View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Central University Of Technology Free State -...

CHALLENGES FACED BY DEANS OF ENGINEERING FACULTIES, FOCUSING ON INNOVATIVE MANAGEMENT METHODS AND ORGANISATIONAL PROCESSES: A GLOBAL PERSPECTIVE

H.J. DE JAGER

ABSTRACT

There have been numerous national- and international-level calls for the reform of engineering education. This includes the need for a shift to a knowledge economy – one that utilises knowledge as the key engine of competitive growth. However, despite several initiatives to address reform, relatively little has changed in the content and conduct of engineering education. It has been argued that engineering education has entered a period where changes are required, but that the management structures that are in place do not provide the needed support to encourage and facilitate these changes in order to promote innovation. The current study employed a multiple case study method to explore challenges faced by the deans of four engineering faculties in four non-adjacent countries and to explain the organisational structures and management processes employed to deal with these challenges in their unique contexts. The analysis identified four areas of challenges and innovative structures and management practices that can be transferred and implemented in other contexts.

Keywords: Innovation, quality, structures, engineering education.

1. INTRODUCTION

Globalisation is radically changing the way national economies around the world design, produce, distribute, and consume goods and services. The need for a shift to a knowledge economy – one that utilises knowledge as the key engine of competitive growth, as compared to the traditional economy to enhance economic development – requires long-term investments in education and innovation (Morell et al., 2006). Engineers are in the midst of this dynamic development. They need to know foreign cultures in designing products and services for global markets. They need to work in teams on projects with people from different nations and continents. They need to be internationally mobile, whether physically or virtually. These requirements raise critical questions, such as “Is tomorrow's engineering workforce being well prepared to meet the demands of the global economy” (Grindel, 2006:3)?

Faculties (colleges or schools) of engineering are faced with many challenges today in trying to educate and properly train engineers for the job market.

Deans and their faculties are under constant pressure to improve on what they are doing, which ranges across a number of areas, including, inter alia, teaching and learning, and research. One area that is somehow in the background is the management and leadership role of deans. Hence, this paper is focused specifically on innovative management methods and organisational processes employed by engineering deans in order to meet the challenges faced by engineering education. It does not cover all the challenges faced, but rather focuses on a few selected challenges, and the response to these challenges.

2. ADDRESSING GLOBAL CHALLENGES: ENGINEERING EDUCATION REFORM

Various international initiatives have asked the same question as that posed above, namely "Is tomorrow's engineering workforce being well prepared to meet the demands of the global economy?" A few such examples will be discussed briefly. Firstly, in October 2005, Continental AG launched the Global Engineering Excellence Initiative and invited an international team of scholars from eight universities known for their engineering programmes to participate in the project. Through this year-long study, the team recommended that the world seek engineers that are technically adept, culturally aware, and broadly knowledgeable, engineers that exhibit an entrepreneurial spirit and that are innovative and lifelong learners, and engineers that understand world markets and that know how to translate technological innovation into commercially viable products and services (Grindel, 2006:21).

Secondly, in 2008, by using the changes in population shifts, urbanisation, the global economy, technological advances, and the resulting challenges that engineering students and educators face, as justification for the need to establish the Global Engineering Deans Council (GEDC). The vision of the GEDC is *"to enhance the capabilities of engineering deans to transform their schools in support of their societies in a globalized world"* (Ramakrishna & Narayanamurti, 2008:16).

Thirdly, in 2010, the White House Office of Science and Technology Policy and the National Economic Council in the USA requested an international group of leading technological thinkers to identify the major engineering challenges of the 21st century (National Academy of Engineering, 2010:1). They identified 14 major challenges that require engineering solutions, including the production of environmentally friendly power, nuclear fusion, capturing carbon dioxide, introducing countermeasures to curb nitrogen cycle problems, improving the quality and increasing the quantity of water, "reverse-engineering" the brain, computerising catalogues of health information, developing new medicines, countering the terrorist violence, sustaining the aging infrastructures of cities and services, improving methods of instruction and learning, creating computer-created virtual realities, and enhancing

investigation into assaults on cyberspace, and reducing vulnerability to such assaults (National Academy of Engineering, 2010:1).

