backgrounds and the degree of funding. There is also diversity in the career paths aspirations of these individuals.

The factor of diversity also allows the researcher to explore the different motives for students to progress into the postgraduate level. A study conducted by Khalifa et al (2018), explores these motives extensively and through literature review, four motives arise but through a study they conducted, two more motives become known based on different reasons. On the contrary, a study conducted by Nghia 2018, Identifies 14 motives of which some support Khalifa’s teams study. The most reoccurring motives include professional motives, self-motives, academic motives and social motives. The first four motives are amongst the most common motives identified in literature regarding student motivation for postgraduate studies

**Professional Motives**

In this category, two types of individuals may occupy in this space, namely; those with extensive work experience and those with very little work experience (graduate traineeship only). For individuals who are already in industry their aspirations may be motivated by the need to earn higher salaries, enhancing their careers to obtain senior positions (Havenga and Sengane, 2018), and possessing skills that can only be earned through such a qualification (Sandri et al, 2018). For those individuals who have just graduated from a bachelor’s degree, their aspirations may be in line to increase their job prospects by creating a marketable stance that allows higher chances of employability (Meginnis & Campbell, 2017). The need to pursue postgraduate studies to attract job opportunities has been considered one of the biggest motivation drivers for undertaking such studies (Kinsella and Zecchin, 2018).

**Self-Motives**
Self-motivation is driven by an individual’s aspiration to accomplish desired goals and objectives. In most cases, the background of these individuals display childhood dreams and ambitions to acquire expected positions as a long-term goal accomplishment and feeling of satisfaction. At this level, many individuals may aspire to obtain PHD higher degree.

**Academic Motives**

Academic motivation reflects in those students who wish to acquire further knowledge in their field and improve their mental abilities as a whole. These students seek new ways of thinking and widening their understanding in order to cope effectively with their life situations. Course relevancy, course interest, affect/emotional, re-enforcement and self-efficacy are amongst the different types of student motivation learning (Muduli, et al., 2018) in a study conducted to provide insight into the learners mindset and learning expectations, factors in influencing their learning experience as well as the context and environment in which they provide the learning.

**Social Motives**

Social motives entail the influence of external factors such as family, friends, role models and other societal members towards higher academic degrees. The section on student diversity shows the different backgrounds that students come from and their differing motives for pursuing a postgraduate degree. At a masters level, the postgraduate degree can be split into either course-work based accompanied by a mini dissertation or research-based degree that is strictly research. Course-work based research is usually tailored for part-time students, these are those candidates who work full time in industry, and however the option of taking a research-based degree is open to these candidates.

Furthermore, individuals at this point may wish to advance to senior positions in an organization or become eligible to obtain employment with the hopes of quickly moving high up the hierarchy in future. The industrial engineering discipline is flexible and can allow candidates to occupy different managerial positions in an organization. The following section explores literature on managerial competencies as one of the requirements that should come out in the curriculum guide.

**MANAGERIAL COMPETENCIES**

Different managerial roles and their ranks (lower level, middle management and higher-level management), exist in an organization. For one to be considered for a managerial position they should possess a particular set of skills that differentiates them from the average worker. For this part of the paper, we explore the different managerial competencies that individuals should possess at this level.

El-Baz & El-Sayegh (2007), identify four core competencies a manager should have in their study and the importance of soft skills. The soft skills identified as supported by (Govender & Parumasur, 2010) include Communication, effective leadership, employee motivation, teamwork and general management. While the core competencies identified include technical competencies, managerial competencies, financial competencies and leadership competencies. Figure 1 gives a detailed description of what each competency entails according to the authors. The competencies identified by the authors are interlinked as one function supports the other. Engineering managers need technical skills to communicate technical issues with customers inside and outside the organisation. Technical competencies are supported by functions in managerial competency to assist the manager in directing organisational resources. This however, cannot be accomplished effectively without the
support of financial competencies that allow the manager to understand how to generate capital and how money is used within each division of the company. Leadership competencies come in handy with synergising an effective workforce.

Barber & Tietje (2004), describe 14 factors that define a competent manager split into three different categories namely; knowledge factors, skills factors and value actors. The knowledge factors include; functional systems, competitive strategies, requisite management, project management, materials management, while the skills factors include; technical analysis, transformational leadership, diagnostic efficiency, workforce development, organisational strategies and value factors include; credibility management, assertive leadership, collaborative management as well as responsiveness management. Most of the competencies identified by the authors are universal for different managerial positions while other competencies relate to specific job functions. Emotional competencies, which are sometimes overlooked also play an important role. Liikamaa, (2015), identifies emotional intelligence as one of the three clusters of competencies including self-awareness and emotional self-control.

The competencies explored in this section are important functions to be employed in the curriculum. The use of these competencies should also follow suit in Work Integrated learning (WIL). WIL outcomes should incorporate these competencies in work-directed theoretical learning, problem-based learning, project-based learning as well as workplace learning.

![Figure 1: Engineering management core competencies. Source: El-Baz & El-Sayegh (2007)](image)

**OTHER FACTORS INFLUENCING AN EFFECTIVE CURRICULUM**
During the design of the curriculum guide, designers should be able to ask and answer several questions that will influence an effective curriculum. Some of these questions include:

- Which career path can the student follow going through the Masters’ program? is the curriculum designed to fit academia or to supply industry?
- What is the role of industry in collaboration schemes if the university has any?
  - What are the needs of industry in this focus area?
  - What are the characteristics required in line with industry challenges to determine the career.

**Master’s Program**

The masters’ program within the department of industrial engineering feeds both academia and industry. The program is divided into two sections, structured research and full research. The structured research program consists of nine modules supported by a mini-dissertation and publication of a paper in order to graduate. The full research candidates provide a full dissertation supported by the publication of one conference paper and submission of a journal. Both candidates may choose to pursue an academic career or industry. However, the type of program an individual may choose to pursue supports favors for each route.

**Industry/Academia collaboration**

Collaboration with industry partners can be valuable to both academia and industry. The product supplied by academia, which is the student, will meet market demand required by industry, as set goals from both entities will be aligned. The benefits of collaboration include solving industry problems with cutting edge research and innovation. However, collaboration between industry and academia is not always executed properly. Some of the challenges faced include:

- Conflict between organisation and researcher pertaining to the timing and disclosure of research results
- Firms prefer to keep secret or appropriate the information (done to control resources that are not available to competitors)
- Different research topic each party is likely to pursue, the type of outputs each partner is interested in may also diverge

In pursuing collaboration with industry partners, university stakeholders should understand the pros and cons in such situations. This will allow both parties to plan accurately and ensure students follow suit in agreements made beforehand to avoid conflicts.

Furthermore, the voice of industry plays a critical role in the development of individuals working for both academia and industry. Understanding their needs and the type of skills required to feed their stream is important to both industry workers and academics. Industrial requirements should be clearly defined and discussed with academia not only to produce work ready graduates, but to produce cutting-edge researchers that benefit the society, economy and general wellbeing of the globe.

Prior to the beginning of the study, it was emphasized that students struggle to graduate on time due to several reasons. A peer support model is presented to help students progress quickly in their
studies and obtain some of the competencies that cannot be acquired through classroom contact alone.

**Peer Support Model**

The peer support model encourages competency development through peer review and peer support. This model is centred on industry partnership and the development of individuals from different levels within their study programmes. It is a striking reality that undergraduate students struggle to adapt and cope with transition from graduate entry into the organisation. Industry practitioners have little time to train and manage these individuals. The peer support model allows post-graduate students at a masters’ level to provide mentorship and support to undergraduate students. This can be done through topic-specific projects that allow researchers full access to industry. Masters candidates can be provided with a team to manage in their project. This will allow masters students to develop professional, social, personal and methodological competencies. At a postgraduate level support can be accomplished in two ways. Either by a masters to masters’ candidate, or by doctoral to masters’ support. Here full time masters’ students who are new graduates from undergraduate level can be paired with masters’ students who have extensive work experience and working on aligning topics. Doctoral to masters’ candidate can be done to provide peer review with an expert in the field. At a doctoral level, support can be achieved with postdoctoral fellow and industry partners. Figure 2 shows the peer support model.

Another challenge solved indirectly through the peer support model is the supervision crisis the students face during their time of study. Working as well as full time students may have very little time to spend with supervisor but peer review can provide useful insight into the study. In other cases, supervisor may not have the in-depth relevant expertise in the field of study, but pairing up with peers who have experience in the field will greatly assist in one’s studies.

A curriculum guide is presented in figure 3, incorporating the aforementioned competencies and delegating factors as explored throughout the paper. The curriculum guide outlines the competencies required, modules that support the development of these competencies as well as the learning factory training guide that will be applied in the learning factory.

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**Figure 2: PEER SUPPORT MODEL**

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CONCLUSIONS

Proper execution of the curriculum guide and use of peer support model strategy will result in an improved percent of on-time completion for graduates, which would be a better compared to the current status. The peer support model presented in figure 2 of the paper demonstrates continuous improvement and displays team playing capabilities at all levels. Further work entails linking engineering postgraduate studies at a masters level from those candidates coming from different backgrounds. This strategy allows students to have flexibility among subjects in other engineering domains that are not offered within the current curriculum. This would be optional based, to avoid students moving from one course to the next for a subject they could easily acquire from their current program.

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Developing a Curriculum Guide for Masters’ Program in Industrial Engineering through a Learning Factory Approach. Matilda Nkateko MAHESO, Khumbulani MPOFU
The Design of a Masters Curriculum in Smart Grid Technology within the Erasmus + K2 DAMOC project.

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ABSTRACT

The power industry is under pressure to change the way it has been operating for most of the past century. Responding to these pressures presents a range of challenges for the industry, which is also beset by aging infrastructure, overburdened grid capacity and outdated technology. While the Smart Grid is often put forward as the means of addressing these challenges, the introduction of a smart grid in a modernized power industry will however require the support of a multidisciplinary workforce with a much broader skill set than is currently the case. As a consequence, universities find themselves under increasing pressure to update their power systems curriculum to better prepare students for a modernized power industry. The incorporation of smart grid technology into the power systems curriculum presents a set of unique challenges. This paper discusses the efforts of Cape Peninsula University of Technology to address these challenges by designing a Masters programme in smart grid technology within the Erasmus + K2 DAMOC project.

Keywords: Smart Grid Technology, Energy Efficiency, Curriculum Development, Academic Capacity Building

INTRODUCTION

The power industry is under pressure to change the way it has been operating for most of the past century. The main drivers of change have been the rapid increase in demand for energy that is more reliable and secure, a greater focus on energy efficiency, a rise in distributed energy generation and a global demand for cleaner energy through a major shift towards renewables. This has been accompanied by a much greater emphasis on active engagement of the consumer in various processes related to energy supply and demand.

Responding to these pressures presents a range of challenges for the power industry, which in many instances is also beset by aging infrastructure, overburdened grid capacity and outdated technology.

The Smart Grid is often put forward as the means of addressing these challenges.

The smart grid may be broadly defined as “any combination of enabling technologies, hardware and software, or practices that collectively make the delivery infrastructure or grid more reliable, more...
The design of a Masters curriculum in Smart Grid Technology within the Erasmus + K2 DAMOC project.

Prof Anthony Staak; Prof Raynitchka Tzoneva.

versatile, more secure, more accommodating, more resilient and ultimately more useful to consumers” (Sioshansi, 2012:xxix).

The introduction of a smart grid in a modernized power industry will however require the support of a multidisciplinary workforce with a much broader skill set than is currently the case. The smart grid will rely heavily on communication and data acquisition technologies for its effective operation. It will involve increased automation and real-time control at all levels and will necessarily incorporate advanced power electronics and digital technologies to ensure system safety, reliability and efficiency. The modern power systems engineer will be required to integrate knowledge from all these different fields.

THE CURRICULUM CHALLENGES FOR UNIVERSITIES

As a consequence, universities find themselves under increasing pressure to update their power systems curriculum to better prepare students for a modernized power industry that is steadily incorporating more smart grid technology. Typically, the traditional power systems curriculum would cover the fundamentals of power generation, transmission and distribution, which would include power systems modeling, protection and control. With the advent of the smart grid such a curriculum would now have to include information systems, network communications, power systems automation and protection within the context of the smart grid. The large-scale integration of renewable energy resources and the challenges this presents, along with the application of power electronics and energy storage technologies to address these challenges will necessarily have to be covered as well.

The Overcrowded Curriculum

While it will be necessary to revise the undergraduate curriculum and make it more relevant by including topics related to smart grid technology, the danger of an overcrowded curriculum needs to be acknowledged. Care must be taken not to broaden the curriculum at the expense of depth, thereby compromising on the fundamental knowledge required by power systems engineers. This is of particular concern at a time when demands are being made for the inclusion of a number of other topics in the undergraduate curriculum.

For instance, universities are already under pressure to produce a more rounded engineer with multiple skills to meet the demands of the 21st century. To achieve this engineering departments are required to include a larger component of humanities and social sciences in the curriculum. The minimum credit requirements for this component is usually stipulated by the relevant professional body or accreditation council. For instance, it is noted that in the United States, the body responsible for accrediting engineering programmes (The Accreditation Board for Engineering and Technology) sets a minimum allocation of 12,5% of the engineering curriculum for topics in humanities and social sciences, exclusive of modules in management and communication (Rojter, 2014: 397). In South Africa, the Engineering Council of South Africa (2004: 2) has set the minimum number of credits for complementary studies in the new undergraduate engineering curriculum at 56 credits (the same number of credits as Mathematical Sciences and Natural Sciences), where complementary studies are defined as “those disciplines outside of engineering sciences, natural sciences and mathematics which are relevant to the practice of engineering including but not limited to engineering economics, management, the impact of technology on society, effective communication, and the humanities, social sciences or other areas that support an understanding of the world in which engineering is practised.” (Engineering Council of South Africa, 2004: 11)
Given all these demands on the four-year undergraduate engineering curriculum, there may be little room in the undergraduate electrical engineering programme to cover the fundamentals of the power systems field and also to include additional modules to adequately prepare the student for the modernized power industry incorporating smart grid technology.

The Cognitive Demand

In an article on smart grids, industry trends and power engineering education Shireen et al (2013) identifies some of the areas of expertise required by the power industry in the 21st century based on feedback from industry and proposes the development of a masters programme on smart grids to follow on the bachelors programme in electrical engineering. Such a masters programme should include specialist courses on advanced topics related to the smart grid as well as a research project that can focus on specific challenges experienced by the modern power systems industry.

This is a view supported by Heyd et al (2009:2), who analyze the demands of a smart grid curriculum in terms of Blooms Taxonomy, and notes that the depth of understanding correlates well with the two highest levels of Blooms Taxonomy, namely synthesis and evaluation, as it involves the integration of various technologies and methods to realize whichever outcomes are aligned with smart grid objectives. The synthesis level approximates to the outcomes of a masters level programme.

Heyde et al (2009:3) illustrate the wide range of topics applicable to smart grid design and operations and argue that the integration of the associated technologies and methods exceeds that of bachelor level education. Besides the areas directly related to power systems, such topics would include automatic controls, systems theory, information and communication technology, energy storage, signal processing, energy markets, and public policy. It is thus recommended that an appropriate course developed for smart grid engineers should be pitched at least at the masters level.

Accommodating Auxiliary Fields

While on the one hand it will be necessary for power systems engineers to integrate knowledge from auxiliary fields in order to support the effective operation of the smart grid, the industry also requires specialists in auxiliary fields such as Information Technology and Communications Networks to apply their expertise in the area of smart grids. Smart grid systems are expected to produce huge amounts of data through monitoring energy usage throughout the day in millions of households. Information Systems specialists will be required to deal with the challenge of processing all this data and presenting the information in a meaningful way to enable consumers to participate in energy delivery and to assist systems operators in optimizing the power system. Smart grid systems will involve numerous intelligent devices, which need to communicate with each other over a digital network. Many of these devices will come from different vendors and the interoperability of these devices presents a particular challenge. Information Systems specialists will be required to address these challenges. With the huge amount of data being generated by smart systems, there will always be the tension between data access and data privacy. Cyber security thus also becomes a challenge relevant to the smart grid, which Information Systems specialists will be required to address (Dedrick & Zheng, 2013: 898). Students with an undergraduate degree in the Information Systems and Network Communications field are unlikely to have a power engineering background. The challenge would be to design a course that provides these students with the necessary background knowledge to enable them to support the smart grid in their area of specialization. The industry will also require specialists in the control field, as the smart grid will be highly automated and rely heavily on real time control. The same challenges may apply to designing
a course for students with an undergraduate degree in the field of automatic control, who may not all have the pre-requisite background in power systems.

THE ERASMUS + K2 DAMOC PROJECT.
The Cape Peninsula University of Technology (CPUT) is a member of a consortium of Southern African and European universities involved in a European Union funded project on the Erasmus + K2 programme entitled “The development of a harmonized modular curricula for the smart grid” (DAMOC). One of the deliverables of the project is the development of a master’s programme on smart grids at CPUT to meet the critical shortage of high-level skills in the power industry in Southern Africa, particularly in the area of smart grids. South Africa’s power industry is currently suffering from aging infrastructure, small reserve margins and has by far the largest carbon footprint on the continent. The recently published draft National Energy Plan of the Department of Energy forecasts the large-scale penetration of renewable energy sources, mainly wind and solar PV (South Africa, Department of Energy, 2016: 142), which includes the installation of rooftop solar panels (South Africa, Department of Energy, 2016: 165) making the increased uptake of distributed energy generation possible. The successful transformation of the power industry in South Africa will of necessity involve the steady transition towards the smart grid.

In preparation for this, the masters programme envisioned by this Erasmus + K2 consortium is aimed at providing power engineering students with a better understanding of the auxiliary fields applicable to the smart grid environment such as communication networks, information technology and automatic control as well as advanced topics that will build on their power engineering background, such as power systems modeling in the context of the smart grid. The programme should enable students to integrate knowledge from these auxiliary fields to effectively support the smart grid operations.

Importantly, consultations are being held with industrial partners as well as various stakeholders in the energy sector to ensure that the curriculum remains relevant and develops students with the necessary expertise to respond to the broader needs of the sector.

Structure of the Master Programme
The masters degree is foregrounded on the following:

- The utilization of the IEC61850 standard as a communication backbone of the Smart grid communication network
- A multi-disciplinary approach – integration of knowledge of the fields of power systems, control, protection and communication in all subjects of the course
- The integration of the Distributed Energy Resources (DERs) in all theoretical considerations, practical exercises, and research projects
- An optimization approach for solution of all problems in the conditions of smart grid
- A systems approach - considering the smart grid as a whole system, built by separate elements interconnected through electrical and communication networks.

This interdisciplinary programme on smart grids, geared primarily at students from a power systems, information systems and automatic control background comprises the following components, as shown in Table 1:
Table 1: Structure of the Masters programme

<table>
<thead>
<tr>
<th>Name of the programme</th>
<th>Master of Engineering in Electrical Engineering in Smart Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of the subject</strong></td>
<td><strong>Third order CESM</strong></td>
</tr>
<tr>
<td><strong>Year 1, Semester 1</strong></td>
<td></td>
</tr>
<tr>
<td>IEC61850 standard and cyber security in grids</td>
<td>Engineering, Other</td>
</tr>
<tr>
<td>Smart Grid and distributed energy resources</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td>Research Methodology</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td><strong>Year 1, Semester 2</strong></td>
<td></td>
</tr>
<tr>
<td>Smart Grid protection automation and control</td>
<td>Engineering, Other</td>
</tr>
<tr>
<td>Power electronics and control in Smart Grids</td>
<td>Engineering, Other</td>
</tr>
<tr>
<td>Elective</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td><strong>One elective from the following list:</strong></td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td>Electricity market in deregulated power grids</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td>Embedded Systems for Signal Processing</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td>Control design and optimisation in Smart Grid</td>
<td>Electrical, Electronics, and Communications Engineering</td>
</tr>
<tr>
<td><strong>Credits for subjects</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
</tr>
<tr>
<td>Research Project</td>
<td>Engineering, Other</td>
</tr>
<tr>
<td><strong>Total credits</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Practical Component of the Master Programme**

Another important aspect of this Erasmus + K2 project is that it makes provision for the establishment of a laboratory that will allow students to acquire the necessary practical experience in the various technologies associated with the smart grid. Practical experience remains an important component of engineering education, and power systems laboratories at universities have generally tended to be neglected with regard to the upgrade of equipment to meet the changing needs of the industry, mainly due to the high costs involved (Nordic & Nafalski, 2014: 734). Since the power systems industry has been relatively slow to change
until very recently, power systems laboratories generally tend to be outdated. In many instances the upgrade of these laboratories has had to rely on funding from outside the university.

This DAMOC project hence provides an ideal opportunity for the university to establish state of the art laboratory facilities to support the offering of a smart grid education programme. The planning of the laboratory and specification of equipment was undertaken in consultation with industry partners to enhance the relevance of both teaching and research.

The laboratory comprises the following industrial grade equipment compatible with the IEC61850 standard for utility automations and smart grid equipment (hardware and software):

- Six workstations, each representing functionality of the Substation Automation System on the bay level. The following hardware and software are used in every workstation: Four to five Intelligent Electronic Devices (IEDs) purchased from or donated by different vendors – ABB, Alstom, GE Schneider, SEL and Siemens to implement functions of protection, control, metering, testing, etc., mounted in a special rack; Phasor Measurement Units (PMUs) or IEDs with synchrophasor measurement capabilities; Merging Units for data acquisition and distribution; Siemens/RuggedCom switch, compliant with IEC61850 and IEEE1588 standards for time synchronisation for integration of the communication networks; and an OMICRON testing device.
- Six multicore PC workstations equipped with software necessary for configuration of IEDs, and switches, and GOOSE communication: Text Universe, IEDScout, PMC600, CCT600, DigiSi4, AcSELerator QuickSet, AcSELerator Architect, EnerVista, MiCOM S1 studio, etc.
- The workstations are connected by data networking infrastructure in a station bus and a process bus to enable research on effects of configuration on performance, redundancy strategies, scalability, and effects of deploying various time synchronization protocols. The structure of the network can be selected by using special panels in the workstation racks and in the main communication rack.
- A four rack Real-Time Digital Simulator (RTDS) is connected to the station and process buses as part of the whole automation system. It is used for various types of projects – real-time simulation of parts of power systems, Control Hardware In the Loop (CHIL) and Power Hardware In the loop (PHIL) real-time simulations, testing of IEDs, model reduction, control implementation, GOOSE and SV communication, building of real-time test beds for the research projects, integration of the renewable energy sources to the Grid, integration of the Smart grid elements, etc.