Thus, numerous national- and international-level calls for the reform of engineering education have been sounded in response to reduced enrolments, a growing and interconnected global economy, and a greater perception that the role of engineering in society must change (Siller & Johnson, 2009:1220). In developing the scientific and technological expertise and workforce to address these challenges, education reform is required at university level, but such reform has to involve students, school learners, professors, administrators, and curriculum planners (Grindel, 2006:51-54).

Many of today's global challenges can only be addressed through engineers working collaboratively in international networks. The complexity of engineering and research projects has increased dramatically, requiring engineers to work not only across geographical boundaries, but also across disciplines (Siller & Johnson, 2009:1219). Yet the complex phenomenon of globalisation and its impact on engineering practice is often not well understood or well integrated into engineering education programmes. Thus, achieving change via engineering education reform presents a formidable challenge.

Relatively little has changed in the content and conduct of engineering instruction (National Academy of Engineering, 2004:59). From the perspective of many engineering educators, the answer to this question lies in the resistance of individuals to traditional practices, and a reluctance to abandon such practices. For example, according to Loui (2006:75), many engineering instructors are not aware of the growing diversity of the student body, the structures in which engineering is performed, and the industrial mix. According to Wulf (quoted in Spalter-Roth & Meiksins, 2008:169), “it is difficult for some deans and faculty to address the compelling need to educate their students in accordance with the new paradigm when their schools depend on an infrastructure of grantsmanship and research productivity”. Thus, there is a need to concentrate on organisational processes and management methods focused on instilling global competence in engineers (Grindel, 2006:51).

It is evident from the above that engineering education is clearly requiring a major “facelift” in order to meet the challenges and changing demands that have been illustrated above. This means that engineering faculties will have to stay focused and relevant and continually make adaptations where needed. One such adaptation will be innovative management methods and organisational processes to be employed by engineering deans in order to meet the challenges faced by engineering education.

3. MANAGEMENT STRUCTURES AND ORGANISATIONAL PROCESSES OF ENGINEERING COLLEGES

According to Siller and Johnson (2009:1218), engineering education is a very structured enterprise in terms of its management and the resulting curricula. The curriculum is the "providence" of the faculty, which is responsible for determining its structure and content (Siller & Johnson, 2009:1218). Because engineering is a profession, the curriculum is further influenced by the engineering professional organisations, resulting in a highly structured curriculum that is slow to change. The global engineering challenges, the need for ongoing education reform to produce prepared graduates for the international market, resistance to curricular and teaching reform, the close connection with external organisations and employers, and the need to grow research and innovation pose specific management challenges for engineering deans. Some of these challenges include

- Making engineering more attractive to top students;
- Improving the quality of teaching and learning, and increasing the output of engineers;
- Improving the quality of governance practices of engineering schools;
- Strengthening capacity building, such as staffing, funding, and infrastructure;
- Developing adequate models for facilitating partnerships between faculties and industry; and
- Developing adequate funding models for engineering schools.

Siller and Johnson (2009:1224) argue that engineering education has entered a period where changes are required, but that the management structures that are in place do not provide the needed support to encourage and facilitate these changes. According to Siller and Johnson (2009:1225), today's world demands a more responsive education system that can rapidly change, while at the same time maintain quality. Therefore, this paper focuses specifically on innovative management methods and organisational processes that are employed by engineering deans in order to meet the challenges faced by engineering education.

4. RESEARCH METHODOLOGY

4.1 Research Design

A multiple case study method was used to explore the challenges faced by the deans of four engineering faculties in four non-adjacent countries, and to explain the organisational processes and management methods employed to deal with these challenges in their unique contexts. The case study research method is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are

used" (Yin, 1984:23). In this study, the research questions are based on the literature study and are divided into four broad themes, as indicated in section 5. The research questions are:

- What are the challenges faced by the deans of engineering in their respective faculties?
- How do the deans of engineering in their respective faculties address these challenges, specifically through organisational processes and management methods?

According to Yin (1984:23), case studies tend to be selective, focusing on one or two issues that are fundamental to understanding the system being examined, that is, the challenges faced by specific faculties of engineering, and the organisational processes and management methods employed to address these challenges. Another condition of case studies, which is evident in the current study, is that the events being examined are the contemporary challenges facing deans and engineering faculties. According to Yin (1984:23), an empirical investigation of a contemporary phenomenon within its real-life context is one situation in which case study methodology is applicable.