The multi-vendor, multidisciplinary infrastructure which was designed and commissioned has the possibility of supporting teaching, projects and training requiring combinations of: real-time simulation, Hardware-In-the-Loop testing, testing individual IEDs, testing protection schemes, studies on networking topology and redundancy, integration of Supervisory Control And Data Acquisition (SCADA) systems, use of parallel computation solutions for optimisation problems, and Computational Intelligence methodologies to enable knowledge-based decision making – amongst other activities. The infrastructural platform developed forms a prerequisite platform for EM systems, inclusive of activities such as State Estimation, Parameter Estimation, Power Generation Economic Dispatch, and Optimal Power Flow. It is of even greater importance in a deregulated, distributed generation and energy trading environment and for investigating the Smart Grid challenges. The participants in the Smart Grid programme have the opportunity to develop and built real smart grid systems and test their operation and performance in real-time.
The Laboratory supports all subjects in the Masters programme. It provides an excellent practical learner experience in the new technologies for design, development and implementation of smart grid systems. At the exit level the learners will be adequately prepared to undertake various advanced and complex projects not only in the framework of Smart grid technology, but in many other areas of Electrical Engineering as alluded to above.

**Accommodating Information Technology Students**

As previously mentioned the industry also requires specialists in the field of Information Technology and Communications Networks to apply their expertise in the area of smart grids.

There are challenges in this regard as demonstrated by Namboodiri et al (2013) who designed and presented a graduate-level course on smart grids, which was offered at Wichita State University in the spring of 2012. The course was specifically aimed at power systems students and computer networking students. It was found that by the end of the course, most students had not really gone into sufficient depth on any of the topics and that much of the time in class was spent dealing with deficiencies in the background knowledge of students. It is evident that students with an undergraduate degree in Information, Communication Technology would require basic underpinning knowledge in electrical circuit theory and power systems in order to make sense of the topics in the course.

To overcome these challenges Namboodiri et al (2013: 49) contend that it would be necessary to ensure that the relevant background deficiencies of students be removed prior to the commencement of classes.

In this Masters programme at CPUT, special articulation measures have been put in place to accommodate students with an undergraduate qualification in Information Technology or Computer Science. The aims of the articulation measures are:

- To introduce the student to basic knowledge of power systems
- To increase the general knowledge in the field of electrical Engineering
- To integrate the specialized knowledge in Electrical Engineering, Information Technology, and Computer Engineering in one extended field of knowledge needed to develop new knowledge in the field of Smart Grids

The students are expected to do special elective subjects in power systems and protection technology that cover the requisite under-pinning power systems knowledge and remove all relevant background deficiencies.

**CONCLUSION**

The power systems industry is under pressure to transform and modernize its operations. The range of challenges the industry currently confronts is being addressed by the incorporation of smart grid technology. However, the smart grid involves the integration of a number of disciplines, and there is a severe shortage of skilled personnel with the necessary expertise across these disciplines to support the effective implementation of the smart grid. Universities have an important role to play in the development of curricular to prepare students for the modernized power systems industry. This paper argues that a programme at the masters level will be most appropriate to integrate the various disciplines applicable to the smart grid. It discusses the efforts of the Cape Peninsula University of Technology to address the various curriculum challenges by designing a master programme in smart grid technology within the Erasmus + K2 DAMOC project. The programme involves a common core dealing with the essential elements of the smart grid, and electives.
comprising advanced topics in areas relevant to the various disciplinary areas. It also discusses mechanisms to accommodate students onto the course from auxiliary fields such as Information Technology and Computer Science.

ACKNOWLEDGEMENT

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Master Program SmaLog: An Integrated Vision for Improving Transport in Cities

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ABSTRACT
Educational reforms in Ukraine and the introduction of European standards can give universities the opportunity to form their own Master programs in the field of Smart Transport and Logistics that can identify actual problems in the development of real transport systems in cities. Today universities are interested in developing advanced educational programs in the field of urban transport. The attraction of information technologies and integration with European experience in the adoption of intelligent transport solutions, together with the reform of educational programs for training professionals will enhance the level of functioning of urban transport systems. The proposed system of Ukrainian teachers’ skills upgrading, students’ and teachers’ mobility within the framework of the program, including virtual mobility can open new opportunities for Ukrainian people. Dissemination and exploitation of the results of Master program “SmaLog” through the Erasmus + platform will enable the exchange of SmaLog results with other people interested in the same topics.

Keywords: Master program “SmaLog”, transport problems, Ukrainian university, cities.

INTRODUCTION
Effective functioning of a transport system allows to solve transport problems, which based on the implementation of logistics strategies [1-2] and in the close future thanks to the opportunities offered by telematics [3]. The experience of cities in the EU countries, Japan and the USA shows that increasing the effectiveness of a city’s transport system is one of the main aspects for improving city sustainability and liveability [1].

In Ukraine, transport problems have not been dealt in a systematic way and connected in the absence of interaction between freight and passenger transport within the urban transport system. The decisions taken are not effective enough for mitigating the negative impacts of transport.
Management strategies based on increasing the efficiency of operation are of particular interest to academic researchers, logistics companies and city decision-makers alike. Due to the economic impact on the transport systems of cities there is a significant drawback to environmental and social issues. Cities in Ukraine have a low level of sustainability. For example, in terms of environmental quality in contradistinction to European cities. In most cases, it has been due to do not effective management of city transport system (e.g. CO2 emissions in Ukraine is twice as high as in the EU, although the motorization rate is less than the half). On the other hand, in 2011-2016, in Ukraine there were about 170.8 thousand road accidents with injuries, in which 26.7 thousand died and 210.4 thousand people were injured [4]. Therefore, much attention should be paid to these transport impacts if in Ukraine the sustainability goals want to be addressed.

Based on the above issues and the improvements requested by educational system in order to be closer to European one, the Master program “SmaLog” germinates. In Ukraine, Master program “SmaLog” is relevant, considering:

- the advancements in understanding and improving basic knowledge on passenger and freight trips;
- the transfer of methodological development in stakeholder analysis, Intelligent Decision Making and the integrated use of several IT systems.

This socio-economic integration of Ukraine into the European area will allow increasing the mobility of members of the educational society [5], employment opportunities, improving the competitiveness of Ukrainian universities. It should be noted that the relevance of the project is also confirmed by the directions of “Strategy of transport development of UA until 2020” [6].

BACKGROUND

The educational reforms in Ukraine [6], the introduction of the European standards and the Bologna process give an opportunity to universities to develop its own educational Masters programs in the field of transport technologies and logistics able to meet the current real country transport needs.

Joining to the Bologna process is important and necessary for Ukrainian Education and University system because of the need to solve the problem of recognition the Diplomas abroad, to improve the efficiency and the quality of education and for offering new work opportunities [7-8].

Master program “SmaLog”, based on methodological and systemic approaches are completely new under the point of view of new transport technologies, to follow the request of society. SmaLog introduces the innovative living laboratory approach which could also contribute to develop researches by student candidates. Beneficing of the experiences of the EU countries, the synergy-based logistic approach to managing freight and passenger traffic flows in cities in a unified city transport sub-system will allow to give an answer to the growing Ukrainian cities’ request.

This will increase the safety and efficiency of transport services and reduce the negative environmental impact of transport.

Master program “SmaLog” is based on the results achieved in cooperation between Ukrainian, Georgian and European universities. The project participants conducted a national and regional research of Smart Transport and Logistics for Cities with successful work experience.

Universities, which are participants in the program, cover different parts of Ukraine. The European universities participating in the program are also experts in the field of Smart Transport and Logistics for Cities.

They conduct investigations on different aspects connected to set-up new generation of route planners, named Personalised Traveller Advisor and designed for mobile applications, are also carried out. They also develop innovative cargo distribution solutions in large cities with the support of research and education funds Volvo, Smart, and others.

The consortium of universities [9] within Master program “SmaLog” will provide the methodological support, strengthen the internationalization of HEIs and the capacity to be network...
effectively in research, scientific and technological innovation and opens up new opportunities for students.

**METODOLOGY**

One of the main innovations of SmaLog is to use a bottom-up approach. The approach is important for the preparation and implementation of this Master program. The main innovating element of Master Program is integration of four major transport subsystems in the cities (fig. 1.).

![Subsystems of Master program “SmaLog”](image)

**Figure 1: Subsystems of Master program “SmaLog”**.

In this view, SmaLog contributes to the identification and deployment of cost-effective urban transport solutions. Bringing together knowledge acquisition, policy co-creation, behaviour change analysis within a single methodological approach aimed at identifying the optimized policy package is both new and needed as testified, in Europe, by the debate on the new challenges of Horizon 2020 program [10]. The Smalog takes into account the current state in Ukraine and encourages the transfer of methodological approaches, focusing on mixed, shared and financially neutral measures, and demonstrating their effectiveness in European and worldwide cities.
The graduates of this Master program will be able to improve transport system in the cities through the use of advanced behavioural models and methods, which allowed to investigate demand, supply and demand-supply interaction and to raise safety and efficiency of transport service of cities while decreasing negative impact.

The other innovating element of Master program is methodological and technological support of the theoretical fundamentals in Smart Transport and Logistics for Cities. Because of the educational reforms, the introductions of the European standards and the Bologna process, Ukrainian universities have an opportunity to develop its own educational Program SmaLog for Cities, which include basis modules and science research.

The presence of methodological and technological basis in the SmaLog direction, implementation of the innovative “living laboratory” approach will facilitate the emergence of advanced science researches, appearance the highly qualified scientists and scientific projects.

The main objective of SmaLog is to elaborate and introduce at partner countries universities Master program in Smart Transport and Logistics for Cities on the basis of the EU knowledge and standards.

The EU Master program in Smart Transport and Logistics for Cities has duration of 2 years (4 semesters), 120 ECTS.

The Curriculum consists of the new courses and the courses, which have to be updated according to the project theme. All courses expected to be developed, or accredited, or implemented.

In order to organize training of university students in higher education institutions of the university in accordance with the EU standards, it is planned to create a website in SmaLog, to equip the resource centers of the university and develop the necessary teaching materials. Website will contain e-versions of manuals, teaching materials and laboratory works in Smart Transport and Logistics for Cities, currently existing and developed within the project. Master students' research centre for training Master students and webinar room of the SmaLog will be created with modern equipment.

EXPECTED IMPACT OF THE PROJECT

Cooperation between universities of the EU and partner countries will allow to implement the Master Program in Smart Transport and Logistics for Cities (SmaLog) in the accordance with modern market requirements.

SmaLog will have scientific (A), technological (B), social (C) and economic (D) impacts (fig 2).

The main impacts from SmaLog results are as follows:

A) Increase, promote and disseminate scientific knowledge in urban smart transport and logistics. In addition, SmaLog students and lecturers will also benefit from international networking within a single discipline (engineering), thanks to the integrated multidisciplinary approach applied;

B) Promote the information technology and telematics applications in order to address the needs of the cities;

C) Boost the city capabilities in engaging smart transport-relevant stakeholders, education new graduates specializing in smart transport and logistics, search practical and effective solutions that positively impact on: health (e.g. air pollution, traffic accidents, noise nuisance), environment (e.g. emission of global pollutants contributing to global climate change; emission of local pollutants); other problems of life quality;

D) Providing competitive advantages for cities, graduates will be able to prepare for new cities challenges.
Figure 2: Impacts of Master program “SmaLog”.

Besides, benefits will also be at local, regional, national and European level. Master program will significantly increase the popularity of the Smart Transport and Logistics for Cities speciality among Ukrainian students, involved partners and stakeholders that will attend the SmaLog events. SmaLog can contribute to disseminate the culture of smart transport and logistics.

CONCLUSION

The results of the project are aimed at graduates of technical educational institutions, masters, teachers and other interested parties, including potential employers. The results of the Master Program in the Smart Transport and Logistics for Cities will regard to different target groups through dissemination strategies that are implemented to create a larger audience. Realization of short and long term impacts of the project through the cooperation between universities and potential employers will allow to realize the Master Program for cities in accordance with modern market requirements.

SmaLog will have scientific, technological, social and economic impacts in the Partner Countries, which can be summarized up as follows:

1) the integration of the smart transport and information technology into management of cities transport systems and to introduce them in the Local universities;
2) the system of Partner Countries teachers’ skills upgrading, students’ and teachers’ mobility within the framework of the program, including virtual mobility;
3) methodological and technological support of Local universities participating in the programs by European universities;
4) International Quality Assurance System (QAS);

The dissemination and exploitation of the results of Master Program “SmaLog” through the Erasmus+ platform will enable the exchange of SmaLog results with other people interested in the same topics, allow them to receive relevant feedback and, ultimately, improve SmaLog’s results according to market requirements.
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Joint Degrees in South African Higher Education: Past, Present and Future Perspectives

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ABSTRACT
The Personalised Engineering Education in South Africa (PEESA III) project commenced in November 2017. One of the goals of the project is the development of three joint coursework Masters Degrees in Engineering. The degrees are being developed through a partnership between eight universities located in Europe and South Africa. The award of a degree through an agreement between partnering institutions is a relatively new initiative in South African Higher Education. The Department of Higher Education and Training has recently developed the ‘Policy Framework for Internationalisation of Higher Education in South Africa’. The framework establishes a new environment for collaborative provision of higher education. This paper explores experiences in South African Universities, and the opportunities and challenges provided by the new Policy Framework.

Keywords: PEESA III Project, internationalization of higher education, collaborative programmes, South Africa

INTRODUCTION
The Personalised Engineering Education in South Africa (PEESA III) Project, which is funded by the European Union, commenced in November 2017. One of the goals of the project is the development of three joint coursework Master’s level degrees in Engineering through international collaboration. These degrees are being developed through a partnership between four universities located in Europe and four Universities of Technology located in South Africa. Durban University of Technology (DUT) is one of the South African partners.

This PEESA III project will need to overcome a number of the challenges to the development of a collaborative qualification such as, different credit systems in South Africa and Europe, different regulatory bodies for the Engineering profession, and different systems for quality assurance and accreditation. It is important to note that currently in South Africa most Master’s level qualifications in Engineering are achieved through a full research project rather than by coursework and research. Another key factor is that a vacuum has existed in South Africa around the development of a comprehensive national policy on the internationalization of higher education more broadly, and collaborative qualifications more specifically. However, the South African Department of Higher Education and Training (DHET) has recently developed the ‘Policy Framework for Internationalisation of Higher Education in South Africa’ (DHET, 2017) (hereinafter referred to as the Policy Framework). The Policy Framework establishes a new environment for cross-border and collaborative provision of higher education.

This paper analyses the implications of the Policy Framework in the context of internationalisation, the experiences of developing collaborative qualifications, and some of the opportunities for the
THE BENEFITS OF INTERNATIONALISATION

There is a wealth of literature on internationalisation and the development of collaborative programmes. Jane Knight who is acknowledged as an expert on internationalisation has authored many publications. This next section draws on her work (2008, 2011, and 2013) as seminal sources. She defines internationalisation of higher education as ‘a process of integrating international, intercultural and global dimensions into the goals, major functions (teaching/learning, research, service) and delivery of higher education at both institutional and national levels’ (Knight, 2004 cited in Knight, 2008).

After several decades of intense development internationalisation has grown in scope, scale and importance and has transformed the world of higher education. The focus should be on the collaborative, mutual benefit, capacity building, and exchange aspects of internationalisation to optimize the benefits for students and staff, higher education institutions as well as the country and region. However, some of the unintended consequences of internationalization include commercialization, diploma and accreditation mills, international rankings and the great brain race (Knight, 2013).

The clear message that emerges is that the scope of internationalisation should be way beyond the narrow concept of it merely being the exchange and mobility of staff and students. Internationalisation of higher education has moved from being dominated by academic mobility in the past, to an increasingly more comprehensive and inclusive approach that includes internationalisation of the curriculum, internationalisation at home, and the use of technology including virtual mobility to drive internationalisation. Internationalisation has continued on this growth and development trajectory in tandem with increasing levels of globalization more generally. In fact internationalisation is often seen as a response to the challenges posed to universities, graduates, and society in an increasingly globalized world. The aspiration of the PEESA III project for the collaborative development of joint degrees fits squarely with reaping the benefits of internationalisation.

COLLABORATIVE INTERNATIONAL PROGRAMMES

Knight (2008) identifies the development of international collaborative programmes (a generic term that includes double, joint, multiple and combined degrees) as a major trend within the internationalisation of higher education. Europe is seen as being a leader in this trend as European universities have been offering joint degrees since the 1990’s. It is important to note that whilst it is a major trend there are a diverse array of programme models with a concomitant multiplicity of inherent issues. Collaborative programmes are definitely a key component of any internationalisation strategy as they address the heartland of academia namely the teaching and learning process and the production of new knowledge. Furthermore, the development of these types of qualifications are a means for institutions to facilitate partnerships and to attract international students. This type of initiative enhances cooperation beyond traditional exchange programmes, formalises investments in relationships, enhances the academic experiences of students and researchers and gives recognition to the contributions of the institutions involved (Dell, 2012).

In Europe some of the catalysts for the development of joint programmes have been the strong political and economic drive within the European Union, the physical proximity with neighbouring countries, and the well-funded Erasmus programmes to support these initiatives. European
universities have also recognised the value of forging partnerships beyond the borders of Europe and have sought out partnerships on collaborative programmes and degrees with the rest of the world.

The drivers for this amplified interest in collaborative qualifications are multi-fold and can be broadly divided into interest at an institutional level, at an individual level and at a political or national level. At an institutional level the interest centres on expanding the forefront of global knowledge through the development of qualifications that not only enrich the discipline specific academic content but also promote the attainment of broader graduate attributes around intercultural competence and global citizenship. The growing focus on institutional rankings is also an important driver, together with promotion of an enhanced institutional reputation.

At the level of an individual, students find collaborative programmes attractive because they believe that greater employability, higher quality programmes, exposure to other cultures and languages, the status of a foreign qualification, and an enhanced career path are some of the opportunities that are perceived to be offered by a joint qualification. They also identify the opportunity to obtain a double degree (‘two for the price of one’) as a key feature. For academic staff collaborative qualifications are seen as an opening for innovation in teaching, learning and curriculum design, promoting academic mobility and personal enhancement through collaboration with fellow international scholars on joint research projects (Knight, 2008).

At a political level joint degrees may give expression to bilateral and multilateral agreements between countries and/or regions and may be funded by national research foundations, often in alignment with political alliances of the governments of participating countries. An example of this would be South Africa’s involvement within the BRICS political consortium. Intellectual property, technological prowess and commercialisation interests are further drivers for joint qualifications. It is also about bringing the brightest and the best together in promoting mutual benefit in north/south initiatives as well as other types of political pairings.

Aerden and Lochoff (2013) describe the rapid proliferation of joint degrees, mainly within the European Union (EU) from 2003 to 2012. They describe the situation in 2003 as being characterised by a medium to low level of interest with more than half of the European Higher Education Area (EHEA) of 48 countries not having legislation allowing for the award of joint degrees. By 2012 the landscape had changed considerably with 84% of universities in this EHEA region offering joint programmes, and 33% of these institutions awarding joint degrees. The remaining universities were developing or planning joint degrees. Furthermore, by 2012 all but one EHEA country had implemented legislation that allowed for joint programmes and joint degrees.

Whilst Europe is a clear leader in the development of collaborative international programmes the situation in the United States (US) is somewhat of a contrast. For example, Helms (2014) reported on a survey conducted in colleges and universities in the US on international joint and dual degree programmes. Key findings from the survey included that whilst international collaborative degrees are mentioned in strategic planning documents, only 15% of respondents indicated that their institutions had a specific policy in place. Interestingly academic issues such as course equivalencies and teaching methodologies overall present a greater challenge for joint degree programmes than do administrative issues such as regulatory frameworks. A further finding is that although the definitions of these collaborative degrees seem straightforward there are substantial variations among programme models.

This survey also revealed interesting findings relating to the top five US partner countries (China, South Korea, France, Germany and Turkey). From the survey results a number of important challenges faced by the five countries emerged including, language and cultural differences,
teaching methodologies, course equivalencies, student expectations, sustainability of programmes and the lack of interest and commitment of academics were challenges (Helms, 2014).

ISSUES AND CHALLENGES WITH COLLABORATIVE PROGRAMMES
The global experiences of developing and offering international collaborative programmes have significantly highlighted the inherent multiplicity of issues and challenges. Knight (2011) stresses the fundamental importance of, and significant challenges around, quality assurance and accreditation for international collaborative programmes. One issue is using the internal quality assurance processes in place for one institution to assure the quality of programmes offered by a partner institution. She recommends that the mutual recognition of respective quality assurance procedures should be included in the partnership agreement for a collaborative programme. Accreditation is arguably even more of a challenge as national systems do not exist in all countries around the world. For professional programmes this challenge is further compounded and it is advisable for statutory professional councils to be brought into the discussions around the development of a collaborative programme as early as possible.

The language of instruction to be used in collaborative programmes is a further challenge that needs discussion early in the collaboration. It is not unusual for programmes to be offered in the home teaching language in addition to English. Sometimes the use of English as the language of instruction is used as a compromise, but may be viewed as language imperialism. More positively, it is important that consideration is given to more than one language of instruction as bilingualism and multilingualism improve communication skills, employability and the understanding of another culture.

In most cases revenue generation is not the central driver for collaborative programmes, although an important consideration is the development of a sustainable business model. However the development of joint programmes becomes more challenging when different partners have different fee models or when extra costs are involved around physical or virtual mobility. Where extra income is generated an agreement for income distribution is necessary.

COLLABORATIVE QUALIFICATIONS IN SOUTH AFRICA
The International Association of South Africa (IEASA) was established in 1997 as a result of the need for South African universities to respond to rapidly growing international education trends. IEASA played a key role in the call for the development of a comprehensive national policy on internationalisation to integrate policy objectives and strategies in all South African Higher Education institutions. The lack of this national policy framework would not be addressed for almost a decade. However, an increase in requests for joint and double degree programmes in South Africa encouraged universities to address the policy vacuum internally and to join the growing number of universities around the world offering such degrees as a way of deepening international partnerships, attracting top students and better preparing students for a globalized future (Dell, 2012). This activity goes back about 15 years and largely occurred in research-driven universities, some of which have well-developed internal frameworks, guidelines and established practices for collaborative qualifications. With these policy frameworks and practices taking place outside a national policy framework, they were largely based on international best practice drawn from international partners in conjunction with the university statutes and academic rules of the South African partner.