4.2 Unit of analysis

A multiple case study involves more than one unit of analysis. Multiple case studies follow replication logic, that is, each individual case consists of a "whole" study in which facts are gathered from various sources, and conclusions are drawn from those facts (Sjoberg, Williams, Vaughan, & Sjoberg, 1991:5). Cases may be selected which are unique in some way, or cases may be chosen which are considered typical, but researchers may also select cases to represent a variety of geographical regions, or a variety of size parameters or other parameters (Yin, in Viral,1997:1). In this study, four engineering faculties from four non-adjacent countries were selected, based on the types of programmes they offer, their research output, innovative management practices and other practices that they employ, and their location in the world. The four faculties are briefly discussed below:

- The College of Engineering at Michigan State University (MSU), East Lansing, Michigan, United States of America: The College has approximately 3,000 undergraduate students and 175 faculty members. It offers nine undergraduate degree programmes, as well as nine degree programmes specialising in different aspects of engineering. The college is also regarded as the leader in the field of automotive engineering and energy. The faculty structure consists of the dean, three assistant deans, for undergraduate studies, graduate studies, and research, respectively, and six chairs of departments (Udpa, 4 May 2010).

- The Faculty of Engineering Sciences at Széchenyi István University (SZE), Győr, Hungary: The university was established in 1968 and in its current format in 2002. It has an excellent reputation in electrical and mechanical engineering. The Faculty of Engineering Sciences is regarded as one of the leading faculties of its kind in Hungary. It offers electrical, mechanical, civil and computer engineering programmes and has approximately 2,000 students (Koczy, 14 June 2010).
- The School of Technology, Reutlingen University (RU) of Applied Sciences, Reutlingen, Baden-Württemberg, Germany: The university has had seven schools or departments (Fakultäten), each offering at least one, and in some cases several, degree programmes. Reutlingen programmes of study are outstanding for their strong international connections, practical orientation, and applied research and development, among other things. Enrolment in engineering stands at about 4,000 students, a quarter of which are international and exchange students (Gruhler, 20 May 2010).
- The Faculty of Engineering, North-West University (NWU), Potchefstroom, South Africa: The faculty continually strives to be a training hub for high-quality, versatile and innovative engineers. Students and staff are driven by innovative thinking and a passion for engineering, which are supported and enhanced by a sound value system and world-class teaching standards. They focus on developing engineers who have the competencies to function in multidisciplinary teams and the versatility to adapt to a range of high-tech engineering problems (Fick, 10 September 2010).

4.3 Data-Gathering Process

The case study method used in this study is known as a triangulated research strategy – that is, multiple sources and techniques are used in the data-gathering process. The rationale for using multiple sources of data is the triangulation of evidence (Yin, in Viral, 1997:13). Snow and Anderson (cited in Feagin, Orum, & Sjoberg, 1991:18) asserted that triangulation can occur with data, investigators, theories, and even methodologies. Tools to collect data can include surveys, interviews, documentation review, observation, participant observation, records, and others (Stake, 1995:52; Yin, in Viral, 1997:14). According to Yin (in Viral, 1997:19), interviews are one of the most important sources of case study information.

In this study, semi-structured interviews were conducted with the deans at SZE, MSU and NWU and with the Vice-President of Research, Professor in Engineering and former Dean at RU. The interviews were followed up with documentation review and observation to collect further data. The deans were provided with a list of global challenges experienced by engineering faculties worldwide, as determined through a thorough literature review.

A similar process was followed in identifying the management processes and organisational structures used by each dean in addressing their unique set of challenges. As part of this study, MSU, RU and NWU were formally visited, and the Dean of SZE visited the author.

Yin (in Viral, 1997:9) recommended that a chain of evidence be maintained to increase the validity of case studies. The procedure followed in the current study was to have an external observer follow the derivation of evidence from initial research questions to ultimate case study conclusions. The section reporting the results will also refer to the case study database where the actual evidence is to be found.

4.4 Data Analysis

According to Yin (1994:140) "data analysis consists of examining, categorising, tabulating, or otherwise recombining the evidence to address the initial propositions of a study". According to Stake (1995:67), data should be coded and issues should be identified, after which the researcher can develop a descriptive framework around which the case study will be organised. Although each case was treated as a "whole" study, and because unique challenges and solutions were present in the different contexts represented by the four cases, results were grouped under the four major challenges, as listed in section 5. In the concluding section, a diagram displays the innovative organisational processes and management methods across the four global challenges identified for all four case studies.

5. RESULTS

The results will be presented under the four overall global challenges or themes, under which the more specific challenges and the innovative organisational processes and management methods employed by the participating faculties for each case study will be discussed. Reference to the participating universities will be general, and not specific.

5.1 Challenge 1: The quality of teaching and learning

The following innovative practices related to the quality of teaching and learning were identified from the case studies:

- A culture shift towards outcomes-based education has been experienced, which has been accompanied by active learning on the part of students;
- There has been pressure from learners on academics to deliver courses and experiences to prepare learners for the global workplace. To respond to the global challenge that engineers are faced with, a new course was implemented at one of the universities in 2010 called "Going Global". The course examines the intertwined roles of economics, engineering, and the environment;

- A dedicated unit dealing with academic development and the enhancement of instruction has been established. This centre plays an active role in promoting outcomes-based instruction;
- There is now a strong focus on curricular review processes. There are curriculum committees in every department, with the role of overseeing the curriculum at undergraduate level and ensuring that its content remains current;
- A conscious shift to learner-centred education and away from faculty-centred education has been another effort to increase active learning;
- The residential experience requirement of the freshman (first-year) programme has also assisted in ensuring a living and learning community and enhanced student success;
- Committee structures have been introduced to deal with teaching and learning issues, such as curriculum changes, in which key teaching professors are represented. The curricula are continually developed in order to balance theory with practical examples. Flexibility is built into the courses, with a choice of many routes through the degree programme;
- Project-based learning has been introduced in teaching projects for first-year students, where senior students are involved as tutors. Students become actively involved in their learning through the projects obtained from the community;
- The delivery of locally pertinent and globally relevant engineering education is of particular relevance, as most of the faculties have international students. Language exposure is an important challenge, and exposure to and eventual understanding of multiple cultures has been identified as being critical to companies;
- Students now have more direct contact with the professor, formally and informally, and sometimes the dean has an open-door policy;
- To make engineering more attractive to top students, an exciting competition on alternative refuel vehicles was held, which resulted in spectators from all over the world coming and bringing their children to view the interesting cars;
- Another initiative was where students from other universities and colleges would be sent out in mixed teams, and each team would get a practical question from industry on an engineering issue that needed to be solved. The teams were given two days to come up with an answer, before presenting their solutions to a jury for evaluation;
- Students now have considerable power in decision-making committees, as high as 33% in some cases. Students have to be won over or persuaded to assist in positive decision making;
- A Women in Engineering programme, which encourages young women who want to pursue a career in engineering, is now active in most faculties. The programme is designed for pre-college students, and sessions are presented on women in engineering issues, diversity, cooperative education, and international education opportunities.

The programme also supports female undergraduate engineering students through a buddy system with female graduate students;

- A Diversity Programmes Office was established, which supports student groups that are underrepresented in engineering;
- The interest of school learners to pursue a career in engineering is declining. One specific interesting challenge is that "in Germany specifically … 90% of primary school teachers are female and will not necessarily influence pupils to pursue a career in science. The current generation is 'second components' who will not be drawn to engineering because of better salary they can earn one day – they will study what they really like and rely on their parents to support them financially". In order to attract students to the field of engineering, one faculty has installed a "Pupil Engineering Academy" in liaison with industry, which invites pupils to work on small projects every Friday afternoon over a period of a year;
- Senior students are involved in, among other activities, recruiting new students where engineering student societies are involved in exposing school pupils to engineering through projects and demonstrations; and
- A well-structured student body and its involvement through various structures, both formally and informally, makes industry involvement and experiential learning easier for the faculty. It also establishes a sense of "community" among the students in the faculty. The student Engineering Society is represented on the Management Council of the faculty and is involved in the day-to-day management of the faculty.