In 2013 DHET appointed a Task Team to draft proposals for a national policy on Joint degrees in South Africa. In 2015 a broader Task Team was appointed to develop a national policy framework for internationalisation, including the provision of Joint Degrees. The Policy Framework was released in November 2017 and it encourages comprehensive internationalisation and specifically
supports various types of collaborative qualifications with the exception of double degrees. The Policy Framework will have major ramifications for internationalisation as it makes it compulsory for every South African university to have an international office and for international activities of universities to be reported to the DHET biannually. DHET planned to have the Policy Framework signed into law in March 2018, however as a result of political changes including a change in the Minister of Higher Education this has been delayed by several months. The HE sector has however been reassured that the final approval of the Policy Framework is on track and is imminent.

The PEESA III project presents a unique opportunity to give effect to the draft Policy Framework, deepen levels of internationalization, and continue to engage in the growing trend around collaborative qualifications as one of the preferred modes of internationalisation. This project also addresses the further challenge of professional accreditation within engineering by including a European accreditation agency in the development phases.

By 2008 Knight was indicating that whilst the interest in collaborative programmes such as joint and double degree is exploding so too is the confusion with a plethora of important and vexing questions raised. Many studies have specifically addressed the ‘vexing issue of defining terms and identifying key concepts and challenges’ (Knight, 2008) and provided terminology and definitions (see for example, Aerden and Lokhoff, 2013, Helms, 2014, Knight 2008, Knight 2011).

Therefore, the development of international collaborative programmes will be aligned to the regulatory framework that has been established by DHET. The Policy Framework provides the following definitions, summarized below, for implementation by South African Higher Education Institutes (HEI) (DHET, 2017):

- **Co-badged qualification**: an accredited qualification that is awarded by a South African HEI where another HEI (or more than one other HEI) contributes a minor part of the curriculum where the contribution of the partner(s) is given by reference to them on the certificates it awards to successful candidates. This reference will usually include the badge(s) of the partner(s) on the certificate

- **Cotutelle**: an agreement between a South African HEI and a partner institution, entered into within a collaboration or partnership and providing for the joint supervision of the candidate for a doctoral degree

- **Consecutive qualification**: a qualification awarded by an HEI where it grants credit, and exemption, for up to 50% of the work required for the qualification on the grounds of equivalent work done for a completed qualification conferred by the HEI, or by another HEI recognised for the purpose, subject to the provisions of the HEQS-F and any applicable law or regulation

- **Joint degree**: a degree awarded by an agreement of partnering institutions at the successful completion of a jointly offered single study programme by two (or more) higher education institutions

**Some future perspectives**

Universities in South Africa have been buoyed by the development of this national Policy Framework and specifically by its support for collaborative qualifications and a significant increase in the development of collaborative qualifications is envisaged. At an institutional level the drive is seen as a quest for qualifications that are academically strong and of a higher quality, against the backdrop of an increasingly keen interest in being competitive within university ranking systems. Collaborative qualifications are also seen as a way of retaining the brightest and best students whilst still offering them opportunities for international study. This view is supported by Rensburg, Motala & David (2015) who argue that one of the essential conditions for better internationalisation
is to reduce ‘brain drain’ by enabling scholars to undertake collaborative research, share knowledge and resources, and build mutual capacities.

The introduction of the national framework for internationalisation in South Africa comes at an interesting time in the socio-political history of the country. A concurrent debate that is taking centre stage in the country is that of decolonising the curriculum. The issue of decolonising the curriculum is being explored by most South African universities as they grapple with how it will be given effect within their university. It has stimulated university-wide debates and has resulted in Position Papers and the development of strategies to address the issue. It will make for interesting engagement as to how the two broad movements for internationalisation and decolonization interface and are rolled out within South African universities. Initially the two movements were seen to be mutually exclusive, and in fact decolonization of the curriculum was feared to be an impediment to internationalisation. However, on deeper reflection the debate around decolonisation can be argued to be a call for deepened, broader and more inclusive internationalisation. It is seen as an opportunity to challenge the dominant paradigms and include previously marginalized world views.

Universities will no longer have carte blanche to shape their collaborative qualifications as they did in the absence of a regulatory framework. However, the basic ethos of the policy framework is hugely positive in encouraging international activities and it will undoubtedly be a stimulus for deepened internationalization including the involvement of more South African universities in international collaborative qualifications. Virtual international engagement and embracing new technologies is also encouraged, allow collaborative qualifications to be offered in a variety of modes on a continuum between pure on-line programmes to programmes requiring physical mobility of students.

Collaborative qualifications are increasingly being seen as having a greater benefit than that experienced by the individual student without the international dimension. Such qualifications are a bridge between potential academic collaborators, between academic institutions, between academic systems and indeed in the sharing of expertise and intellectual capital between countries.

REFERENCES (bold, capital, Times New Roman, font size 12) (ALPHABETICAL ORDER)


Sourcing Organic Cotton from Sub-Saharan Countries
Benefits and Obstacles for the Apparel Industry Supply Chain

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ABSTRACT

In the saturated apparel sector, diversification is a potential key to market share. Ecological and social sustainability within a corporate supply chain is a way to prevent being associated with the many negative examples in the industry, presented on a regular basis by NGOs and the media. An early stage in the fashion supply chain is sourcing of the raw material, which due to the focus of this paper is cotton, a renewable and biodegradable material. While the conventional cultivation with its main producing countries China and India, is criticized for its use of pesticides and working conditions of the laborers, apparel companies seek out to find alternative sources such as organic cotton from Africa.

The paper at hand illustrates opportunities to strengthen sustainability in apparel supply chains. Based on a systematic review of related literature, a taxonomy of apparel supply chains is derived and sustainability aspects are identified. A particular focus is put on finding alternative sources such as organic cotton from Africa.

The presented study represents a basis to stimulate future research on sustainable apparel supply chains. Practitioners may find innovative approaches to improve supply chain sustainability.

Keywords: Supply Chain Management, Apparel Industry, African Cotton.

1. INTRODUCTION

In the course of globalization, many production sites were not only relocated within saturated economies but also shifted to emerging markets and developing countries. Hence, structures of and material flows within respective supply chains altered due to these shifts. The apparel industry represents a good example for such changes. Besides rising pressure to reduce cost and lead time (Iannone et al., 2015), the geographic complexity is adding to the challenges faced by apparel companies (Dicken, 2015; Bruce, et al., 2004). But since these shifts were particularly profitable for the apparel industry, the majority of production sites in this line of business were moved to low-income countries in Central and South-East Asia.

Sourcing in these regions has become a common practice in the apparel industry from which sustainability-related challenges arise in context to often poor social and ecological standards of the production force. This is in contrast to high level of sustainable sourcing and operations achieved in industries of saturated markets and industrialized regions (see, e.g., Gold & Awasthi, 2015; Kumar et al., 2015; Kozba & Schuster, 2016). Consequently, NGOs and media put public pressure on apparel firms to review and adapt their practices (LoMonaco-Benzing & Ha-Brookshire, 2016; Andersen & Skjøtt-Larsen, 2009). Sustainability practices can affect the sourcing of the raw material, being the first step within the textile supply chain (Paul, 2008). Fashion manufacturers and retailers are able to pass on environmental and social sustainability to cotton farmers who represent the first stage in the textile supply chain. The conventional cultivation of cotton, a renewable and biodegradable material with its main producing countries China and India, is criticized for the use of...
pesticides and labor conditions of the workforce. Hence, apparel companies seek out to find alternative sources such as organic cotton from Africa.

This paper focuses on cotton as raw material since it is renewable as well as biodegradable and therewith allows a comparison between different sourcing regions and qualities (organic vs. conventional). Characteristics and structures of the textile supply chains are outlined based on scientific literature and practitioners’ reports. In addition, sourcing options of both conventional and organic cotton are compared. The paper gives an outlook on the economic, environmental and social sustainability of the integration of African countries for organic cotton supply. This exemplifies how apparel firms benefit from the added value they generate by sourcing organic cotton for their target group. The study illustrates that these benefits depend on quality and price of both the raw cotton as well as the final product offered to the customer.

Sourcing from Africa and promoting sustainability in emerging economies represent promising areas for future research. Hence, the taxonomy of apparel supply chains and potential levers for sustainability improvements presented in the paper may be insightful for researchers. Practitioners find recommendations for sustainability sourcing practices and gain valuable understanding for related decision making.

This paper is structured as follows. The next section is a brief literature review outlining the past years’ focus in scientific literature on fashion supply chains. The third section gives an insight into the apparel supply chain with its processes, organizations and regions involved. The fourth section highlights the sustainability aspects throughout the fashion supply chain concerning Triple Bottom Line dimensions, the potential risks as well as the role of African suppliers within the chain. The final section names the limitations of the paper and gives an outlook on future research potential.

2. LITERATURE REVIEW

In order to get insight into the state of research in the field of sustainable supply chain management (SSCM) in the fashion industry, a systematic literature review was conducted. Three databases, ScienceDirect, Emerald Insight and MDPI were searched with Boolean search based on combinations the keywords “sustain*”, “apparel”, “textile” and “fashion”. The review was limited to papers written in English language from peer-reviewed scientific journals within the time span of ten years (see Fig. 1). The abstracts of the journals were read to ensure the main emphasis is on the apparel industry as well as sustainability. A total of 61 papers remained and their content was analysed regarding categories identified as significant. The categories are sustainability effects, methodology, level of analysis, process stage within the supply chain and risk type.

![Figure 1: Publication years of papers reviewed.](image-url)
As illustrated in Table 1, a majority of the papers reviewed are based on empirical methods, mostly empirical-qualitative as Kozlowski et al. (2015) analysing corporate sustainability reports, or using case studies as Grosvold et al. (2014).

**Table 1: Methods used in reviewed papers**

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SSCM is the “management of material, information and capital flows as well as cooperation among companies along the supply chain while integrating goals from all three dimensions of sustainable development, i.e., economic, environmental and social, which are derived from customer and stakeholder requirements” (Seuring & Müller, 2008). The named dimensions of sustainability, economic, environmental and social are referred to as triple bottom line (TBL) approach (Elkington, 2002). The reviewed literature focuses mainly on the TBL as a whole as well as ecological sustainability while the combination of social and economical sustainability is barely represented (see Fig 2).

![Figure 2: Breakdown of TBL dimensions in reviewed literature.](image)

Table 2 exemplifies that the distribution of the level of analysis is well balanced. The intra-organizational perspective of a single firm or a particular function is taken by 28 papers (46%) while 33 papers (except 54%) elaborate on inter-organizational aspects of dyads, chains or networks. In total 30% of the reviewed papers analyze on firm level, and eleven of these papers use empirical-qualitative methodology. The previously mentioned case studies as conducted by Grosvold et al. and Khan et al. (Grosvold, et al., 2014; Khan, et al., 2012) represent respective examples.

**Table 2: Level of Analysis in reviewed papers**

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The papers reviewed are analysed considering the main process stage within the apparel supply chain (see Fig. 3). Supply of yard goods and manufacturing of apparel combined are the focus of 25% of papers. When referring to suppliers, in most cases these both stages are described (Guo, et al., 2017; Hartmann & Moeller, 2014). While six papers focus on the raw material stage, none is doing so on cotton in particular.

The risks addressed in the reviewed papers are mainly environmental, social, economic and reputational. Since only 10% of the papers make the raw material a subject of discussion, only four papers focus on demand or supply risks (Huq, et al., 2016; Blengini, et al., 2017).

3. THE APPAREL SUPPLY CHAIN

The apparel supply chain (Fig. 5) shows the main process steps with the respective sub-processes from the sourcing of the raw material cotton to the finished piece of clothing and its sales in retail stores. The supply chain shown in Fig. 3 is based on the textile pipeline (Paul, 2008), which describes the main processes with their respective sub-processes. The organizations involved as well as materials and goods used and produced are based on expert knowledge. The regions of the process steps are drawn from current statistics while the TBL effects in the chain are based on the findings of the literature review as well as expert knowledge. As the focus of this paper is on cotton products, processes regarding the production of synthetic products are not taken into account.

The first process within the chain is cotton farming in order to source the raw material needed. Cotton farming includes cultivation, growth and harvesting (Fayet & Vermeulen, 2014). The TBL effects at this process step are mainly environmental due to the water consumption and use of pesticides in conventional farming (De Brito, et al., 2008). Main producing countries of conventional cotton are India, China and the USA, producing 59% of the total volume (USDA Foreign Agricultural Service, 2018). The main producers of organic cotton are India, China, Kyrgyzstan with India alone accounting for 56% of the global production while African organic cotton sourced from six different nations holds a 4% share (Textile Exchange, 2017).

The supply of yard goods is the subsequent process, which includes the preparation and treatment of the raw cotton (e.g. cleaning and combing). The prepared cotton is spun in spinning mills and the yarn is woven in weaving mills. Home textiles such as bed linen or curtains are produced in this process step (Paul, 2008). Both social and environmental effects are expected, which is resulting from the use of bleach and questionable working conditions of the labourers. (Goworek, 2011; Winter & Lasch, 2016). Main supplying regions of yard goods are China and India, which process the “home-grown” raw cotton.

The manufacturing of apparel follows the supply of yard goods, which in this process are dyed, printed (i.e. all-over print) and receive add-ons (e.g. sequins) if required. This is followed by tailoring (i.e. cutting, sewing) the clothing piece and if desired receives a finishing like buttons, washings and logo prints (Paul, 2008). The majority of negative media reports consider this process step, with its effect on both environmental and social issues as water pollution due to use of chemicals and reports of child labour and overall poor working conditions as well as low wages (Winter & Lasch, 2016; Yadlapalli, et al., 2018). Main exporting countries for apparel in 2016 were China, Bangladesh and Vietnam (WTO, 2017).

The distribution and sales of the finished product are the final steps in the process. The product is picked up by a logistics service provider, who controls the flow of goods and information, making sure the products are handed to the respective distribution channels (Paul, 2008). The product is sold by retailers. The TBL effect is mostly environmental due to the carbon footprint caused by the shipping from South-East Asia to the main importing regions as the EU and the USA (WTO, 2017; De Brito, et al., 2008).
Return flows may arise from selling on secondary markets or recycling of apparel. These aspects are excluded from the study at hand.
4. ASPECTS OF SUSTAINABILITY

The TBL effects on the stages of the fashion supply chain are also reflected by the literature review, which gives the additional information on the risks addressed in the papers. Yet the process stage of raw material is underrepresented with six papers, of which none particularly focuses on cotton. Hence this paper mostly relies on expert knowledge at the raw material stage. Potential causes for supply risks for cotton are bad harvest, which lead to higher purchase prices as well as environmental disasters. The economic risk resulting from the unstable purchase price of the raw material can barely be minimised, as the previously mentioned causes can not be influenced. Transitioning the sourcing of raw material from conventional to organic cotton is linked to a purchase price increase. However, it also is an opportunity to buffer the instable prices through higher sales price since the price tolerance of customers for organic apparel proves to be higher (Yang & Dong, 2017). The demand risk is expected to be lower due to the forecasted higher demand for organic cotton in the future years (Textile Exchange, 2017; Yang & Dong, 2017). The use of organic cotton is also an opportunity to reduce the environmental risk since the use of pesticides and is prohibited (Textile Exchange, 2017). Thus, the cotton farmers save money they would have spent on buying the pesticides while at the same generating more income through the higher price the can ask for their product. In general, higher income of farmers reduces the social risk.

The reduction of the aforementioned risks through the sourcing of organic cotton, particularly from African countries, which still hold a small market share in cotton production, has on the other hand a high potential to reduce reputational risks for apparel companies. The production in the six African countries trading organic cotton is expected to grow more extensively than the established producers like India and China (Textile Exchange, 2017). In a scenario of sourcing organic cotton from African all three TBL dimensions would be affected. Social sustainability can be reached through higher income for the farmers. Environmental sustainability can be achieved by the abandonment of pesticides. The increased retail price for the final apparel product as well as potential new customer groups attracted by the new product improve the economic sustainability.

5. CONCLUDING REMARKS

The study at hand has presented a taxonomy of apparel supply chains and potential levers for sustainability, which were identified by a systematic literature review. In particular, the study reveals insight into sourcing of cotton from Africa and outlines how such a sourcing strategy can promote sustainability. The related findings may be interesting from a research perspective as well as from a practitioner’s point of view. Limitations arise from the paper length as well as from the focus and the level of detail of the study. These weaknesses point towards directions for future research. Furthermore, research opportunities can be derived from the results of the study at hand. Taking into account a large share of empirical-quantitative studies, we encourage conducting conceptual research and quantitative studies. The developed framework may be seen as a first step into this direction. In-depth case studies or broad surveys in the related field may empirically substantiate the theoretical insights of the paper at hand. Moreover, quantifying sustainability-related risks helps managing and mitigating risk and, thus, improving sustainability of textile and apparel SCs. Extending the perspective from traditional markets and industrialized economies to growth markets in emerging economies is one potential direction for sustainable textile SCs. As outlined in the study at hand, the geographical focus of analysis can be broadened from the African countries to...
other developing regions in the world. In general, studying sustainability-related impacts of sourcing from emerging economies and including these markets into (sustainable) supply chains represent promising areas for future research.

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Performance Management Evaluation Methods in the Field of Supply Chain Management

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ABSTRACT
This paper aims to analyse specific performance management evaluation methods in the field of supply chain management and to identify the most relevant key performance indicators in order to ensure an efficient supply chain management. Following the bibliographical study by using different secondary sources, specific performance management evaluation methods have been presented.

Various gaps in measuring company’s supply chain management performance have been determined. The most relevant key performance indicators of this field have been highlighted in order to develop an own innovative performance evaluation method and to bring real contribution regarding the efficiency and efficacy of the entire company’s performance.

Keywords: performance evaluation, key performance indicators, supply chain management.

INTRODUCTION
Taking into consideration the current environment of globalization, economic turbulences and fast-tracked technologic advances, more and more tools and methods to evaluate performance management have arisen in order to cope with the challenges organizations faced over time, making them today a must-use in the lives of management. Efficiency and effectiveness have become a key aspect in a company’s growth. With stress to increase productivity, boost revenues, improve quality, measuring efficiency and effectiveness based on specific methods to evaluate performance management have become a main focus to plan for the future, add value and gain a competitive edge on the global market.

This paper analyses the supply chain management as a system, presents the most relevant performance evaluation methods and identifies the most relevant key performance indicators for each supply chain management subsystem, in order to develop a new performance evaluation method.

ANALYSIS OF THE SUPPLY CHAIN MANAGEMENT SYSTEM
Supply Chain Management represents the flow of goods from the producer to the customer, by presenting the movement of the product from the producer to the manufacturer and from the manufacturer to the distributor for shipment. The product is then shipped to the wholesaler or retailer and then distributed to various shops from where the customer can easily get the product.
The core of the supply chain management is presented by several key processes: Customer Relationship Management, Order Fulfillment, Procurement, Customer Service Management, Manufacturing Flow Management, Demand Management, Product Development and Commercialization, Return Management. Specific activities are linked to these key processes and assure the optimal function of the entire process: Purchasing, Production, Logistics, R&D, Finance, Marketing.

Customer Relationship Management refers to the relationship with the customer. It provides the structure for its development and maintenance. Customers are categorized and differentiated taking into consideration their type.

In order to achieve an effective and efficient supply chain management, customer requirements in terms of order fulfilment have to be met. All the requirements for the order fulfilment have to be defined, a plan have to be settled in order to generate, communicate, enter, process, pick and deliver the order in a short time and with reduced costs, aspects that influence the effectiveness and efficiency of the supply chain management.

Procurement refers to the process of interaction between the company and its suppliers. Several criteria of categorizing suppliers in order of evaluating, selecting and categorizing them have to be set. Specific guidelines, agreements and contractual terms have to defined.

Customer Service Management provides specific information to the customer, such as shipping dates, product availability, order status.
Manufacturing Flow Management includes all the activities that are necessary for manufacturing the product, identifying manufacturing constraints and requirements, synchronising capacity and demand.

Demand Management focuses on balancing customers’ needs with the company’s capabilities. This includes synchronising customers’ demand with procurement, production and distribution and forecasting customers’ demand.

Product Development and Commercialization refers to developing new products and placing them on the market in an efficient manner. This is a key aspect of the company’s success. Customers and suppliers have to be integrated in the product development.

Returns management enables the company to identify improvement opportunity in order to increase its productivity and represents a very critical part of supply chain management. It manages the return requests and complaints. (Croxton, Garcia-Dastugue, Lambert, Rogers, 2001)

**RELEVANT KEY PERFORMANCE INDICATORS IN THE FIELD OF SUPPLY CHAIN MANAGEMENT**

In the author’s point of view each model described above presents some gaps regarding its subsystems and processes described or regarding its influence factors. A supply chain management is a very complex process influenced by several factors, that includes numerous subsystems. With a purpose of capturing all the subsystems and influence factors involved in the supply chain management a new approach of the supply chain management as a system has been developed.

In order to ensure a complex, efficient and effective supply chain management system it is recommended to involve various subsystems such as demand management, product development, supplier management, product development, contract management, purchasing, warehouse management, distribution, production management and sales management.

Demand Management refers to estimate current and future demand based on the evaluation of past sales and forecasting future sales. It covers the customer order analysis, acceptance or revision. In order to evaluate and improve the demand management quality, specific performance measurements are required.

Supplier Management includes the identification, evaluation and selection of the suppliers. In order to have a good collaboration with suppliers and to ensure a performing supply process, a supplier performance evaluation is needed. Supplier Management focuses also on supplier development.

Contract Management refers to contract development, terms and conditions negotiation, product development but also performance measurement based on specific key performance indicators. Delivery conditions issues, price, incoterms, quantity, payment terms, quality, design requirements and adjustments, transportation conditions, packaging and return policy conditions have to be established.

Product Development includes the design of products, specific research and development activities but also the prototype research and development in order to ensure the material planning and the bill of materials. In order to increase the quality of the product development a performance management is needed.
The purchasing subsystem of the supply chain management is based on the acquisition of goods and services, on order tracking and performance measurement, in order to ensure an in time and in a good time delivery of goods.