5.2 Challenge 2: The quality of research and innovation

The following innovative practices related to the quality of research and innovation were identified from the case studies:

- Inter- or multidisciplinary research is viewed as essential, and undergraduate students need to understand the dynamic and evolving nature of their discipline, which includes formal programmes with minor modules in business;
- The promotion of interdisciplinary work is a high priority, where interdisciplinary work is encouraged by funders of research, who specify joint projects. A new programme called "International Project Engineer", which includes business people and other faculties, was introduced to prepare students for the world of work;
- A postgraduate school was established in a particular faculty, which means that postgraduate students are not attached to and accountable to specific undergraduate departments, which allows for greater interdisciplinary research and innovation. This reduces conflict between undergraduate departments to retain students for postgraduate study;

- Scholarship of teaching and learning is a recognised scholarly endeavour and needs to be promoted as a research area;
- An active centre to support engineering education research has been established;
- A centre was established to help senior and postgraduate students to find resources and connect with employers, alumni, or faculty members aiming to prepare graduates for the job market of the 21st century. In this centre, students study globally and work on programmes such as biomedical imaging, and researching ways to produce inexpensive alternative fuel sources; and
- Large engineering companies fight for more qualified staff and thus quality graduates and fund research projects. This in turn encourages partnerships with industry.

5.3 Challenge 3: Staff recruitment, retention and development

The following innovative practices related to staff recruitment, retention and development were identified from the case studies:

- The recruiting, retaining and developing of quality academic staff members has been supported by the employment of a number of staff from abroad, to raise the international status of the faculty;
- Faculties will experience strong losses of faculty members to retirement in the coming decade. The main concern is general capacity retention and selected capacity building. According to one dean, “Institutions who chase hot topics continuously play catch up”;
- Maintaining the good reputation of the faculty and its ability to raise private funds and to pursue external research funding are motivations for recruiting and retaining quality academic staff;
- The tension that has traditionally been encountered between undergraduate education and research/graduate education exists in some faculties. One dean mentioned, “In reality that is a false tension, because one of the strongest suits that brings a faculty into the academy is the ability to work with and influence new scholars”;
- There is a need to actively elevate the scholarly examination of teaching and learning to a model of instruction that is outcomes-based;
- In the German context, there is a discrepancy between the expected workload of academic staff from traditional universities and the expected workload of academic staff from technical universities. (The same scenario would apply in South Africa between universities and universities of technology, respectively.) Award systems have been implemented to supplement the salaries of academic staff. However, it is difficult to implement award systems for teaching and learning, as Senate requires portfolios of staff members to approve such implementation, and staff are reluctant to put in the effort to compile these; and

- The shortage of quality academic staff is perceived as a problem experienced in many countries. The challenge is to obtain efficient staff and retain them by introducing a flexible working environment and accommodating private consultation work.

5.4 Challenge 4: Faculty Structure, Governance and Partnerships

The following innovative practices related to faculty structure, governance and partnerships were identified from the case studies:

- Industry involvement, as one particular university has been strengthened by the provision of a Vice-Dean for Industrial Relations in the faculty structure, and, as a result, the faculty has landed a few new industrial contracts;
- Public funds for higher education have declined in recent years, and faculties are fighting government policies determining higher education funding for engineering programmes. However, engineering faculties are well positioned to garner external funds. Set priority-based targets for funding and an endowment culture to fund endowed faculty chairs and create opportunities for students through scholarships;
- Specific ties to research initiatives, for example, a research unit, will have an advisory group from industry, which helps to ground the research and allows undergraduate students intern experiences in industry to enrich educational experience and receive industrial liaison feedback on all instructional programmes;
- In terms of faculty structure, governance and quality, academic staff feel isolated from decision making in faculties. Quality governance translates into involvement of academic staff in governance. Academic staff need to collectively contribute to the governance of the faculty;
- A "Study Dean" has been appointed in each engineering programme in a faculty which focuses on quality of teaching and learning, and quality assurance in general. In another faculty, in terms of quality assurance, the dean created a position for a Director: Quality and Teaching;
- The links to industry, research, technology transfer, and continued education all enable students to benefit from the experience with local industry. Practical training is an essential part of all degree courses. This complements and consolidates knowledge gained during the theoretical part of the programme and helps students make informed career choices; and
- A controversial issue in Germany at the moment is discussions of having a Professional Dean or professors for deans. The dean is still responsible for teaching and is one of the faculty members who is elected as the dean for a certain period.

6. DISCUSSION AND CONCLUSION

It is clear from the findings of this study, which focused on four faculties (colleges or schools) of engineering, that these faculties are faced with many challenges today in trying to educate and properly train engineers for the job market. The deans of these four faculties are under constant pressure to improve on what they are doing.