Warehouse management focuses on goods receipt, stock replenishment, inventory management, production supply, quality assurance, goods issue and performance measurement. The warehouse receives the goods and ensure their availability and quality.

Production management plans the production, includes the manufacturing operation quality assurance of the products and performance measurement.

Distribution covers packing and handling of products, their transportation to warehouses and clients and performance measurement.

Sales management includes delivery scheduling, after sales services, such as warranty, maintenance, reparations, returns, refunds, the entire customer relationship, feedback, improvement ideas, complaints or loyalty actions and performance measurement.

Following these specific subsystems several KPIs have been highlighted as most relevant. (Chase, 2016; Eagle, 2017; Kpilibrary.com, 2018; Hydac.com, 2018; Quality-one.com, 2018; Bradley, 2018; NCMA, 2017, SME, 2018; AssessTEAM, 2018; Smallbusiness.chron.com, 2018; Almquist & Cooper, 2018)

<table>
<thead>
<tr>
<th>KPI name</th>
<th>KPI definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Orders, Delivery Errors</td>
<td>Measures the percentage of time a product is considered unacceptable against standard criteria. The number of unacceptable products divided by the total number of units produced during the manufacturing run.</td>
</tr>
<tr>
<td>KPI name</td>
<td>% Schedule lines delivered early / late</td>
</tr>
<tr>
<td>KPI definition</td>
<td>Measures how many of the suppliers’ purchase orders are delivered on time as agreed. To indicate the supplier’s performance in terms of delivering the orders purchased on time.</td>
</tr>
<tr>
<td>% Contract complaints</td>
<td>Measures the number of complaints or exceptions for the active contracts in a given period. To indicate the quality of contracts management as complaints indicate customer dissatisfaction.</td>
</tr>
<tr>
<td>% Customer satisfaction with new products and services</td>
<td>Measures the level of satisfaction among customers as percentage of satisfied clients with the new products and services resulted from innovation projects. To indicate the satisfaction level of the customers with the new launched innovations (products services) as this is an important indicator for the success of the organization.</td>
</tr>
<tr>
<td>% Supplier on-time delivery</td>
<td>Measures the percentage of units or order value that arrives on or before the requested delivery date. The on time shipping rate is key to customer satisfaction. A high rate indicates an efficient supply chain.</td>
</tr>
<tr>
<td>% Sales growth</td>
<td>Expresses the changes in the sales value or the sales volume from one period to the following. To indicate whether there is positive or</td>
</tr>
</tbody>
</table>

Performance Management Evaluation Methods in the Field of Supply Chain Management
Oana DUMITRASCU, Manuel DUMITRASCU
negative evolution of sales from one period to another and the intensity of the change.

**KPI name:** % Damaged stock  
**KPI definition:** Measures the percentage of damage value of the stock, from total stock value.

**KPI name:** % Finished product value  
**KPI definition:** Measures the percentage of finished products’ value, out of the total costs encountered with production.

**KPI name:** % Damage-free shipments  
**KPI definition:** Measures the percentage of delivered shipments that are distributed without any damage to the freight, out of the total number of shipments delivered. To indicate the quality of services in delivering to customers without damage.

**PERFORMANCE MANAGEMENT EVALUATION METHOD**

Access to methods to evaluate performance management is nowadays both a plus for managers, as information has become vast, abundant and widely accessible, and a minus, as it becomes more troublesome to select, adapt and implement the right tool or method for the specific dilemma the regular manager is confronted with.

It is the author’s opinion that one should be aware of the most frequently used methods to evaluate performance management. The author also strongly believes there is no right or wrong solution as long it allows managers to find a solution to surpass the obstacle arisen. Moreover, managers should be aware of the strengths and weaknesses of these methods and not be afraid to creatively adapt, combine and integrate the right method, in the correct form, at the right time.

**Balanced Scorecard as a performance management method**

The Balanced Scorecard is a method to evaluate performance management split into four categories: Customer, Financial, Internal Business Processes and People, Learning and Growth. It focuses on the strategic goals, translating the mission, vision and values of an organisation into a complete set of objectives and KPIs that can be quantifiable, calculated and achieved.

As defined by Bain & Company a Balanced Scorecard allows an organisation to measure its performance by structuring the objectives, KPIs and initiatives on four stages (Bain.com, 2017):

- Financial (earnings, revenues, cash-flow, return on capital);
- Customer (customer satisfaction and loyalty, market share);
- Internal business process (productivity rates, timeliness, quality measures, innovation);
- People, learning and growth (knowhow, turnover, morale, best practices).

The Balanced Scorecard translates the mission, vision and values of an organisation into key performance indicators which can be measured and evaluated.

**Dashboard as a performance management method**

A dashboard can be defined as a visual representation of the most relevant information required to achieve one or several objectives. These visual representations are arranged and concentrated on a single screen as to allow viewers to monitor all the information at a glance. (Few, 2007)
Dashboards should be designed according to a specific set of requirements. There are numerous suggestions on how to build and design a dashboard.

**Juice, Inc. in 2009 present a 3-part design for a dashboard (Juice, 2009):**

- Part 1: Dashboard foundation, implies to define the target audience, identify the type of dashboard is required and the reasons it is valuable to the business. The dashboard should focus on the metrics that matter;
- Part 2: Dashboard structure refers to the actual design of the dashboard, including form, simple design to ensure audience understanding, and overall navigation and capabilities to make the dashboard useful, insightful, engaging and allow interactions to better understand the data;
- Part 3: Information Design adds interface and information design. The focus is on dashboard layout and best practices for charting and data presentation.

**According to Fry, B. a dashboard should follow a 6 stage implementation (Fry, 2008):**

- Acquire – obtain the data;
- Parse – structure the data;
- Filter – keep only the data of interest;
- Represent – choose the visual mode;
- Refine – make the visual clear and visually engaging;
- Interact – add methods for manipulating the data or control the available features.

**CONCLUSIONS**

The entire supply chain management system and every of its subsystems is influenced by the performance management, so that specific performance management evaluation methods were analysed.

After an intensive analysis of the key performance indicators in the field of supply chain management and of the supply chain management performance evaluation methods, it has been determined that an efficient performance management evaluation method has to be based on key performance of all nine identified subsystems. KPIs in demand management, supplier management, warehouse/inventory management, contract management, product development, production management, procurement/purchasing and distribution management have been identified.

It is the author’s point of view that KPIs in Demand Management should follow customer order analysis, acceptance or revision, evaluation of past sales and demand forecasting. KPIs should be set following an organisational specific objective with an impact on the organisation’s main objective and long-term strategy.

It is recommended to develop a demand management objective by increasing the value from customers through an effective past sales evaluation, improving the organisation’s ability to serve its customers, increase trust levels, increase information flow, identify new customers and a resultant sale forecasting.

It is the author’s opinion that KPIs should focus on supplier sourcing, supplier performance evaluation and supplier development. KPIs objective could be to increase supplier collaboration by improving the process, increase of product manufacturing, quality and delivery capabilities, increased service provided, lower delivery risk, reduced cost, continuous improvement and monitoring.
It is the author’s opinion that KPIs in Contract Management should outline contract development, terms and conditions negotiation. It is recommended to develop a contract management objective by increasing value creation for the organisation, by increasing contract quality, financial stability and profitability, communication and ensuring the policies and procedures are respected.

In the author’s point of view KPIs in Product Development should outline new product development capabilities, prototype research and development, design, material planning and market value add.

In the author’s opinion KPIs in procurement/purchasing should outline all acquisitions of goods and services and order tracking. It is recommended to develop a procurement/purchasing objective by increasing the revenue growth and improving profit margins.

It is the author’s point of view that KPIs in Sales Management should outline customer relationship, delivery schedule, after sales services, warranty, maintenance, returns and refunds. KPIs should not be set without an organisational specific objective that directly and effectively impacts the organisation’s main objective and long-term strategy.

It is recommended to develop a sales management objective focusing on increasing customer sales volumes by increase of product market penetration, contributions to the organisation’s profit, meet and surpass customer’s expectations by ensuring continuous market share growth.

KPIs in Warehouse/Inventory Management should outline goods receipt, stock replenishment, inventory management, production supply, quality insurance and goods issued. It is recommended to set an objective that focuses on increasing the service by keeping the stock levels at adequate levels, managing the resources economically, maximizing profitability, ensuring the supply flow of demanded materials and finished products, supporting the timely order fulfilment.

In the author’s opinion KPIs in production management should outline planning, organising and controlling the production activities and quality assurance. It is recommended to propose a production management objective by taking into consideration to increase customer product supply and satisfaction, utilizing the full production capacity and keeping the production flow continuous.

In the author’s point of view KPIs in Distribution Management should outline goods receipt and issue, packing and handling and transportation. These KPIs should have as objective increasing customer product availability by assuring an efficient flow of goods, a proper packing, storing and handling, a qualitative supply to the customer and reducing cost of goods transportation.

REFERENCES


Regional Aspects of SMEs in Poland – International Risk Versus Bank Security Products

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ABSTRACT
The sector of small and medium-sized enterprises continues to play an important role in creating the main macroeconomic values in the modern market economy and the processes of internationalisation and globalisation. Enterprises of this size account for 99.8% of all enterprises, employ nearly three quarters of all professionally active population, create about 75% of GDP, and hold a significant share in international trade. The relevant research is dominated by an approach according to which the SME sector is homogeneous, and micro and small enterprises are not the subject of any special attention. However, it should be noted that in the overall structure of active enterprises, micro enterprises constitute 95.8% of all businesses, small – 3.2%, and medium-sized – 0.8%. Therefore, they are extremely important due to the fact that, for example, they employ the most workers (6.4 million, i.e. 69% of all enterprise workers). Moreover, enterprises of this size are growing and evolving from micro through small to medium-sized and large enterprises. These processes can be varied in many respects, including in terms of regional factors and internationalisation. The purpose of the article is to determine the role of micro and small enterprise internationalisation in the individual regions of Poland. It also aims to show how they use derivatives and trade finance in their risk management which they face in international trading, and the need to support SME education by both private and public institutions to provide them with access to information, which is required for efficient enterprise management in the light of internationalisation.

Keywords: internationalisation, risk, risk management, SME, small and medium-sized enterprises international trade

INTRODUCTION
Small and medium-sized enterprises play an important role in every economy in the world. It is the most numerous group of business entities. In 2016, micro and small enterprises accounted for approximately 99.2%, while medium-sized enterprises for 0.7% of all registered enterprises (PEKAO, 2017A, p. 27). In addition to their quantitative share, their qualitative contribution to the Polish budget structure is important. Micro, small, medium-sized, and large enterprises are responsible for creating,
and small enterprises, which is prepared annually by Bank PEKAO S.A. based on a sample of approximately 7,000 micro and small enterprises, also examined. The article uses data from the Report on the Situation of Micro and Small Enterprises, Access to private and state institutions supporting their development, which includes information on the depth analysis of the market data indicating that in 2015, 4.4% of enterprises operating in Poland sold products abroad, and only 1.0% sold services. An in-depth analysis of the data showed that only 3.1% of micro enterprises exported products and 0.5% exported services. Goods were sold abroad by 29.9% of small enterprises, nearly half of medium-sized enterprises (46.3%), and 66.2% of large enterprises, while services were sold by, respectively, 9.9%, 24.6%, and 56.9% (PARP, 2017, p. 41). These data confirm that 99.8% of enterprises operating in Poland prefer to operate domestically, with only 0.2% seeking foreign markets. Among enterprises that exported products, nearly half of medium-sized enterprises (46.3%), and 66.2% of large enterprises exported goods. Services were sold abroad by 9.9% of micro enterprises, 24.6% of small enterprises, and 56.9% of large enterprises (PARP, 2017, p. 41). These data confirm that 99.8% of enterprises operating in Poland prefer to operate domestically, with only 0.2% seeking foreign markets. Among enterprises that exported products, nearly half of medium-sized enterprises (46.3%), and 66.2% of large enterprises exported goods. Services were sold abroad by 9.9% of micro enterprises, 24.6% of small enterprises, and 56.9% of large enterprises (PARP, 2017A, pp. 10-15). Given the large share of SMEs in the development of entrepreneurship, they play a significant role in creating and maintaining jobs. Their agility is an undisputed asset – smaller companies can adapt faster and more efficiently to changes occurring in the economic environment and the current situation on the market, both national and international. On the other hand, large corporations have greater resources to pursue projects. They identify, mitigate and manage risk and potential barriers in their domestic and foreign operations more effectively.

One of the manifestations of entrepreneurship is the internationalisation of companies. Available market data indicate that in 2015, 4.4% of enterprises operating in Poland sold products abroad, and only 1.0% sold services. An in-depth analysis of the data showed that only 3.1% of micro enterprises exported products and 0.5% exported services. Goods were sold abroad by 29.9% of small enterprises, nearly half of medium-sized enterprises (46.3%), and 66.2% of large enterprises, while services were sold by, respectively, 9.9%, 24.6%, and 56.9% (PARP, 2017, p. 41). These data confirm that 99.8% of enterprises operating in Poland prefer to operate domestically, with only 0.2% seeking foreign markets. Among enterprises that exported products, nearly half of medium-sized enterprises (46.3%), and 66.2% of large enterprises exported goods. Services were sold abroad by 9.9% of micro enterprises, 24.6% of small enterprises, and 56.9% of large enterprises (PARP, 2017A, pp. 10-15). Given the large share of SMEs in the development of entrepreneurship, they play a significant role in creating and maintaining jobs. Their agility is an undisputed asset – smaller companies can adapt faster and more efficiently to changes occurring in the economic environment and the current situation on the market, both national and international. On the other hand, large corporations have greater resources to pursue projects. They identify, mitigate and manage risk and potential barriers in their domestic and foreign operations more effectively.

In economic literature, two models of stage-by-stage internationalisation can be distinguished: the Uppsala model and the innovative model (Gulanowski, Papadopoulos & Plante 2018, pp. 35-60; Kasperkowiak, Malecka & Łuczka 2017, pp. 309-404). Increasingly, new enterprises choose the born global model, which, instead of phases, assumes parallel enterprising activity both domestically and abroad (Zalan, 2018, pp. 19-34). Regardless of whether SMEs are originally created for the global market or gradually mature towards this decision, they need support in every possible aspect of internationalisation.

The aim of the study is to identify the risks occurring in the process of SME internationalisation in regional terms, and the banking products used by them to secure transactions in international trade. Access to private and state institutions supporting the development of SMEs on foreign markets was also examined. The article uses data from the Report on the Situation of Micro and Small Enterprises, which is prepared annually by Bank PEKAO S.A. based on a sample of approximately 7,000 micro and small entrepreneurs, and from the authors’ own research conducted on the basis of data provided by commercial banking institutions. The analysis was carried out on a sample of 300,000 small and
medium-sized enterprises and regarded their use of money market hedging in national and regional terms.

**INTERNATIONALISATION OF SMEs**

The opening of borders after Poland’s accession to the Schengen Area and the European Union has made it easier for domestic companies to change their management strategies and expand into international markets. Those SMEs which had decided to go international had to identify the possibilities of acquiring knowledge about new directions and opportunities of development. An organisation can learn through experience, using an internal team of employees in charge of international trade, or use the knowledge of its key partners: customers, suppliers or investors (Bruneel, 2010, pp. 164-182; Małecka, 2017). Alternatively, knowledge may be obtained from other market participants, such as government institutions in charge of supporting exports and imports, and banks which sell financial instruments that help support risk management in a particular industry in which the company operates, in accordance with the Polish Classification of Economic Activity (PKD) (www.klasyfikacja.gofin.pl).

An analysis of the geographical structure of international trade indicates a noticeably higher involvement of exports than imports from the EU market: 79.3% of the exports of products from Polish companies goes to the EU, and 20.7% to other countries. In the case of imports, 69.6% comes from EU countries, and 30.4% from other countries (PARP, 2017 p. 42). In 2010–2015, there was an increase in the number of companies conducting export activities, the exception being a slowdown in 2013, but, at the same time, this tendency cannot be confirmed in share terms for enterprises with a survival rate of more than 3 years (Figure 1).

**Figure 1: Enterprises involved in export and geographical structure of enterprises operating in 2017 [%].**

*Source: Based on PEKAO, 2018, p. 85.*

Since 2014, there has been a growing interest in activity outside the country among born global companies, which means that entrepreneurs are beginning to think about global expansion from the very moment the idea for a business germinates. In the era of widely available Internet, they do not limit themselves territorially and do not see the necessity of developing regionally first. In 2017, 31.0% of the surveyed entrepreneurs in the Lubuskie province conducted export activities. They were
followed by the provinces: Zachodniopomorskie (22.0%), Podlaskie, and Kujawsko-Pomorskie (each 19.0%) as well as the Dolnośląskie and the Wielkopolskie province (each 17.0%) (Figure 1).

The analysed data may lead to the formulation of the thesis that young companies are less afraid of the risk associated with foreign activity, which has a direct impact on the estimated revenue from exports in their successive years of operation. It is clearly higher among younger companies, with a shorter history (less than 3 years) (Figure 2).

![Figure 1](image1.png)  
**Figure 1:** Average assessment of export revenues; in each province in 2017 [by response rate / index].

**Source:** Based on PEKAO, 2018, p. 87.

When examining the regional aspect, the greatest financial benefit is demonstrated by entrepreneurs from the Świętokrzyskie province, followed by Podlaskie and Łódzkie. The values showing the average revenue estimate were taken from a PEKAO report, for which an index (response rate) was created. An index equal to 50 means the worst possible rating, 150 is the highest possible rating, while 100 is a neutral value (the detailed scale is as follows: 50 – much worse, 75 – worse, 100 – neither better nor worse, 125 – better, 150 – much better) (PEKAO, 2018, p. 18).

![Figure 2](image2.png)  
**Figure 2:** Average assessment of export revenues; in each province in 2017 [by response rate / index].

According to Eurostat data, 7.2% of domestic enterprises exported their products in 2015. Domestic companies rank above the EU average, and are even ahead of countries such as the United Kingdom, Sweden or Norway. The leaders of the ranking remain the dynamic economies of Estonia and Slovenia (Figure 3) (PARP, 2017B, p. 34).
The latest data on the economics of Polish exports indicate that in the period between January and November 2017, exports at current prices amounted to PLN 802,528.1 million, and imports – PLN 794,712.0 million, which means that exports increased by 9.0%, and imports by 10.4% y-o-y (www.forbes.pl). The three most dynamically growing export destinations in 2017 were the US, Russia and Ukraine (www.wnp.pl). Internationalisation is not only about expansion into foreign markets, increase in revenues, and more dynamic – as compared to companies operating locally – enterprise development and increase in its value. The owners of such companies encounter many barriers to entrepreneurship development, economically related to risks and barriers of other kinds. An analysis of the date from a survey conducted in 2017 on the Polish market showed that the constraints most frequently indicated by entrepreneurs included: (1) lack of capital to finance exports, (2) lack of time among executive management, (3) lack of qualified staff, (4) limited information about the relevant market, (5) difficulty in determining competitive prices, (6) no possibility of contacting potential foreign contractors (Kasperkowiak, Malecka & Łuczka, 2017, p. 393; OECD, 2009, pp. 8-9). These results are confirmed by global data contained in the OECD report, indicating the top ten barriers to the development of SMEs. The most important of them are: (1) lack of working capital to finance exports, (2) trouble with identifying the business potential of the enterprise, (3) lack or limited information about a given market, (4) problems with contacting potential foreign clients, (5) lack of credible foreign representation, (6) lack of time among managerial staff to deal with the internationalisation process (OECD, 2009, pp. 8-9).

Theoretical considerations on the subject matter distinguish various types of risks identified both by companies starting to expand and by those that already operate abroad. Economic literature lists risks such as the risk associated with the transformation of the enterprise and the possibility of its bankruptcy, political risks, exchange rate and currency risk, interest rate risk, cross-border legal risks, economic risks, transport risks, and force majeure (Kaczmarek & Królak-Werwińska, 2008, pp. 36-66; Zhang, Yu & Liu, 2018, pp. 328-240; Tunc, Solakoglu, Babuscu & Hazar, 2018, pp. 167, 152-
One of the ways to mitigate most of these risks is to use products which support foreign trade (Niepmann & Schmidt-Eisenlohr, 2017, pp. 111-126). For small and medium-sized enterprises, which have for years been subject to credit discrimination, such a solution may be a determinant of effective development and even existence of the enterprise (Galbraith, 1957, pp. 124-133; See also Malecka, 2016, p. 91-122).

**BANKING PRODUCTS SUPPORTING THE DEVELOPMENT OF INTERNATIONALISATION OF POLISH SMEs**

Banking instruments that provide effective support for the development of international trade, which are available to Polish enterprises through commercial banks, are an inherent element of the offering of modern financial institutions. They include:

- Derivatives – “options, futures, swaps, interest rate forwards, and other derivatives whose underlying instrument is a commodity and which are executed by cash settlements of one of the parties, relating to climate change, freight rates, emission allowances and rates of inflation or other official statistical data” (Journal of Laws No. 183, item 1358, p. 2).
- Letter of credit – a bank, by opening a letter of credit at the request of an importer, agrees to pay the beneficiary (an exporter) a certain amount if the beneficiary meets all the conditions of the letter of credit, i.e. sends the goods or performs the service within a specified time and submits the required commercial documents to the bank in accordance with the letter of credit. The obligation of the bank which opens the letter of credit becomes due and payable within a time limit resulting from the terms of the letter of credit, after the beneficiary presents the documents in accordance with the letter of credit (see also Alavi, 2017, p. 28).
- Documentary and financial collection – a bank acting on behalf of an exporter mediates in releasing certain documents to the importer/buyer in accordance with the collection instruction, i.e. after making payment or accepting a bills of exchange. Collection is initiated by the exporter after sending the goods, and the decision about payment is made by the importer. Due to the nature of the documents being the subject of collection, a distinction is made between financial collection (financial documents such as bills of exchange and cheques are the subject of collection) and documentary collection (commercial documents such as invoices, transport documents, certificates – and possibly financial documents such as bills of exchange – are the subject of collection) (see also Niepmann & Schmidt-Eisenlohr, 2017, pp. 111-126).
- Bank guarantees – an obligation of a bank to pay the authorised entity the amount indicated in the guarantee if the principal who had ordered issuance of the guarantee fails to fulfil its obligations (see also: Niepmann & Schmidt-Eisenlohr, 2017A, p. 1111-126).
- Forfaiting – a bank purchases export receivables with deferred payment dates, secured with a letter of credit confirmed by a bank or with a promissory note, or a bill of exchange, secured by a bank, the risk of which is accepted by the financial institution. The amount of the receivables paid out is reduced by the discount interest due (see also Adašková, 2014, pp. 278-288).

**GOVERNMENT AND NON-GOVERNMENT INSTITUTIONS SUPPORTING THE INTERNATIONALISATION OF POLISH SMEs**

Surveys of various business sectors that are available on the market have showed that the profitability of sales is, in certain sectors, considered to be is higher on foreign markets than on domestic markets (NBP, 2016, p. 6). This is one of the reasons why both the Polish state and financial institutions support enterprises which see their future on European and global markets. However, this is not selfless help. Those businesses are potential customers using financial solutions for the development.
of international trade. The government benefits as those companies generate higher taxes, and the banks benefit as their bank account turnover is significantly higher and the demand to buy more expensive products (and incur liabilities) is greater. However, all stakeholders remain in a symbiotic relationship with each other. Among the institutions which support SMEs in their export activity, the money market and the banking sector are of key importance, which is related to the investment needs of companies, advance invoice financing or issues related to advantageous and efficient exchange of currencies (PEKAO, 2013, p. 115). The government sector supports exporters and importers by making it possible to obtain funding for the development of an enterprise, and by generating numerous reports that aggregate the knowledge required by managers to reduce the barriers faced by them. Such public and free-of-charge publications available to entrepreneurs include, for example, Terms and Conditions of Foreign Trade in the European Union, and Currency Risk in the Activities of Small and Medium-Sized Polish Export Enterprises (www.parp.gov.pl).

Government agencies and institutions cooperating with them include:

- Polish Agency for Enterprise Development, which supports the implementation of projects financed from structural funds, the state budget, and long-term programmes of the European Commission.
- Polish Investment and Trade Agency, which helps investors enter the domestic market.
- KUKE Export Credit Insurance Corporation, which insures commercial transactions of Polish entrepreneurs.
- BGK Bank Gospodarstwa Krajowego, whose main task is to support the country’s economic development and improve the quality of life of Poles.
- Chambers of Commerce and Business, whose task is to help their members with economic expansion in the country and abroad.
- Trade and Investment Promotion Sections at Embassies and Consulates General of the Republic of Poland, which provide free services to Polish entrepreneurs and support mainly small and medium-sized enterprises, but also help foreign companies interested in buying Polish goods and services and investing in Poland.
- The Ministry of Foreign Affairs has created a portal that contains a collection of useful knowledge for exporters and importers (www.trade.gov.pl).

There is a lot of competition in the market of banking and financial services. Each institution wants to distinguish itself to attract clients who had decided to set up a business and are choosing a bank which they want to operate their business account. The majority of banks offer current accounts free-of-charge under the condition that monthly payments are made to the State Insurance Institution (ZUS) and the Tax Office – which are obligatory requirements for entities operating in the Republic of Poland. How can an institution convince an entrepreneur that its “zero cost” offer is better than the “zero cost” offer of its competitors? The consumer receives an offer of additional services, not necessarily financial. Our own research has shown that clients who are proficient in navigating foreign markets know how important the bank’s operational involvement in their business is. Issuance of letters of credit or bank guarantees may be a determinant of the success of a given transaction. Banks, in turn, know how important it is to convince the buyer, especially exporters and importers, to use their services due to the large revenues they generate. Therefore, one type of added value offered by financial institutions is support in expanding abroad. Both customers who have been pursuing their foreign expansion for many years and entrepreneurs planning to open a new business in the future can benefit from such an offer.
In addition to Bank Gospodarstwa Krajowego, there are two other commercial banks on the Polish market which support small and medium-sized companies in the internationalisation process. These are Bank Zachodni WBK S.A. through the portal santandertrade.com, and PKO Bank Polski S.A. through the portal wspieramyeksport.pl. The Ministry of Foreign Affairs has also created a website for exporters and importers: trade.gov.pl. The extent of support offered by those websites is very similar (Table 1). The portals offer information, tools and resources to help clients develop their business abroad: discover new markets, find partners and contractors, organise transport, and set up their foreign operations. In addition, they provide online seminars and practical examples presented by entrepreneurs who are experts in many areas of international trade. A SME may be given assistance with recruitment abroad or organising of marketing campaigns. These institutions also arrange foreign missions, or meetings of clients seeking new contractors, which are mainly used by large companies or corporations, and rather rarely by SMEs. Some of the services offered by commercial banks are subject to a fee, and prices are determined individually.

**Table 1: Comparison of the market offers for exporters and importers**

<table>
<thead>
<tr>
<th>Service</th>
<th>Santandertrade.com</th>
<th>Wspieramyeksport.pl</th>
<th>Trade.gov.pl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector-specific reports</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Customer search</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Knowledge base</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Offers and tenders</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Promotion among customers</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Marketing abroad</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Arrangement of meetings with foreign customers</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Arrangement/sharing of a foreign office</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Legal and bookkeeping support</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Visas</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Recruitment</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Webinars</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Organisation of foreign missions</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

The purpose of those portals is to provide comprehensive knowledge and tools to support internationalisation. In addition to helping in finding contractors and aggregating information about offers and tenders, one of the key functions is to educate entrepreneurs about risk management and the possibilities of its mitigation.

**USE OF BANKING PRODUCTS WHICH SUPPORT EXPORT AMONG POLISH SMEs**

The data available on the market allow an analysis of the use of derivatives by Polish companies. They are financial instruments which are not securities and their value depends on the underlying
instrument, for example interest rate or exchange rate (Sittisawad & Sukcharoensin, 2018, pp. 71-86). In the case of large companies, the value of derivative instruments in 2015 amounted to PLN 6.1 billion, and in 2016 to PLN 5.9 billion, while in the case of small and medium-sized enterprises it was, respectively, PLN 0.5 billion and PLN 0.6 billion (GUS, 2016, p. 8; GUS, 2017, p. 7). Such a large disproportion may indicate that smaller companies are not aware of those products or they are too complicated for them. Perhaps, due to the fact that their prices are custom-tailored, those offers may also seem too expensive. A drop in the value of the aforementioned products in large companies and a minimal increase in SMEs is also observed (Table 2).

Table 2: Structure of derivatives in non-financial enterprises in Poland in 2015 and 2016

<table>
<thead>
<tr>
<th>Description</th>
<th>2015</th>
<th>2016</th>
<th>Dynamics [value]</th>
<th>Dynamics [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value [PLN million]</td>
<td>Structure [%]</td>
<td>Value [PLN million]</td>
<td>Structure [%]</td>
</tr>
<tr>
<td>Derivatives–total assets, of which:</td>
<td>6615.1</td>
<td>100</td>
<td>6560.1</td>
<td>100</td>
</tr>
<tr>
<td>Forwards</td>
<td>4651.6</td>
<td>70.3</td>
<td>3912.8</td>
<td>59.6</td>
</tr>
<tr>
<td>Futures</td>
<td>82.8</td>
<td>1.3</td>
<td>61.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Options</td>
<td>170.5</td>
<td>2.6</td>
<td>463</td>
<td>7.1</td>
</tr>
<tr>
<td>Swaps, of which:</td>
<td>1610.7</td>
<td>24.3</td>
<td>1242.6</td>
<td>18.9</td>
</tr>
<tr>
<td>CIRS</td>
<td>580.9</td>
<td>8.8</td>
<td>736.6</td>
<td>11.2</td>
</tr>
<tr>
<td>Other derivatives</td>
<td>99.4</td>
<td>1.5</td>
<td>880.4</td>
<td>13.4</td>
</tr>
<tr>
<td>Derivatives–total assets, of which:</td>
<td>7026.8</td>
<td>100</td>
<td>6456.1</td>
<td>100</td>
</tr>
<tr>
<td>Forwards</td>
<td>4010.5</td>
<td>57.1</td>
<td>4442.5</td>
<td>68.8</td>
</tr>
<tr>
<td>Futures</td>
<td>61.3</td>
<td>0.9</td>
<td>72.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Options</td>
<td>294.5</td>
<td>4.2</td>
<td>463.4</td>
<td>7.2</td>
</tr>
<tr>
<td>Swaps, of which:</td>
<td>2522.3</td>
<td>35.9</td>
<td>1082.1</td>
<td>16.8</td>
</tr>
<tr>
<td>CIRS</td>
<td>197</td>
<td>2.8</td>
<td>412.7</td>
<td>6.4</td>
</tr>
<tr>
<td>Other derivatives</td>
<td>138.1</td>
<td>2</td>
<td>396</td>
<td>6.1</td>
</tr>
</tbody>
</table>

In addition to the complex derivatives, entrepreneurs may avail of other products supporting international trade (trade finance products), such as letter of credit, collection, forfeiting or bank guarantees. On the basis of data collected and shared by one of Polish commercial banks, with a portfolio of about 300,000 small and medium-sized enterprises, the structure of how those banking products are used was examined. The cognitive value of these data is limited because banks in Poland do not use the EU classification of the SME sector. The division of small and medium-sized enterprises applied by banks depends on the risk model adopted in the given organisation. On the other hand, a corporation which provided data defines micro and small enterprises as businesses with revenues of up to PLN 5 million per year, while medium-sized enterprises are those that generate revenues from PLN 5 to 40 million per year.

The study covered 306 companies from the SME sector which in 2017 were a party to 1,078 transactions to help them improve their international trade (Figure 4). The most common were collection and guarantees, followed by letters of credit. The least common is forfaiting, as only 19 transactions related to this product.
The surveyed group showed that products which help mitigate risk in international exchange are most often used, on a national scale, by limited liability companies (38.0%) and sole traders (26.4%). On the other hand, they are the least common among private partnerships (2.4%) and joint-stock companies (4.3%) (Figure 5).

These data are very promising due to the fact that the share of basic economic activity (sole trader) in the use of banking products is second highest.

The above products are most frequently used by entrepreneurs in the Wielkopolskie (16.6%), Mazowieckie (15.5%), Dolnośląskie (12.8%) and Łódzkie (10.5%) provinces. On the other hand, those services generate the least interest in the Podlaskie and Lubelskie provinces (less than 1.0%). Letters of credit are the most popular product in the Warmińsko-Mazurskie province (50% of all trade finance products), collection dominates in the Zachodnio-Pomorskie province (91.2%) and guarantees in the Opolskie province (84.2%), while forfaiting was purchased only in the Pomorskie province (Figure 6). The information provided indicates low use of those products in the eastern and northern regions of the country. An important aspect will, therefore, be raising entrepreneurs’ awareness about the risks associated with internationalisation and the possibilities of mitigating them by private and state institutions in those locations.
Both derivative products and trade finance products had previously been reserved for clients from the corporate sector. The fight for customers in the banking services market has caused financial institutions to adjust their offer for SMEs and expand it to include the above products.

Based on an expert in-depth interview with an employee of an institution which provided the data, it can be concluded that derivative products and trade finance products are not very frequently used by small and medium-sized enterprises due not only to prices, but also to (1) lack of a tailor-made offer for SMEs, (2) the language used by advisers at the branch being too technical, (3) under-trained intermediaries who are not able to fully present the product’s advantages, (4) low customer awareness, and (5) lack of access to information and professional literature.

A synergy of the activities of state institutions and banks is extremely important in the education and support of entrepreneurs. Together, they will have a much wider reach than each of them individually. One of the examples is the economic mission in Georgia organised by the Wielkopolska Development Fund and the Wielkopolska Regional Government with the support of Chambers of Commerce and Business (www.wiph.pl/informacje/wizyta-gospodarcza-gruzja/), or the training in sales on foreign markets. A larger target group would be reached if this initiative is joined by a commercial bank.

CONCLUSIONS

Running a business is a process which involves many risks. Their number further increases when an enterprise decides to go international. The SME sector is characterised by authoritarian owner power, defining the financial policy of enterprises, including the decision on the selection of security mechanisms for the functioning of the company and risk diversification by spreading it onto other market participants. Despite the growing interest in international expansion, owners fail to protect companies against the risks associated with export and import. In 2017, the highest percentages of
surveyed companies conducting their operations both domestically and abroad were found in the following provinces: Lubuskie (31.0%), Zachodniopomorskie (22.0%), Podlaskie (19.0%), however derivatives were used by, respectively, 5.0%, 5.3% and 0.8% of the companies. When data are examined in terms of financial benefit, this is indicated by entrepreneurs in the following provinces: Świętokrzyskie, Podlaskie, and Łódzkie, where the percentage of derivative use is, respectively, 5.8%, 0.8% and 1.5%. An analysis of the geographical structure regarding the use of derivative products in terms of the legal form of the organisation indicates that in all provinces they are mostly used by limited liability companies and sole traders.

The conducted research has shown that small and medium-sized entrepreneurs in Poland do not fully benefit from the possibility of delegating liability offered by financial institutions, even those with an established position on the European market, such as banks. The purchase of derivative or trade finance products still remains a financial tool that is virtually unused in the sector under investigation. On the other hand, it should be noted that the analysed financial instruments had been, in a country with such young capital economy, mainly directed to large companies. Banking institutions, well aware of this fact, are systematically introducing revamped schemes, with their parameters and the formal banking language tailored to the competences of SME managers and the sector’s specific nature. However, the share of use of those instruments revealed by the research undoubtedly indicates that micro and small companies need support in expanding their knowledge about risk management. A major role in developing this niche should be played by both state and private institutions, mainly commercial banks operating on an individual basis.

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Regional Aspects of SMEs in Poland – International Risk Versus Bank Security Products
Mirożwia MODUCKA, Joanna MAŁECKA


Roles and Opportunities of Research Organisations in Innovative Regional Development. A Presentation of the German-Danish Project “Innovative Border Region” (GrinSH).

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ABSTRACT
By extending its transfer services for enterprises and other institutions in the German-Danish border region, Flensburg University of Applied Sciences (FUAS) aims to strengthen its network and its position as a driver for innovation. FUAS particularly seeks to increase the transfer services in those areas that are relevant for the regional industry and reflected in the research-based disciplines at home at the university. These include wind energy technology/renewable energy, maritime technologies and mechanical engineering and food technology.

The GrinSH project (funded by the German Federal Ministry of Education and Research) consists of a number of sub-projects based on the research areas mentioned above as well as the sub-project “Preliminary assessment of a regional management” which serves as an umbrella for the different sub-projects. Each project follows its own work plan and contributes to the overall aim of strengthening the German-Danish economic region for future challenges. This will also be achieved by promoting the STEM subjects with young school children in order to attract more (female) students and strengthen the bonds between the university and industrial partners.

The variety of research and application-oriented activities emphasises FUAS’ role not only as a research organisation but also as a driver for technology transfer and innovation and promotes its competences in regional development.

Keywords: Regional development, innovation, applied research, technology transfer

INTRODUCTION
Germany’s northernmost university, Flensburg University of Applied Sciences, was founded in 1886 as “Royal School of Marine Steam Engineering”. Today about 4,000 students are enrolled in ten bachelor’s degree and nine master’s degree programs. The university has four faculties:

- Faculty of Mechanical Engineering, Process Engineering and Maritime Technologies
- Faculty of Energy and Biotechnology
- Faculty of Information and Communication
- School of Business
Several research institutes with high standards for applied research, development and technology transfer aim to guarantee an applied education for students while at the same time providing highly qualified employees for companies. The research institutes are:

- Centre for Maritime Studies (ship bridge, radar and navigation and engine room simulators)
- Center for Sustainable Energy Systems (development and implementation of environmentally and climate friendly energy systems and technologies)
- Dr. Werner Jackstädt Centre for Entrepreneurship and SMEs
- Institute for eHealth and Management in Health Care
- Wind Energy Technology Institute (research focus on wind turbine control, grid integration, turbine tower concepts)
- Centre for Business and Technology in Africa (projects with partners from Namibia, Kenya, Ghana and Cameroon)

**Innovation performance – the “GrinSH” project**

According to the European Commission’s Innovation Union Scoreboard some regions in Europe are among the top in terms of innovation performance. The key to their success lies in a comprehensive focus on the entire value chain from research to product development and economic growth. The German-Danish border region – despite having the opportunity to catch up with neighbouring innovation leaders such as Hamburg and Copenhagen – is still underperforming.

When the German Federal Ministry of Education and Research (1) established a programme for small and medium sized universities to support technology transfer and regional development in the summer of 2016, Flensburg University of Applied Sciences successfully applied with the project “Innovative Border Region” (GrinSH).
In the five years between 2018 and 2022 Flensburg University of Applied Sciences aims to strategically expand its numerous cooperations, projects and activities in research, development and the technology and knowledge transfer resulting from them. FUAS wants to strengthen and expand its network with businesses and institutions in the northern border region of Schleswig-Holstein.

The overall project focuses on a number of different subject (see figure 1) reflecting the industry of the region as well as the research and teaching subjects of FUAS.

Challenges - in the region and worldwide
Society rightfully expects its universities to not only provide academic qualifications and “produce” knowledge but to make this knowledge accessible and to make a contribution to closing the gap between research and the (further) development of technology. Universities should not only contribute to the realisation of their research results, i.e. the improvement of existing products, processes and services. As part of a strong regional development they should be spearheading this progress. German Fachhochschulen as universities of applied sciences in particular are in a distinct position. They are easy to access as research partners in their region and they are familiar with working across disciplines. As they pass on knowledge on the state of research in the subjects they represent and teach, they take on an important role in the region, often with a particular focus on SMEs. This “antenna function” is carried out through information (education and further education), cooperation (projects, assignments, partnerships) and heads (students).

In general, the framework conditions in the regions are changing due to both economic and demographic structural change and through an increase in globalisation. The biggest challenges currently result from an increase in the complexity of the tasks to be fulfilled, constraints on public budgets, the integration of citizens with a migrant background, major changes on the job market and an increased local competitiveness and digitalisation. The resulting competition between German federal states, regions and municipalities for limited resources such as highly qualified professionals, mobile capital, technical knowhow and infrastructure (transport links, broadband access) must be met. This development into being a more resilient region marks a challenge for a fairly rural region that is located right at a national border, and thus characterised by different cultural influences, and has a low density of small and medium enterprises.

“The structural change ... to becoming a knowledge society will occupy Schleswig-Holstein more in the upcoming decades than it has so far. Activating innovative potential, strengthening good research and teaching, creating a strong network of educational and research institutions amongst each other as well as with industry and business and civil society actors and thus creating a new way of using employing knowledge will become a central necessity...” (quote from the Landesentwicklungsstrategie Schleswig-Holstein 2030, own translation).

CONCLUSIONS
The upcoming years will show whether the GrinSH project, which is funded by a joint initiative of the German government and the federal states (3) in order to promote research-based idea, knowledge and technology transfer at German universities, will help to strengthen regional ties and to make a relevant contribution to innovation in industry and society. The universities and the funding parties are currently developing indicators to facilitate an evaluation and assessment.

It remains to be seen how a region as a whole, including all enterprises and institutions involved, will engage in and support the project. As the programme understands itself to be a learning programme, an opportunity to learn from one another across regions is an actual option. This
creates the possibility to use resources efficiently and to learn from fellow partners’ successes as well as from their failures.

What can a university achieve as the innovation driver of a region? What resources are necessary? And what paths need to be taken – both in regards to content and to cooperation? These questions need to be discussed and while the resulting discussion will certainly be interesting, it will not be possible to answer these questions comprehensively.

This paper and the ICEBE conference create opportunities to discuss the roles of universities as innovation drivers and to examine opportunities arising from the so-called “third mission” as well as the necessary framework conditions also on an international level.

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(3)
Information and Transport Connectivity on Small Island: a Case Study on Maratua Island

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ABSTRACT
Many small islands are characterized by the remoteness and the limitedness of economic scale. These portraits bring us to two things. First, limited availability of transport services, whilst many fleet has a lower utilization. Second, the smallness of its economic size is often associated with the smallness of technological choices. These choices, by default, are in the area of low technologies or applied technologies. Therefore small islands often deploy advanced technologies, including the information communication technology, much later than the big economies in bigger islands. The paper outlines empirical evidence showing the portraits. A special attention goes to the issues of transport and information connectivity.

Keywords: Small islands, sustainability, transportation, information connectivity.

INTRODUCTION
Indonesia is a country with 17,504 islands scattered in an area of some 6 milion sq.km. Its nature and culture are diverse. Most of them are small islands, with an area of less then 2000 sq km each. Some 3000 islands are inhabited, where they face abundant challenges, from healthcare, education, energy supply till transport connectivity. This paper addresses transportation connectivity of Maratua Island, located in Macassar Strait, East Borneo, and proposes ideas to overcome them. The Digital Island project was established under the Sustainable Island Development Initiatives (SIDI) aims at adopting Information and Communication Technology (ICT) as an instrument to contribute addressing challenges there.
The inhabitants of Maratua island is 4400 people. They include those who are originally born and raised there, permanent residents such as shop owners, teachers, medical staff, local municipality staff, and security officers. The visitors or non permanent residents are mostly tourists and few traders. A variety of touristic destinations, for diving, snorkling, swimming or sunbathing on the island of Maratua or the fourteen islands in its surrounding, up to 100 nm from Maratua.

As in most remote small islands, Maratua has a very limited size of space, inhabitants and economy, poor healthcare and education, limited supply of energy and fresh water. The natural biodiversity of in the seabed has attracted many divers from many nationalities. Increasing promotion of the island has been attracted more domestic visitors as well, the number of resorts and simpler homestays grows rapidly. The need for smooth mobility ashore has driven the government to build roads on this U-shaped island. A small airport on Maratua has been operational since 2017,
where a regular service is available, twice a week between Maratua-Berau vv, and Maratua-Balikpapan vv respectively.

**TRANSPORTATION CONNECTIVITY**

Daily about three boats are deployed to serve Berau-Maratua vv. The route is fixed, but the schedule is a bit loose. A general rule is, when the boat is occupied by 50%, then the boat is ready to depart. Otherwise, the boat owners negotiate to reach an agreement to reallocate the passengers to one boat in order to increase efficiency. Malacca Strait is a 2000 meter deep water area between Borneo and Celebes, with an average width of approximately 240 km. This strait is one of three main sea passages in Indonesian waters, where big vessels pass through.

The sea lane connectivity is served by some 25 boats of a capacity 12 and 20 pax, calling from Berau port to three villages, Tanjung Harapan, Bohe Silian and Payung-Payung. Speedboats deployed between 06:00-17:00 travel with a speed of 25-30 knots. With this range of speeds, the trip between Tanjung Redeb and Maratua can be accomplished in 3.5-4 hours in friendly weather.

<table>
<thead>
<tr>
<th>Table 1 Tariff vs Departure Time vs Comfort: a Survey (Alafi, 2017)</th>
</tr>
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<tbody>
<tr>
<td>Departure</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>1 Boat 1</td>
</tr>
<tr>
<td>2 Boat 2</td>
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<tr>
<td>3 Boat 3</td>
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<td>4</td>
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**PERSISTENT CHALLENGES: A TRIGGER FOR A NEW APPROACH**

Remote areas face persistent challenges, namely low demand and poor supply of transportation services. The result is to provide sufficient transportation services, it would incur huge costs. Two options are at hand, namely a classical transportation approach, where hard or physical elements or infrastructure are subject of intervention. This mounts in the form of improvement or enlargement or building new jetties or size of fleet. The size of fleet is achieved through the increase of number of boats or speed of boats. This approach entails usually a lot of investment, operating costs and time. The effort to achieve it is huge.
Soft infrastructure approach is on the other hand conducted without massive investment in physical items. Routing of boats could be used as the first alternative. The number of ports of call is limited, each one port at both sides in Maratua and Berau, respectively. So this option could be neglected.

What we witness at both ports is the challenge to obtain information about the departure time of boats. The boats provide a quasi regular service. The boats lie at berth in a row. The boat owners, acting as the boat driver at the same time, try to lurk passengers. In best times, each boat’s departure is determined regardless the departure of other boats. In time where the number of passengers is low, then the boat owners collaborate. The one who obtains more passengers receives additional passengers from other boats with lower number of passengers. This is efficient, in order to minimize waiting time and operating costs. This works well in Berau port, where the passengers gather and are waiting in the vicinity, at a particular berth area.

The difficulty lies in particular on Maratua Island. Passengers have obtained an information on the schedule of the boats. Sometimes the departures are postponed or even cancelled, without prior notification in advance. The unavailability of such information, postponement and cancellation and even additional boat’s departure, has a severe impact.

People living or staying far from the berth, or having not received immediate information through phone call from boat owners, are exposed for waisting time and costs. In case of emergency, it is not easy either to obtain a boat available for charter. One should obtain information from several boat owners or middlemen. The key to address this is to organize information in such a way that the useful information, such postponement, cancellation or additional boat service, could be broadcasted in the right way.

A prerequisite is the availability of telecommunication infrastructure, i.e. internet. The quality of telecommunication service has been gradually improving in the period of 2013-now. The usage of mobile phone and tables is spreading pretty quickly. The upload speed 2.3 MB/s and upload speed of 0.59 MB/s. This forms an opportunity to provide a solution by providing an information service, without sacrificing too much resources.

PUTTING ICT IN CONTEXT

The immense advantage of e-commerce the the conventional offline one for places out of Java are manifested in terms of massive shipping cost reduction between 11-25%. This magnitude could be achieved by using existing transportation services. There has been no investigation so far how to achieve it given the present challenges of small transport connecting to small areas outside bigger economies. Is there any prerequisite for enabling the e-commerce, specifically for those remote islands?

The above figure shows the distribution of mobile phone users (Fahmi, 2017). Teenagers and younger working people are the main users of mobile phones. This counts for approximately 90% of the total users. As we witness the fast growing number of mobile phone users across the country, picture would change from a total user s of some 10% of the population in 2017. We expect the the penetration would move to 50% in less than two years, and to 80% in 5 years time.
Information and Transport Connectivity on Small Island: a Case Study on Maratua Island.

Setyo NUGROHO, Author 2 Name SURNAME etc.

At present, some 19.9% of Maratua inhabitants use mobile phones (Rizaldi, 2017). This is below the national rate of approximately 30%. In five years time form now, the number would be tripped to 62.9%. The group of 15-49 years old inhabitants would count for some 83% of the users.

A recent study on the potential of e-commerce in Indonesia (Das et al., 2018) reveals a.o. the following:

- The growth of mobile phones users in rural areas including remote areas has been higher than in urban areas. Mobile phone, gadget etc belong one of the most popular spendings for people in rural areas through e-commerce.
- Average shipping costs for a small town outside Java is between 24-47% of the total purchase cost, compared to a small town in Java ranges between 5-24%.
- The e-commerce growth rate in all provinces outside Java is high, the market is still infant, the average growth rate is 3 time per year.
- E-Commerce increases the gender parity. The involvement of female users enables the women to be involved in economic activities.
- E-commerce in rural regions is expanding quickly, with rural buyers spending relatively more on mobile phones, tables etc.
- 30% of Indonesian online commerce spending is new consumption that would not have occurred otherwise.
- Users of mobile phone in Indonesia is 105.6 million users, with an annual growth of 19%.
- The mobile data tariff in Indonesia is very affordable US$ 3.40/ 5000MB data, it is just 50% of the rates in ASEAN countries. This boost a rapid growth of internet users, also in remote areas.
- Consumer in non-Java regions are saving form 11-125% by shopping via online commerce.

APPLICATION DEVELOPMENT

An effort to improve the efficiency of transport management has been conducted by investigating the business process for ordering a boat’s seat. Omitting few processes could save time and inconvenience. The architecture of the Digital Island Transport was established prior to making them a market package, called "Nebeng Kapal". This application is expected to offer convenience from perspectives of passengers and boat owners on Maratua Island. Its features are:

1. Provide information on boat services available for that day.
2. Provide ship schedule.
3. Facilitate prospective passengers to process the boat ticket order. This feature will ease passengers to book tickets online without needing to queue at the port counter.

Nebeng Kapal will also provide convenience to boat owners, with the following features:
1. Facilitate boat owners to set the schedule.
2. Provide information on the number of passers who have purchased the ticket. 
3. Provide passengers’ reviews concerning the trips

At present the Nebeng Kapal, which is a revised version, has completed prototyping stage, and is in the process of being coded. Nebeng Kapal provides two type sof displays, from the views of passengers and boat owners.

Figure 4 Nebeng Kapal App from Passenger and Shipowner Account

CONCLUDING REMARKS
Persistant challenges to increase sea transport connectivity seems to be more efectively addressed by improving the information connectivity over the classical hard-infrastructure approach, by increasing the fleet capacity. The opportunity for deploying an ICT-based solution is promising, since adoption of mobile phones and gadgets has been increasing rapidly. A wide usage of mobile phones opens another window of future opportunity to involve a small island in a network of e-commerce.
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Gender Equity in Engineering Education at Durban University of Technology: A Baseline Study

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ABSTRACT
Durban University of Technology (DUT) is a partner institution in the three year Personalised Engineering Education III Project. One of the project ‘work packages’ is around gender equality. A small research group was established to investigate gender equality in the Faculty of Engineering and the Built Environment (EBE) at DUT. To establish a baseline for EBE at DUT, Student Management Information data were analysed. The data are presented initially to compare EBE with DUT (headcount, pass rate and throughput rate). The data for EBE are presented as headcount by gender and qualification type (undergraduate and postgraduate), pass rate, attrition rate and throughput rate by gender. From the aggregated data for 8 academic departments in EBE, it emerges that females are under-represented in engineering education at DUT. Even though females are under-represented, they consistently perform better than their male counterparts in terms of pass rate, attrition rate and throughput rate. Whilst the aggregated data shows that females are generally under-represented, it is only when the data is disaggregated by department, that a spectrum of representation is revealed. The disaggregated data by department further revealed minimal improvement in representation from 2013 to 2017. This baseline study will inform further research.

Keywords: Gender equity, Engineering Education, Universities of Technology, South Africa

INTRODUCTION
Durban University of Technology (DUT) is a partner institution in the three year Personalised Engineering Education III Project (PEESA III). The project, which is funded by the European Union, involves eight institutions. Four, which are Universities of Technology (UOT), are located in South Africa. These are Cape Peninsula UOT, Tshwane UOT, Vaal UOT and Durban UOT. The European partners are Hochschule Flensburg University of Applied Sciences (Germany), Hochschule Wismar University of Applied Sciences (Germany), University of Szczecin (Poland) and the University Lucian Blaga din Sibiu (Romania). One of the key goals of the PEESA III project is capacity building in the partner institutions. The outcomes of capacity building can be considered to include development of the students, the staff and the institution as a whole. One of the project ‘work packages’ is around gender equality. A small research group comprising the authors was established to investigate gender equality in the Faculty of Engineering and the Built Environment (EBE) at DUT.

At DUT EBE has nearly 7000 students who are registered in ten academic departments. Of those ten departments, there are eight, namely Chemical Engineering, Civil Engineering, Civil...
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Engineering (Midlands), Construction Management and Quantity Surveying (CMQS), Electrical Power Engineering, Electronic Engineering, Industrial Engineering, and Mechanical Engineering that are taking part in the PEESA III project. The students and staff from these eight departments are therefore the participants in the gender equity study.

GENDER EQUALITY AND GENDER EQUITY
Gender equality and gender equity are terms that are sometimes used interchangeably. Equity relates to the principles of fairness, and in education applies to the models, programmes and strategies that may be considered fair but not necessarily equal. Equity is the process, equality is the outcome (The Glossary of Education Reform, updated 04/21/16). Furthermore, UNESCO expand on these definitions and explain that gender equity is the process of being fair to men and women. And that targeted measures are required to overcome the historical and social disadvantages that prevent women and men from operating as equals. Gender equality exists when women and men enjoy the same status, have equal conditions, treatment and opportunities for realising their full potential, contributing to and benefiting from economic, social, cultural and political development UNESCO, 2017a).

As this study in EBE is focusing around the current experiences of female students and female staff the authors decided to adopt the concept of gender equity as the underpinning principle in this phase of the research. It is anticipated that outcomes of the comprehensive research project that is being undertaken will enable strategies to be developed to ensure the achievement of gender equality in EBE in the future.

WOMEN IN STEM: THE GLOBAL PICTURE
According to UNESCO (2017a) over the past decades there have been remarkable gains in participation by women in both education and in the workforce. However progress in participation has been uneven, particularly in the fields of science, technology, engineering and mathematics (STEM). STEM fields are considered as critical drivers for economic growth, however, there is a large imbalance in the participation of women in STEM when compared to men (UNESCO, 2017a). Furthermore, science, technology and innovation are also key to the achievement of the Sustainable Development Goals such as addressing the impact of climate change, increasing food security, improving healthcare, managing limited freshwater resources, and the protection of biodiversity. Girls and women are key players in developing solutions to these challenges because they are the greatest untapped sector of the population to become the next generations of STEM professionals (UNESCO, 2017b).

A UNESCO study on the current status of girls and women in STEM education reveals that a clear gender pattern emerges in higher education. Specifically for the engineering, manufacturing and construction component of STEM, the data from a study of 115 countries and dependent territories show that male students are the majority (73%) of those enrolled (UNESCO, 2017 b). Furthermore, within the female student population in higher education globally, only 30% choose STEM related fields of study. Of that 30% only 8% chose engineering, manufacturing, and construction as a field of study (in 110 countries and dependent territories) (UNESCO, 2017 b).

In studies of women in STEM the question ‘why so few?’ has been repeatedly asked (see, for example citations in Kodate, Kodate, & Kodate (2014)). This question becomes more relevant and vital in the context of engineering and technology. Blair, Miller, Ong, & Zastavker (2017) note that although there have been initiatives to improve gender equity across STEM, the representation of women in undergraduate engineering programmes remains low, with what Sax et al (2016) refer to as a ‘particularly stubborn gender gap’.

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Kodate, Kodate, & Kodate (2014) cite figures provided by the European Commission in 2012 whereby the ratio of female to male PhD graduates in science, mathematics and computing is 23% in Japan, 41% in the USA and 48% in Spain. However, in engineering, manufacturing and construction the ratio almost halves with 12% in Japan, 24% in the USA and 34% in Spain. Kodate, Kodate, & Kodate further explain that there is a general perception of technology as being male, which influences women’s access to technology. The lack of appeal of engineering and technology to females has caused problems at entry point. The choice of specialisation by females is influenced by, for example, social factors such as gender biases and stereotyping, and structural factors such as the type of school attended. According to Kodate, Kodate, & Kodate even when women decide to enter engineering the male-dominated environment and the subsequent marginalisation which they encounter, contribute to a vicious cycle of the image problem.

WOMEN IN ENGINEERING EDUCATION IN SOUTH AFRICA

It is notable that there appears to be a paucity of published literature around female representation in engineering education in South Africa. However, there has been some research conducted on women in the engineering workplace (see for example, Nel & Meyer, 2016; Martin & Barnard, 2013; Mlambo & Mabokela, 2017).

Nel & Meyer (2016) point out that the world-wide concern relating to the under-representation of women in engineering is also reflected in the situation in South Africa. They conclude that few countries are more sensitive to the impact of inequality than the citizens of South Africa. Furthermore, they argue that no profession is more gender-biased than engineering. However, they emphasize the findings of the World Economic Forum Global Competitiveness Report for 2014 - 2015 which highlighted that the quality of science and mathematics education in South Africa is ranked lowest out of 144 countries. Mathematics and science are not attractive to secondary learners, and the school materials contain no gender-specific examples and do not specifically encourage female learners, so these subjects are pursued by boys rather than girls. This resonates with the issue raised by Kodate, Kodate, & Kodate (2014) around the lack of appeal of engineering and technology to females which influences their entry to further studies in these discipline areas.

In 2016 the Council on Higher Education (CHE) published data for the 26 public universities in South Africa (CHE, 2016). The data presented on the headcount enrolments by gender in Table 1 shows that female students have consistently outnumbered male students from 2013 to 2016. It is important to note that the data in Table 1 represents the total headcount across all 26 public universities in South Africa in all the fields of study offered.

<p>| Table 1: Headcount Enrolments in 26 Public Universities Across All Fields of Study by Gender |
|--------------------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Source: CHE (2016)                                        |</p>
<table>
<thead>
<tr>
<th>Female</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>573 698</td>
<td>564 784</td>
<td>574 677</td>
<td>567 119</td>
</tr>
<tr>
<td>Male</td>
<td>409 988</td>
<td>404 365</td>
<td>410 523</td>
<td>408 697</td>
</tr>
</tbody>
</table>

Table 2 presents the CHE data on course success rates by gender. Course success rate refers to the total number of ‘courses’ passed by students in a given academic year relative to course enrolments. The data shows that females consistently have a higher success rate than their male counterparts. The data presented in Table 2 is also for all fields of study across the 26 public universities in South Africa.
Table 2: Course Success Rates in 26 public Universities Across All Fields of Study by Percentage by Gender  
Source: CHE (2016)

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>75%</td>
<td>79%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Male</td>
<td>71%</td>
<td>74%</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>Overall</td>
<td>74%</td>
<td>77%</td>
<td>78%</td>
<td>78%</td>
</tr>
</tbody>
</table>

The data presented in Table 3 are the headcount enrolments disaggregated for science, engineering and technology (SET) at a national level. In South Africa the definition of SET includes Mathematics, thus SET equals STEM. When expressed as a percentage of the total headcount enrolments across all 26 universities, the data indicate that in 2011 22% of females and 37% of males were enrolled in SET. In 2016 these percentages had marginally risen to 24% and 39% respectively.

Thus, there is a distinct similarity to the findings by UNESCO (2017b) in that a low percentage of South African females (24% in 2016) enrol for SET, which is even lower than the 30% global figure reported by UNESCO (2017b). The CHE data for SET is not disaggregated into science, engineering and technology individually therefore a comparison with the global figure of 8% for females enrolled in engineering cannot not be made.

Table 3: Headcount Enrolments in SET by Gender  
Source: CHE (2016)

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET Enrolments</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>118 421</td>
<td>146 022</td>
<td>136 520</td>
</tr>
<tr>
<td>Total Enrolments</td>
<td>542 997</td>
<td>395 116</td>
</tr>
</tbody>
</table>

STUDENT MANAGEMENT INFORMATION AT DUT

In order to establish a baseline for the further comprehensive study at DUT, Student Management Information (MI) data were analysed. The findings from the analysis of these data are the focus of this preliminary paper on the DUT EBE gender equity case study.

The student information includes data around demographics, qualification type, programme of study, and the major field of study. The data are used at DUT to, for example, provide information to internal and external stakeholders, for statutory reporting, to support strategic and operational decision making and for the preparation of the enrolment plan. The Management Information Department at DUT provided the data. It should be noted that to date the audit of the 2017 data is not complete.

The following definitions are applicable to MI reporting:

- Headcount - the number of unduplicated students registered at DUT in a reporting year
- Pass rate – the number of students who passed as a percentage of the number of students enrolled at DUT in a reporting year
- Throughput rate – tracks a cohort of students registering for the first time at a tertiary institution and completing in a minimum time (three years), minimum time + 1, minimum time + 2
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× Attrition rate / dropout – attrition rate provides a measure of the proportion of students who ‘dropout’ of a qualification at DUT each year

GENDER EQUITY WITHIN EBE

The data are presented initially to compare EBE with DUT as a whole (headcount, pass rate and throughput rate). The data for EBE are presented as headcount by gender and qualification type (undergraduate and postgraduate), pass rate, attrition rate and throughput rate by gender.

Table 4 compares the total headcount and pass rate for EBE and DUT. There are six faculties at DUT and from the headcount data presented it can be concluded that EBE has approximately 25% of the total headcount for DUT but consistently has lower pass rates.

<table>
<thead>
<tr>
<th>Year</th>
<th>EBE Headcount</th>
<th>DUT Headcount</th>
<th>Year</th>
<th>EBE Pass Rate</th>
<th>DUT Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>7040</td>
<td>26,472</td>
<td>2014</td>
<td>76%</td>
<td>82%</td>
</tr>
<tr>
<td>2015</td>
<td>7014</td>
<td>27,023</td>
<td>2015</td>
<td>79%</td>
<td>84%</td>
</tr>
<tr>
<td>2016</td>
<td>7041</td>
<td>28,377</td>
<td>2016</td>
<td>78%</td>
<td>84%</td>
</tr>
<tr>
<td>2017</td>
<td>6900</td>
<td>29,787</td>
<td>2017</td>
<td>77%</td>
<td>85%</td>
</tr>
</tbody>
</table>

Table 5 contextualises the aggregated throughput rate in minimum time for EBE and DUT. These data are only for the cohort study of National Diploma first time entering students. From these data it can be seen that the throughput rate for EBE in 2014 was 11% and for DUT was 33% for all National Diploma students. The data available is to the year 2014 because the data for the next cohort are not yet available.

<table>
<thead>
<tr>
<th>Throughput rate – minimum time</th>
<th>EBE</th>
<th>DUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort study of National Diploma first time entering students for 2012</td>
<td>10%</td>
<td>33%</td>
</tr>
<tr>
<td>Cohort study of National Diploma first time entering students for 2013</td>
<td>11%</td>
<td>34%</td>
</tr>
<tr>
<td>Cohort study of National Diploma first time entering students for 2014</td>
<td>11%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Figure 1 shows the aggregated headcount per undergraduate qualification across the 8 departments in the PEESA III project. The data show that male enrolment is higher than female enrolment which resonates with the UNESCO study (2017b) whereby male students are the majority of those enrolled in engineering, manufacturing and construction.

It is important to note that, in South Africa, the National Diploma articulated with a Bachelor of Technology (BTech) degree at Universities of Technology. With the promulgation of a new Higher Education Qualification Sub-Framework (DHET, 2014) the BTech degree became a legacy qualification type. Thus, at DUT the National Diploma and the BTech qualification types are being phased out in Engineering and, in most instances are being replaced by 3 year Bachelor of Engineering Technology degrees (BEngTech). The BEngTech qualification was introduced in 2017 in Chemical and Civil Engineering. The data for the BEngTech qualification also indicates a higher male enrolment (134) compared to female (37) in 2017. The data show that the headcount for both males and females have remained fairly static over the years from 2013 to 2017.
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The aggregated headcount by postgraduate qualification across the 8 engineering departments, as shown in Figure 2, demonstrate a continued higher male enrolment. This corresponds to the trends indicated by Kodate, Kodate, & Kodate (2014) whereby the ratio of female to male PhD graduates in engineering, manufacturing and construction is low. The aggregated headcount figures for 2017 convert to 17% female and 83% male doctoral students and 29% female and 71% male master’s level students. These percentages correspond with the international trends reported for Japan (12%) and the USA (24%) by Kodate, Kodate, & Kodate (2014). It is notable that from 2013 - 2017 there has been a small but steady increase in female enrolment (headcount) in the master’s level qualifications.

The data shown in Figure 3, show that the female students have consistently outperformed their male counterparts, even though the female headcount is lower than the male headcount. The pass
rates shown in Figure 3 are aggregated across all undergraduate and postgraduate qualifications in all 8 departments.

![Pass Rate Graph](image1)

**Figure 3: Pass Rate Across All Undergraduate and Postgraduate Qualifications in 8 Departments in EBE**

*Source: DUT Management Information System*

The data for attrition rates are presented in Figure 4. The attrition rate is the percentage of students who dropout of a qualification at DUT each year. These data are aggregated for all the undergraduate and postgraduate qualifications in all 8 departments. From the data it can be seen that, there is a small but consistent lower attrition rate for female students compared to their male counterparts.

![Attrition Rate Graph](image2)

**Figure 4: Attrition Rate Across All Undergraduate and Postgraduate Qualifications in 8 Departments in EBE**

*Source: DUT Management Information System*

The throughput rates reported in Figure 5 are for the National Diploma qualifications across all 8 departments. The data for the National Diploma qualification were selected because this is currently still the entry level qualification. The minimum time to complete a National Diploma is three years, followed by minimum time + 1 (4 years) and minimum time + 2 (5 years) which is the maximum time within which the National Diploma may be completed. As this is a cohort study, the data for 2013 and 2014 is to date incomplete.

The throughput rate is an indicator of the graduation rate. Throughput rate is calculated as a percentage of the number of graduates against the number of first-time entering students in a cohort. The data in Figure 5 indicate that female students have a higher throughput rate compared to their male counterparts.

![Throughput Rate Graph](image3)

**Figure 5: Throughput Rate for National Diploma Qualifications in 8 Departments in EBE**

*Source: DUT Management Information System*
The data in Table 6 shows the female headcount in each of the eight academic departments by qualification type (undergraduate).

<table>
<thead>
<tr>
<th>2013</th>
<th>Diploma</th>
<th>BTech</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMQS</td>
<td>30%</td>
<td>38%</td>
</tr>
<tr>
<td>Chemical</td>
<td>50%</td>
<td>47%</td>
</tr>
<tr>
<td>Civil</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Civil (Midlands)</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Power</td>
<td>19%</td>
<td>24%</td>
</tr>
<tr>
<td>Electronic</td>
<td>25%</td>
<td>20%</td>
</tr>
<tr>
<td>Industrial</td>
<td>32%</td>
<td>34%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>13%</td>
<td>13%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2017</th>
<th>Diploma</th>
<th>BTech</th>
<th>BEngTech</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMQS</td>
<td>29%</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td>49%</td>
<td>60%</td>
<td>26%</td>
</tr>
<tr>
<td>Civil</td>
<td>26%</td>
<td>32%</td>
<td>18%</td>
</tr>
<tr>
<td>Civil (Midlands)</td>
<td>34%</td>
<td>34%</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>19%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Electronic</td>
<td>23%</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>32%</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>13%</td>
<td>12%</td>
<td></td>
</tr>
</tbody>
</table>

The data in Table 6 revealed an interesting finding about the spectrum of female representation across the 8 departments in EBE. To elaborate this spectrum, the disaggregated data for female enrolment across all undergraduate qualifications in each of the 8 departments were calculated as a percentage. These percentages, when represented on a linear scale, reveal the spectrum of female representation, and are shown in Figure 6. There are two outliers, namely Chemical Engineering (49%) and Mechanical Engineering (13%). Three of the departments, CMQS, Industrial Engineering and Civil Engineering (Midlands), have over 30% female representation. Civil Engineering, Electronic Engineering and Electrical Power Engineering have female representation of a range between 20% and 30%. A further interesting finding from the data presented in Table 6 is that there has been no improvement in female enrolment in each of the 8 departments from 2013 to 2017 in the National Diploma (the entry level qualification). There has mostly been an increase in the female enrolment in the BTech qualification. This is possibly due to the consistent pass rate in the National Diploma.
Figure 6: Spectrum of Female Undergraduate Enrolments for each of 8 Departments in EBE as a percentage of total enrolment

Source: DUT Management Information System

CONCLUSIONS AND FURTHER RESEARCH

From the aggregated data presented above (Figures 1 and 2), it emerges that females are under-represented in engineering education at DUT which is in accordance with global (UNESCO, 2017b) and national (CHE, 2016) trends. Even though females are under-represented, the aggregated data shows that they consistently perform better than their male counterparts in terms of pass rate, attrition rate and throughput rate (Figures 3, 4 and 5). Whilst the aggregated data shows that females are generally under-represented, it is only when the data is disaggregated by department, that a spectrum of representation is revealed. The disaggregated data by department further revealed little improvement in representation from 2013 to 2017 in the National Diploma.

The findings from this baseline study have generated key research questions. These questions include:

- What inspired female students to embark on studying for a career in the engineering programme of their choice (for example, school background; role models; career guidance)?
- What factors influenced their choice of engineering programme?
- What has been their experience studying the engineering programme of their choice at DUT (for example, with text books, field work, and laboratory and/or workshop sessions)?
- What have been the main challenges with their studies on the engineering programme of their choice?
- What would they change about their chosen programme to support female students?
- What have been the main contributing factors to their success?
- What advice would they give to prospective female students wishing to study the engineering programme they themselves have chosen?

These research questions will be further explored through a comprehensive study, using both quantitative and qualitative methodologies to investigate the overarching ‘why so few?’ question at DUT.

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Retaining Female Engineering Students at the Vaal University of Technology

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ABSTRACT

It is a worldwide challenge to attempt to gender equalise the engineering undergraduate programmes in the higher education system. It is, therefore, also not possible to gender equalise the engineering workplace. The Vaal University of Technology initiated an Extended Programme in order to assist students during their first year of study, which aids in building a solid academic foundation, that will allow students to successfully complete their undergraduate studies. This paper aims to explore the contribution of an extended programme, offered as a means of retaining more female students in the engineering undergraduate programmes. During the previous years, it was evident that female engineering students entering the diploma programme do not always graduate. One of the factors was that students were not equipped to handle their first year of study, due to their poor academic background. A four-year diploma programme was developed and implemented. This will become a longitudinal study, as the students are tracked throughout each academic year until graduation. The aim is to retain as many female students as possible, in order for them to successfully graduate and move into the industry to start balancing out the major gender inequality, that currently is seen in the engineering workplace.

Keywords: women in engineering, foundational curriculum, extended programme, female engineering students, retention of female students

INTRODUCTION

It is a worldwide challenge to attempt to gender equalise engineering undergraduate programmes in the higher education system. It is, therefore, also not possible to gender equalise the engineering workplace. Although the workplace faces more underlying problems regarding retention of female engineers, only some of the factors are highlighted in this article. When a female applies for a typical male-dominant position and is selected or shortlisted for the position, she is evaluated more negatively. Several researchers concur on this and state that women are usually less often recommended for employment into these positions (Stamarski & Son Hing, 2015) and there is evidence that women experience biased performance evaluations on typical male-type tasks (Eagly, Makhijani & Klonsky, 1992; Boldry, Wood, & Kashy, 2001; Thomas-Hunt & Phillips, 2004; Stamarski & Son Hing, 2015). Women in male-dominant professions also receive fewer opportunities in the workplace than their peer male colleagues do. Furthermore, managers rate women as having less promotion potential than that of their male peers and are underpaid compared to their male peers (Martell, Lange & Emrich, 1996; Eagly & Carli, 2007; King, Botsford, Hebl, Kazama, Dawson & Perkins, 2012; Glick, 2013; Stamarski & Son Hing, 2015). Even though the author believes that there are even more difficulties that females endure within typical stereotyped male employment positions, this paper will not engage in those issues. Females entering a male-
dominant employment position face more difficulties than males from the time they apply for the position until they leave the profession. This should not discourage females from these professions, on the contrary, if they are technically and scientifically inclined, they may just outperform their male counterparts. The problems associated with these professions cause a dearth of strong female candidates entering the engineering workforce and higher education institutions are tasked with ensuring gender equality becomes a reality in the field of engineering.

THE ENGINEERING STUDENT IN HIGHER EDUCATION

According to the Congressional Joint Economy Committee of the United States, only 14% of engineers are women. The University of Virginia estimates that 31% of their graduates are female (Crawford, 2012). The difference is these numbers is notable and could be attributed to the graduation rate of the higher education institutions. Crawford (2012) opines that reasons for the low female graduation rates might include the lack of female engineering role models, or misconceptions of what the engineering profession entails. Retention of engineering students has been studied, as well as the reasons why students transfer out of the engineering field of study. It is not only academic difficulty that leads to transfers, the majority of reasons are not due to the students’ academic performance, but due to other reasons such as financial constraints and difficult first-year experiences (Pascarella & Terenzini, 1980; Seymour & Hewitt, 1997; Seymour, 2002; Santiago & Robin, 2012; Sutherland, 2014).

Many problems have been identified regarding student retention, including the negative first-year experiences of students. Investigation into the first year of a student’s life is recommenced and currently, South African higher education institutions are investing more time for research into the deteriorating retention rate of their first-year students. There are different approaches, methodologies and programmes completed by the different higher education institutions of learning.

The Vaal University of Technology (VUT) initiated an Extended Programme in order to assist students during their first year of study, which aids in building a solid academic foundation that will allow these students to complete their undergraduate studies successfully. This paper aims to explore the contribution of an extended programme, offered as a means to retain more female students in the engineering undergraduate programmes. During the previous years, it became evident that female engineering students entering the programme did not always graduate. Studies were conducted on the causes of this occurrence and various factors were exposed, including that students were not equipped to handle their first year of study due to their poor academic background (Sutherland, McFarlane & Vermeulen, 2002; McFarlane, Sutherland & Vermeulen, 2004; Sutherland & Waetzel, 2006; Dicks, De Jager & Sutherland, 2006; Sutherland, 2009; Santiago & Robin, 2012; Sutherland, 2014). This factor is notwithstanding the fact that post-1994, equality in education is practised and all learners, supposedly, receive the same standard of education. However, according to the Department of Higher Education and Training (DHET) (2012, p. 1-5) there are still unprepared as well as under prepared learners entering the higher educational institutions.

However, it was determined that, irrespective of their schooling background, students appear ill-equipped for their first year of study; they still underperform and the dropout rate is extremely high. This is not only for female students, but all students in their first-year of study. The number of successful engineering students that complete their qualifications depends on two factors. The first factor is the enrolment rate, which on its own is a function of multiple factors such as recruitment and course fees and, the second factor is the annual retention rate, which measures the number of students staying in the engineering courses from year-to-year (Geisinger & Raman, 2013).
Upon investigation of the different studies that were conducted in the different higher education institutions in various countries, it was observed that the results are very similar and each institution tries to implement different recommended constructs and programmes to ensure maximum retention of their engineering students. The Extended Programme for the engineering students was implemented in VUT and has been operational since 2016.

THE ENGINEERING EXTENDED PROGRAMME

The purpose of foundational provision (extended curriculum) is to improve the academic performance of students who are at risk due to their educational backgrounds. The key role of the extended qualification is to support educationally disadvantaged students who are underprepared despite meeting minimum admission criteria, by enabling them to be placed on an extended curriculum that will give them the academic foundations for successfully completing their studies (DHET, 2012, p. 1-5).

Research leading towards the implementation of the Extended Programme has been conducted as a longitudinal study that started in 2002. Over the years, different practices and educational methodologies have been experimented with. This allowed the university to implement an engineering Extended Programme with sound academic standards and the best applicable teaching and learning practices. Students entering the Extended Programme complete the three-year degree in four years. The first year is used to integrate the students successfully into the higher education environment. This entails that more than the academic well-being of the student is considered. All teaching practices applied also include the determination of how much learning has taken place. After determining that the lessons taught are understood, another period is allocated to practically apply the taught concepts. The majority of the practical applications are based on real world applications, which keep the student interested in the subjects and assist them to understand why it is necessary to do the subjects in the first place. The project-based teaching methodology was adapted due to the shortage of laboratories within the institution. The teaching and learning methodologies, which are applied in the Extended Programme, combined with maximised contact hours, successfully contribute to the positive outcome of the study.

The focus of the Extended Programme qualification is particularly on first-time entering university students. The high drop-out rate of students in their first year of study, which was revealed through an analysis of specific cohorts, is highly disconcerting. Student success rates are determined by Higher Education Management Information System (HEMIS) and full-time equivalent (FTE) degree credits awarded to students divided by HEMIS and FTE total student enrolment for a particular year. A graduation rate is the total number of graduate student heads in a given academic year divided by the comparable total number of enrolled student heads in the same academic year, using the HEMIS data. Foundation provision focuses particularly on basic concepts, content and a learning approach that fosters advanced learning. Even where the subject matter is introductory in nature, foundational provision must make academic demands on the students that are appropriate to higher education. For that reason, foundation provision is intended primarily to facilitate the academic development of university students whose prior learning has been adversely affected by educational or social inequalities (DHET, 2012, p. 1-5; Geisinger & Raman, 2013).

Since the purpose of foundation provision is to enable students to complete approved university qualifications successfully, it is necessary that foundation provision is located within ministerial-approved degree/diploma programmes. Foundation provision must be divided into components – formal courses (or modules) – that are subject to the same design, presentation, assessment, administration and quality assurance standards as that of regular courses (DHET, 2012, p. 1-5).
The VUT Extended Programme offers modules specifically developed to assist underprepared students with the academic fundamentals that will enable them to complete the undergraduate programmes successfully. The one-year extended curriculum is divided into five modules and all modules offer specific subjects within the first year. The students are required to pass all module subjects in order for them to proceed to the next academic year successfully. The foundational credit is divided into five modules, as every part of the curriculum offered is essential and the university commits itself to ensure that students are equipped with the correct academic knowledge as well as soft skills to ensure a successful completion of the diploma/degree programme for which they are enrolled.

This Extended Programme offers a generic first year extended academic programme. Students must complete all the module subjects of Applied Mathematics, Science, Language Literacy, Computer Literacy and Entrepreneurial Skills successfully before they can advance to the second year of study. Semester 1 is used to offer modules 1 and 2, while Semester 2 is used to offer modules 3, 4 and 5. The first semester is used to acclimatise students into a higher education environment, while the second semester prepares them for the full load of academic responsibilities in the following year.

Although the Extended Programme was designed and implemented for all the engineering students, it has proved a significant retention tool for female students. As the study progresses, it should become clear that the retention of students on an annual basis is high. Currently, the study is only based on the female engineering students within the extended year. This will naturally increase each year, as the retention of the female students is measured. The VUT official database programme is used to obtain the results.

RESULTS

Since 2016, VUT has offered the Extended Programme for undergraduates of the Engineering and Technology Faculty and the author’s research focuses on this group, as well as the 2017 cohort of students to determine if the four-year undergraduate diploma programme attracts more female students, as well as their retention in the programme until they graduate. It will be a longitudinal comparison study between the four-year undergraduate engineering students against the three-year undergraduate engineering students.

Figure 1: 2016-2017 female students registered within the disciplines
The 2016-2017 first-time entering female students is depicted in Figure 1. In order to see which engineering discipline needs more attention from the recruitment team, the results are depicted per discipline in which the students registered. The recruitment team visits the secondary high schools scouting for potential students to be enrolled in the VUT.

From Figure 1 it can be determined from the ratios of female (2016-71%; 2017-92%) that there are far more female students registered for chemical engineering than male students (2016-29%; 2017-8%). There are very few female (2016-35%; 2017-38%) students registered for civil engineering compared to male students (2016-71%; 201792%). There were no female students registered for computer systems. There are very few female (2016-37%; 2017-27%) students registered for electrical engineering compared to male students (2016-63%; 2017-73%). There are very few female (2016-41%; 2017-42%) students registered for industrial engineering compared to male students (2016-59%; 201758%). There are very few female (2016-22%; 2017-13%) students registered for mechanical engineering than male students (2016-78%; 2017-87%). There are very few female (2016-50%; 2017-45%) students registered for metallurgical engineering compared to male students (2016-50%; 2017-55%). There are no female students registered for power engineering during 2016, however there were a few registered for 2017 (37%).

![2016 and 2017 retention rate of female students](image)

**Figure 2: 2016 - 2017 retention rate of female students**

The retention rate of female students during the 2016 and 2017 extended year was very high (Figure 2). Chemical engineering retained 92% for 2016 and 100% for 2017. Civil engineering retained 100% for 2016 and 2017. Electrical engineering retained 87% for 2016 and 91% for 2017. Industrial engineering retained 89% for 2016 and 100% for 2017. Mechanical engineering retained 100% for 2016 and 2017. Metallurgical engineering retained 60% for 2016 and 100% for 2017. Power engineering had no female students recorded for 2016 but had a retention rate of 93% for 2017. This indicates that the Extended Programme helps to retain more female students.

**CONCLUSION**

After interpreting the results obtained over the two years, it can be concluded that the number of females registered for the engineering disciplines are very low compared to the number of males for the same faculty. The only engineering discipline that has more females registered than males is chemical engineering. It will be interesting to determine, by means of a group interview, why male chemical students are not so keen to register for this discipline.
Even though the minority of students are female, they pass very well in the extended year. They, therefore, can continue with the normal undergraduate diploma programme. Phase 2 of this research will determine if the university continues to retain the students in the normal undergraduate diploma programmes. It is envisaged that this should not be a problem, as the foundational education layer has been dealt with sufficiently. Should the retention rate stay high, it will be obvious that a higher graduation rate will occur. This will be the last phase of the research, with the main objective to retain more female students in the undergraduate engineering programmes.

Once the graduation rate of female engineering students is raised, there will be more role models in the undergraduate programmes and later on in the workplace. Triangulation within the literature study will be obtained and the research project complete. However, it is reiterated that this is a longitudinal study, where the final phase of the study can only reach completion after five to six years.

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Statistical Analysis of Regional Labour Markets in Poland: Gender Perspective

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ABSTRACT

This study investigates gender inequalities existing on regional labour markets in Poland. Differences between men and women are induced by distinct employment rate, wages, market segregation or social and cultural aspects. The objective of the research is to find regional patterns of women situation on the labour markets. To achieve this purpose authors used gender segregation index, measure of similarity of time series as well as some classification methods. The data came from Statistics Poland, and covered the period 2009-2016. The novelty of this research is examination of regional gender inequalities on the Polish labour market using methods of multidimensional analysis. The main findings indicate that the participation rate of women is characterized by strong differentiation at the regional and sectoral levels, the same pattern of gender inequality across regions occurs and there still exists significant gender wage gap, although its range is business-cycle-sensitive.

Keywords: labour market, gender inequality, statistical analysis.

INTRODUCTION

The contemporary processes are the reason that human capital level is one of the main factors restricted the economic growth in the next years in European Union. Disequilibrium on the labour market caused by lower supply is the consequence of demographic and migration processes. Countries that are able to neutralize the negative effect of lowering number of employees will have faster economic growth and higher level of development. The increase of the number of employees could be realized by means of various tools of socio-economic policy. One of these tools could be effective adopting of migration and the second one – increasing propensity of women to take up work. Recent studies suggest that societies that increase women’s access to employment and narrow differences between men and women in economic opportunities increase the pace of economic development, greater macroeconomic stability and reduce poverty (Stotsky, 2006, p.5). Heathcote et al. (2017) studied the impact of the rise in female labour supply on the economic performance of the United States over the period 1967–2002, and found that preference shifts and the rise in relative wages of women were the most important driving forces behind rising women’s participation.

1 A comprehensive discussion on economic growth factors can be found e.g. in (Batóg, 2010, pp.29-42).
Gender differences in behavior may lead to different outcomes in the macroeconomy, thus macroeconomic policies have to consider this to influence effectiveness of public policy decisions (Stotsky, 2016, p.3-5).

This research explores some key regularities of women participation in labour market among Polish regions. We address two main research questions within this study: Does the pattern of gender inequalities in the labour market differ across Polish regions? Can we expect, despite of such inequalities, higher propensity of women to undergo employment in the future? To answer these questions we analyze level of women’s entrepreneurship in comparison to men, using such characteristics like employment rate, ownership level, market segregation and wage gap.

The aim of this paper is to investigate the size and the patterns of gender inequalities related to these aspects from the regional perspective in 2009-2016, using data from Local Data Bank provided by Statistics Poland. We consider three aspects of gender inequalities related to the labour market. The first is the difference between men and women participation in the labour force. The second is the women’s wage discrimination while the third is different attitude to the ownership between man and females. The paper differs from previous literature, because we have also employed, apart from simple indices, two methods of statistical multidimensional analysis: linear ordering and cluster analysis. The paper is organised as follow. The next section provides background information based on current literature. The third section discusses the methodology. The fourth highlights our statistical findings and explores some possible causes for the observed regularities, and finally the main conclusions of this research with some policy implications are presented in the concluding section.

**LITERATURE REVIEW**

Women and men are characterized by different employment activity, wage rates and tendency to cluster in different occupations (Blundell and MaCurdy, 1999; Matuszewska-Janica and Witkowska, 2010). These differences lead to different wealth accumulation, risk preferences, probabilities of owning a home, family structures, marriage patterns and the institutional and legal environment (Sierminska et al., 2008, p.4-6). The authors of mentioned research argue also that inequalities and diverse behaviour of men and women have different dimension in micro scale related to e.g. human capital, age, employment status and household structure, in comparison to macro-scale connected with e.g. welfare state concept, labour market flexibility, women empowerment, income inequality and development level (Bárcena-Martín and Moro-Egido, 2013, pp.74-76). Many sources indicate early retirement programs, migration and higher propensity to study as main determinants of lower participation rates among women in comparison to men (Witkowska, 2016, p.135). Ouedraogo and Marlet (2018) using a panel dataset of 94 developing countries from 1990 to 2015, find that Foreign Direct Investment inflows increase labour demand, technological spillovers, corporate social responsibility and economic growth, bringing improvement of women’s welfare and decrease of gender inequality. Most important reasons of professional inactivity of women in EU27 in 2014 with the distinction according to age groups we can find in (Matuszewska-Janica, 2016, pp.113-114), whereas a comparative analysis of women’s situation on the labour market in EU in 2004-2014 (without wage aspect), based on linear ordering, was conducted by Bąk (2016). The latter study shows that in 16 EU countries women were characterized by shorter unemployment duration. This conclusion is in a contradiction with the results received for Poland by Batóg and Batóg (2016).

The wage gap is often pointed out as a crucial aspect of gender inequality. Its intensity depends on economic branches, job contracts, age, occupations and ownership sectors and may generate several negative social and economic consequences (Witkowska, 2016, pp.138-139). According to Heathcote et al. (2017) gender wage gap has narrowed over time. One explanation of this tendency

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is shift towards services and white-collar occupations, reducing labour productivity gap between women and men. Another theory is related to the change of attitudes towards women (Heathcote et al., 2017, p.522). Gallego-Granados and Geyer (2015) explore at length, using German data, income and labour supply consequences of gender wage gap. Negative influence of fast, foreign capital led economic growth, accompanying by structural adjustment and global market integration, on gender poverty gap in Central and Eastern Europe was observed by Fodor and Horn (2015). Quite different conclusions were derived by Kleven and Landais (2017), who analysed the evolution of gender inequality in labour supply and wage rates, over the path of economic development. Using 248 surveys from 53 countries between 1967 and 2014, they find that there is large convergence in the earnings of men and women, driven by higher female participation and wage rates. Some authors argued also that gender wage gap is larger when wage and education level are increasing (Zwiech, 2010, p.276; Vilerts and Krasnopjorovs, 2016; Landmesser and Urbańczyk, 2018).

Another issue related to gender inequality on the labour market is occupational segregation that may channel women into certain economic sectors and occupations characterized by lower wages, resulting in losses of productivity and output (Tzannatos, 1999).

**DATA AND METHODS**

All data comes from Local Data Bank (LDB) provided by Statistics Poland, and covers period 2009-2016. Previous years were excluded from conducted research because of some change of data generalization within national census in 2011. The whole economy was divided into five economic sectors: agriculture, forestry and fishing (sector 1), industry and construction (sector 2), trade; repair of motor vehicles; transportation and storage; accommodation and catering; information and communication (sector 3), financial and insurance activities; real estate activities (sector 4) and other services (sector 5). Both classification methods (linear ordering and cluster analysis) were based on the following set of variables: share of women in total employment (X₁), share of women in public sector employment (X₂), share of women in private sector employment (X₃), employment rate for women (X₄), share of owners, co-owners including contributing family workers women in the number of employed women (X₅) and ratio of average wages and salaries for women and average wages and salaries for men (X₆).

To compare similarity of time series the following first order temporal correlation coefficient proposed by Chouakria and Nagabhushan (2007) was used:

\[
CORT = \frac{\sum_{t=1}^{T-1} (u_{t+1} - u_t)(v_{t+1} - v_t)}{\sqrt{\sum_{t=1}^{T-1} (u_{t+1} - u_t)^2} \sqrt{\sum_{t=1}^{T-1} (v_{t+1} - v_t)^2}}
\]

where:

\(u_t, v_t\) – values of the first and second time series in period \(t\).

To assess if there exists gender segregation on the labour market standardized index IP of Karmel and MacLachlan (1988) was applied:

\[
IP = \frac{1}{N} \sum_{i}^{N} \frac{F}{M} M_i - \frac{M}{N} F_i
\]

where:

\(N\) – total employment,

\(M\) – men employment,

\(F\) – women employment,

\(M_i\) – men employment of sector \(i\),

\(F_i\) – women employment of sector \(i\).

\(^2\) See also analysis conducted for Australian (Bamberry, 2017) and Greece regions (Georgiadis and Christopoulos, 2017).
Measure IP is interpreted as a fraction of employees that should be reallocated between sectors to assure the homogeneous distributions of men and women in all sectors. Its value ranges from 0 (the equal number of men and women in every sector) till 0.5.

The next method applied was linear ordering with pattern (Balicki, 2009). It allows to point out regions that are characterized by the best and the worst situation of women on the labour market. The raw data was standardized and Euclidean distances between pattern and objects were calculated. Taxonomic measures of gender inequality (TMGI) were computed as follows:

\[ TMGI_i = 1 - \frac{d_i}{d_0} \]

where:
- \( i \) – number of object,
- \( d_i \) - distance between pattern and object \( i \),
- \( d_0 \) - distance between pattern and anti-pattern.

The homogenous groups of regions according to the situation of women on the labour market were identified by means of one of the clustering method – Ward algorithm of hierarchical grouping (Härdle and Simar, 2012). Concordance of groups received in two years was verified using Rand index (Rand, 1971):

\[ RAND = \frac{\sum_{s < s' \leq n} \eta_{ss'}}{n(n-1)/2} \]

where:
- \( r, s \) – number of object (voivodship),
- \( n \) – number of objects,
- \( \eta_{rs} = 1 \) when objects \( r \) and \( s \) are in the same group in both years or objects \( r \) and \( s \) are not in the same group in both years,
- \( \eta_{rs} = 0 \) when objects \( r \) and \( s \) are in the same group in one year and are not in the same group in the second year.

EMPIRICAL RESULTS AND DISCUSSION

The change of the number of employees in Poland in 2009–2016 was over 1.5 million people that is 11.3% with the exception of 2010. In 2010 the level of economic activity was lower and the small drop in the number of working men occurred. In the examined period the growth rate of working women (14.3%) was greater than growth rate for working men (8.6%).

The share of women in total employment in Poland in 2016 was equal to 47.6%. This share was higher in public sector (65.0%) than in private one (43.6%). The lowest level of the share of women in total employment in public sector was in mazowieckie (59.1%) and śląskie (58.2%) voivodships, whereas in private sector – opolskie (38.0%) and podkarpackie (38.7%) voivodships.

The lowest share of women in total employment was in sector 2 (industry and construction), while the shares in sector 4 (financial and insurance activities; real estate activities) and sector 5 (other services) were much above average (61.4% and 66.5% respectively).

The highest share of women in total employment in sector 1 was in podkarpackie (0.528) and malopolskie (0.524) and the lowest one in zachodniopomorskie (0.403). The highest share of women in total employment in sector 2 was in lódzkie (0.315) and lubuskie (0.313) and the lowest
one in opolskie (0.240). The highest share of women in total employment in sector 4 was in kujawsko-pomorskie (0.676) and the lowest one in mazowieckie (0.584). In sectors 3 and 5 the differences between voivodships were very small.

The similarity of time series for employment rates for men and women in voivodships in economic sectors in 2010-2016 was examined by means of CORT. The maximum values of CORT were in dolnośląskie (0.961), małopolskie (0.946) and śląskie (0.933) while the minimum values were in lubuskie (0.124), warmińsko-mazurskie (0.493), podkarpackie (0.610), lubelskie (0.659), mazowieckie (0.690) and świętokrzyskie (0.733). It could be observed that tendencies for employment rates for men and women were different in voivodships with high and low level of development.

The share of men as owners, co-owners including contributing family workers in the number of employed men is higher than in case of women in Poland during 2010-2016. In 2016 these shares were 29.1% for men and 24.0% for women. The highest shares of women as owners, co-owners including contributing family workers in the number of employed women in 2016 were in lubelskie (44.3%), podkarpackie (42.5% – more than for men), świętokrzyskie (41.6%) and podlaskie (36.6%) – these voivodships are less developed. The lowest shares of women as owners, co-owners including contributing family workers in the number of employed women in 2016 were in mazowieckiego (16.6%), dolnośląskiego (16.3%), śląskiego (16.9%) and pomorskie (18.0%) – these voivodships are high developed.

The gender wage gap was calculated as a ratio of average monthly nominal wage and salary for women and average monthly nominal wage and salary for men. The values for Poland in consecutive years had changed only a little – from 82.2% in 2004 to 84.4% in 2016. In 2006, 2008 and 2010 the gender wage gap was bigger in private sector than in public one. In 2010 (downturn) the situation of women had improved in both sectors. It could be observed that this ratio is sensitive to changes in business cycle.

The value of IP index in Poland in 2016 was equal to 0.119. It could be concluded that the shares of employed men and women were quite balanced, and we do not observe gender segregation related to the economic sectors. The lowest values of IP index characterized lubelskie (0.101) and wielkopolskie (0.110) voivodships and the highest ones – śląskie (0.144) and opolskie (0.142) voivodships.

Rankings of voivodships according to gender inequality in two years: 2011 and 2016 are presented in Table 1.

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The orders of voivodships in both rankings are very similar (Spearman coefficient of correlation is equal to 0.96). The lowest gender inequality occurred in małopolskie and podlaskie, while the highest one was assigned to śląskie and mazowieckie.

The results of hierarchical grouping of voivodships according to gender inequality for 2016 is presented in Figure 1.

![Dendrogram for voivodships in 2016](image)

**Figure 1: Dendrogram for voivodships in 2016**

*Source: own calculations based on LDB data.*

Three homogenous groups of regions could be distinguished. The value of Rand index (0.70) confirms the high level of concordance of groups received in 2011 and 2016. Only four voivodships (lubuskie, pomorskie, wielkopolskie and zachodniopomorskie) changed group membership – in 2016 they joined the group composed of three regions: dolnośląskie, mazowieckie and śląskie.

**CONCLUSIONS**

The essential condition of the economic growth in the case of the decrease in the potential labour supply is the implementation of programmes increasing the share of women on the labour market and leading to diminishing the wage discrimination. The different ways of making decisions and different responses to impulses from socio-economic policies for men and women should be taken into account in creating the principles and tools of women employment policy. The conclusions from analyses conducted on the national and regional level could be the base of establishing of adequate and effective actions. The results of current study could add to this base by identifying the fundamental regularities on the labour market in Poland. On the base of the conducted analyses the following findings could be drawn: (i) employment of women grows faster than employment of men and the number of women employed in public sector is greater than the number of men employed in the same sector, (ii) the share of women employed is characterized by strong regional differentiation, (iii) low shares of women as owners and co-owners characterized high developed voivodships, (iv) almost the same level of gender wage discrimination occurred during last several years, although its range was business-cycle-sensitive, (v) conducted analyses confirmed quite
strong stability of association of regions to particular classes according to the women situation on the labour market, and proved that the level of regional economic development was the most important differentiating factor. To develop general policy and recommendations, more comparative research at the European Union regional level is required. Such analysis may include comparisons of women and men wage distributions or employment rates by age groups.

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Gender Diversity: an Example of the Organization from the Higher Education Sector

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ABSTRACT
The aim of the paper is to discuss and evaluate the gender diversity in organization on the example of the organization from Polish higher education sector. Firstly the Authors discuss the idea of diversity within work teams. In the empirical part the analysis of gender diversity in particular organization is conducted. Theoretical part is based on the literature review (the Web of Science Core Collection database is used as a main source of data). In the second part of the article Authors use the method of case study. Drawing on empirical evidence it is shown that in some aspects the gender structure of employment in the University of Szczecin is balanced while in others it is not. More women than men are hired on the University of Szczecin but more men than women have the highest position of Full Professor. By this article the Authors take part in the discussion about the gender issue in modern management on the universities.

Keywords: diversity, gender, universities.

INTRODUCTION
It goes without saying that people do differ from each other. Every day we interact with people of different sex, skin color, culture, religion or outlook on life. This causes that we discuss to each other, we learn from each other but at the same time we want to force our own point of view and we are even ready to fight with dissimilarities. The way we behave is strongly associated with our attitudes towards diversity – the fear, anger, nonchalance or affirmation appear in social relationships. Taking the above into consideration it must be remembered that diversity occurs also in work environment and affects people’s behavior.

A work-team is a kind of social group within which people should work collectively to achieve synergic effect [12, p. 62]. Getting familiar with the factors of diversity in work environment is crucial as it helps to understand the source of people’s behavior and to foresee its impact on collective work.

Referring to J. Fazlagić [5, para. 6] heterogeneity of team-work is an effect of so called primary, secondary and organizational criteria. In the first case factors like: the race, ethnicity, age, sexual orientation are beyond the control of the individual. In case of secondary criteria e.g.: the level of education, place of living, family status, language, religion et al. individuals change them more or less consciously during lifetime. Finally organizational variables which differ employees from each other are e.g.: seniority, job position, sector and form of employment et al. [10, p. 8].
In turn Loden & Rosener present the idea of diversity wheel to discuss four dimensions of differences, but also similarities, between people [9, p. 33]:

1. Personality that reflects the character, temperament, attitudes of individuals and show the way all these elements together affect the person is perceived by social environment.

2. Internal dimensions which base on factors that an individual cannot control or shape, as they are determined by the nature: age, gender, sexual orientation, physical ability, ethnicity, race. These aspects are visible and have an impact on the way the person is treated by others while communicates and interacts with them. So that internal dimensions can be the source of discrimination.

3. External dimensions are created by outcomes of individual’s life experiences and decision made in different areas such as the education, career path, income, family status. These factors have combined effect on one’s status in organization and society.

4. Organizational dimensions include number of hierarchical as well as functional aspects of work and describe employees’ diverse taking into account the job position, range of power in organization and performed functions.

In accordance diversity is something more than just hiring employees of different sex or race. Nowadays diversity has broader sense and refers to lifestyle, position in organization, age, sexual orientation et al.

At the same time it must be remembered that most of the developed countries face demographic changes like ageing of the population, the increasing number of disabled people, migration. All those trends have diversified workforce and made managers to change the way they manage people within organization.

As it was mentioned before gender is one of the aspect of diversity in organization and gender diversity deals with equal representation of men and women in workplace. The issue is still important as women face serious problems on labour market. In Western Europe, only 17 percent of executive-committee members are women, and women comprise just 32 percent of members of corporate boards for companies listed in Western Europe’s major market indexes (exhibit) [5, p. 6]. Additionally for example women still work more unpaid hours than men and suffer from gender pay gaps [2, p. 163]. It seems that stereotypes and prejudices are still the main barriers in terms of gender diversity in organizations. Discrimination concerning gender, namely unequal treatment of women, is specifically evident, which is not justified by any objective reasons [13, p. 191]. That is why there still is a need to join the discussion about gender diversity and its impact on the working environment.

Although the idea of gender management is popular and widely discussed in case of enterprises, there is still not enough scientific description of the mentioned concept in higher education sector. Bradley et.al [3, p.103] even states that there is not much focus on women’s’ problem of representation in higher education sector. In turn Patterson, Kirschke, Seaton and Hossfeld focused on numerous gaps like salary, promotion, discrimination, harassment that women experience in academic leadership [11, para. 2] . Considering the above the Authors of the article has decided to take up the subject of gender diversity in Polish higher education sector on the example of University of Szczecin. To do so some research questions were formulated: Whether the gender structure of employment on University of Szczecin is diverse? What is the gender structure of employment on particular job positions on the University of Szczecin? What are similarities and differences in gender structure of employment on University of Szczecin in comparison to the data for the whole Polish higher education sector?

**THE ROLE OF HIGHER EDUCATION SECTOR IN POLAND**

Polish traditions of academic education started in 1364 when King Casimir the Great established the Cracow Academy (Jagiellonian University). Since then higher education system has developed dynamically. Poland holds fourth place in Europe (after the United Kingdom, Germany and France)
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in terms of the number of people enrolled in higher education [7, para. 2] and the gross scholarisation index was in 2017 at the level of 47% (the net scholarisation index 36,8 %).

Today the sector of higher education plays significant role in Poland as it put a milestone in a process of socio-economic development after political transformation in 1989. The mission of higher education is: to increase the quality of life of Polish society by creating and disseminating the knowledge, shaping the ability to use it for individual and general purposes and increasing the quality of public services. The mission also refers to creating mutual relations between domestic academic society and external environment. But, what is the most important considering the subject of the article, the mission also express openness for diversity, as Polish higher schools tend to break down barriers and prejudices against people of different ethnicity, religion or opinions [7, para. 2]. Nowadays Polish higher schools face different challenges. First of all the society is aging. Due to population decline higher schools are forced to compete for students. Additionally most of the developed countries face demographic changes the increasing number of disabled people or migration. Those phenomena affect both workforce and students and as a result cause more diverse population. Finally Polish higher schools are on the eve of the new law regulations\(^1\). The change of situation in external and internal environment of higher schools makes them to transform from so called Humbolt model of University into entrepreneurial one [4, p. 4]. So that there is a need for reorientation the way the modern university is managed.

**RESEARCH FINDINGS**

**The characteristic of the diversity of higher education sector in Poland**

In academic year 2016/17 there were 390 higher schools in sector. 66.2% of them were non-public. However, public schools recorded higher number of students 76.7% of all students. So that there is a high polarization of the sector due to form of the ownership (public and non-public). Comparing to the year 2006 one can observe decreasing number of higher schools (in 2006 there were 445 higher schools in Poland) and decreasing number of students (as since 2006 the population aged 19-24 has decreased for about 30 %). Due to this fact some of higher schools are closed or transformed into agencies. The largest number of higher schools are placed in big cities, although over 30% of all students comes from villages. The biggest high school in Poland is Warsaw University, which educates 3,3% of all Polish students [8, p. 25].

Polish higher education sector offers wide range of forms (full-time, part-time), levels (bachelor, master, doctoral, postgraduate studies) and fields of study. Most of students prefer full-time studies (66,4%) and the most popular fields are: business and administration, technical – engineering, social sciences. Women accounted for 57,6 of all students. They chose mainly social care studies (87,1%), pedagogical studies (80,7 %) and languages (79,0%). On the contrary studies that were the least popular among women were: ICT technologies (12,2 %), technical – engineering ( 24,8%) and fishing (25,3%) [8, p. 31-32].

Studying is still not very popular among disabled people, as they were only 1,9% of all students. On the other hand the number of foreign students has been increasing (in 2005/06 there were 10092 foreigners and in 2016/17 65800). The most of incoming student are from Europe (81,6%), and majority of them are Ukrainian (66,2% of all foreign students). 18,35% of foreign students come from another than European countries (India, China, Taiwan, USA, Canada and other). Foreign student attended the course of business and administration the most often (25,2%) [8, p. 34-35].

At the end of December 2016, 95,4 thousands of academic teachers were employed (95,8% as full-time employees) of which 45% were women. 2,0 thousands of academic teachers were foreigners.

\(^1\) On the 4th of July 2018 the lower chamber of the Polish Parliament passed the new legal Act called “Constitution for Science” which assumes changes in many dimensions of higher education system in Poland.
The structure of full time employed academic teacher considering job positions in the sector is presented in the table below [8, p. 44].

**Table 1: The structure of employment considering job positions in the higher education sector in the academic year 2016/2017 in Poland**  
(Source: based on Higher Education Institutions and their Finances in 2016, 2017, p.162.)

<table>
<thead>
<tr>
<th>Position</th>
<th>Professor</th>
<th>Assistant Professors</th>
<th>Tutors</th>
<th>Assistant Lecturers</th>
<th>Senior Lecturers</th>
<th>Lecturers</th>
<th>Lectors</th>
<th>Instructors</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand total</td>
<td>22,844</td>
<td>519</td>
<td>39,332</td>
<td>11,060</td>
<td>10,670</td>
<td>4,900</td>
<td>1,009</td>
<td>724</td>
<td>322</td>
</tr>
<tr>
<td>Of which women (%)</td>
<td>27,9</td>
<td>31,0</td>
<td>47,5</td>
<td>53,7</td>
<td>50,9</td>
<td>60,3</td>
<td>79,5</td>
<td>56,9</td>
<td>82,6</td>
</tr>
<tr>
<td>Public higher schools</td>
<td>18,716</td>
<td>392</td>
<td>3,4842</td>
<td>10,166</td>
<td>9,992</td>
<td>4,041</td>
<td>879</td>
<td>672</td>
<td>272</td>
</tr>
<tr>
<td>Of which women (%)</td>
<td>28,8</td>
<td>32,4</td>
<td>47,8</td>
<td>53,5</td>
<td>51,1</td>
<td>61,7</td>
<td>80,2</td>
<td>56,8</td>
<td>82,4</td>
</tr>
<tr>
<td>Non-public higher schools</td>
<td>4,128</td>
<td>127</td>
<td>4,490</td>
<td>894</td>
<td>678</td>
<td>859</td>
<td>130</td>
<td>52</td>
<td>50</td>
</tr>
<tr>
<td>Of which women (%)</td>
<td>23,8</td>
<td>26,8</td>
<td>45,3</td>
<td>55,8</td>
<td>47,4</td>
<td>53,9</td>
<td>74,6</td>
<td>57,7</td>
<td>84,0</td>
</tr>
</tbody>
</table>

The employment in higher schools is gender balanced in case of Tutors, Assistant Lecturers, Senior Lecturers and Instructors. On the other hand in case of positions: Professor and Assistant Professor about 70% of employees are men. Contrary, most of Lecturers, Lectors and Librarians (marked as other in the table) are women.

**Gender diversity on the University of Szczecin**

The University of Szczecin is a public university in western Poland. It is the biggest university in the region of West Pomerania. It was established in 1984 and since then has been one of the very important entity in socio-economic environment of the region. The University is a member of the European University Association (EUA) and holds full rights of an autonomous university. The Bologna Process has been implemented in the university what caused over 470 agreements with around 200 universities within the Erasmus+ programme and “MOST” (Polish university exchange programme). The educational offer is wide and includes 100 courses of study within 11 faculties of: Philology (FP), Humanities (FH), Physical Education and Health Promotion (FEHP), Economics...
Gender diversity: an example of the organization from the higher education sector. Barbara Czerniachowicz, Anna Wieczorek-Szymańska.

The employment is gender balanced only on some of the faculties e.g. Faculty of Humanities, Faculty of Physical Education and Health Promotion, Faculty of Economics and Management and Faculty of Law and Administration. At the same time three units of University of Szczecin are strongly feminized (Faculty of Biology, Faculty of Philology and Inter-faculty Unit) while in other four units mostly men are hired (Faculty of Mathematics and Physics, Faculty of Geosciences, Faculty of Theology and Socio-Economic Faculty in Gorzów Wielkopolski).

Trying to deepen the analysis of gender diversity on University of Szczecin, the Authors conducted the research related to job positions. The structure of job positions (calculated in full-time job positions) is shown in the table 2 and as next the gender diversity on particular job positions is presented on figures 2 and 3.
Table 2: The employment on particular job positions on University of Szczecin on May 2018

<table>
<thead>
<tr>
<th></th>
<th>Assistant</th>
<th>Tutor</th>
<th>Tutor with habilitation</th>
<th>Associate Professor</th>
<th>Full Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of posts</td>
<td>221,5</td>
<td>689</td>
<td>71</td>
<td>344</td>
<td>121</td>
</tr>
<tr>
<td>%</td>
<td>15,31</td>
<td>47,63</td>
<td>4,91</td>
<td>23,78</td>
<td>8,37</td>
</tr>
</tbody>
</table>

Figure 2: The percentage of women employed on particular job positions on University of Szczecin
Figure 3: The percentage of men employed on particular job positions on University of Szczecin

It can be observed that the structure of job positions is less diverse, as most of employees are hired as Tutors (Tutors and Tutors with habilitation). This can cause the problem of aging and lack of staff replacement in the future, as only 15.31% of employees are Assistants. Considering the gender issue, men and women have the position of tutor or tutor with habilitation on University of Szczecin the most often. However, in case of positions of Full Professor and Associate Professor, they are more popular among men than among women. Additionally, higher job positions (Tutor with habilitation, Associate Professor, Full Professor) are occupied mainly by men and lower job positions are more feminized (see figure 4). At the same time it is worth to stress that the mentioned rule is not always true when analyzing the structure of employment on particular faculties (see figures 5, 6, 7).
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between particular faculties of University of Szczecin considering the gender structure and job positions. The least balanced structure is observed in case of positions of Professors. Similar to the whole sector the full time employment is more popular than part – time employment on the University of Szczecin. Traditional employment forms usually do not favor the combining of professional duties with family life. On the other hand it must be stressed that on the University of Szczecin academic staff can together with supervisors and dean’s office employee set a schedule of classes and fulfill some professional duties on the distance (like writing scientific articles, do some research, e.t.c.). In this way working hours are more flexible. So one can state that the is a work-life balance policy introduced on the University of Szczecin what in turn can encourage women to take on employment on the University of Szczecin. The Authors of the article are aware that the presented case study discusses only the problem of gender structure of employment. Due to this fact there is a need to deepen the analysis and evaluate the strategy of gender management on the university.

REFERENCES