It is important to note that the findings from a sample of four universities located in different parts of the world cannot be claimed to be representative of global challenges facing engineering education. This study therefore does not cover all the challenges faced, but rather focuses on a few selected challenges, and the response to these challenges.

A number of innovative management methods and organisational processes employed by the four engineering deans were identified in order to meet the challenges faced by engineering education. In conclusion, a summary of the most important innovative management methods and organisational processes identified from the case studies is summarised in Figure 1 below.

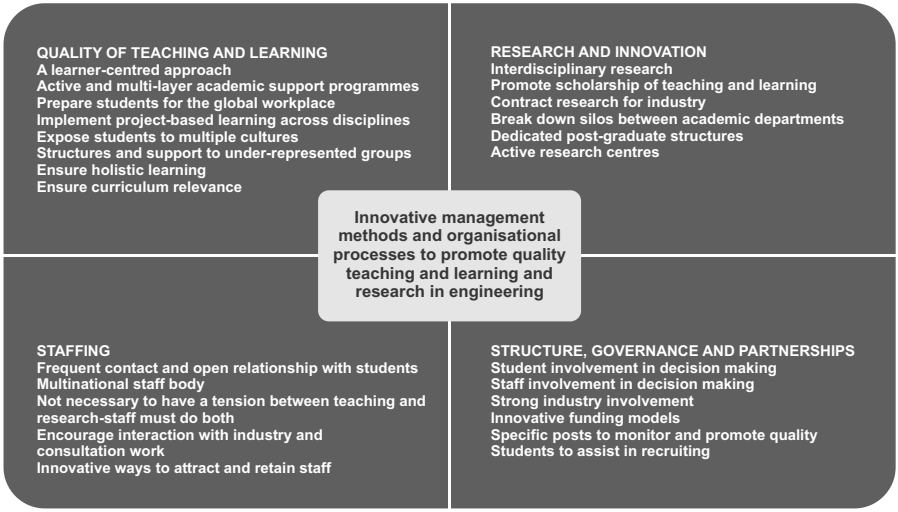

Figure 1. A summary of the innovative management methods and organisational processes identified from the case studies

Engineering education is under growing pressure to change, in some cases radically. The challenge for deans of engineering is to offer academic and research programmes that are locally pertinent and globally relevant. The summarised innovative management methods and organisational processes are a contribution of best practices to meet the changes needed in a global engineering profession.

Although the above findings apply to the field of engineering, they could also apply to certain other fields of study, or at least sub-fields thereof. This study was conducted within the field of engineering, mainly because of the challenges facing engineering education, as highlighted in the literature study, and because of the author's involvement as dean of engineering for twelve years.

An analysis of the above findings reveals that there has indeed been positive transformation of engineering education in response to the numerous local and international calls for the reform of such education. This includes the shift to a knowledge economy – one that utilises knowledge as the key engine for competitive growth. From the case studies of the four faculties sampled in this study, it is evident that several initiatives to address reform have been implemented in various ways, which has given effect to positive changes in the content and conduct of engineering education. In addition, it is widely accepted that engineering education has entered a period where changes are required. The innovative management methods and organisational processes that have been implemented at the faculties sampled in this study are a step in the right direction to provide the needed support to encourage and facilitate such changes, in order to promote innovation in engineering education.

However, a more critical analysis of the findings highlights the need that more effort be made in addressing challenges related to the areas of quality of teaching and learning globally, active learning, well-qualified and experienced academic engineering staff, funding, and engineering as an attractive field of study. The successful resolution of these challenges is critical for the success of engineering education, and also for many other similar fields of study in higher education, particularly in the South African context. The five challenges facing engineering education are:

- To deliver quality education and courses and provide experience to prepare learners for the global workplace and to respond to the global challenges that engineers are faced with. Delivery of locally and globally relevant engineering education is essential;
- Alternative teaching methods must continually be introduced, such as project-based learning, where students become actively involved in their learning;
- The lack of quality academic staff is perceived as a problem that is experienced in many countries. The challenge is to recruit efficient staff and to retain them, by creating a working environment that is conducive for them to flourish in their careers. Part of this should be to develop the scientific and technological workforce to address the reform in engineering education that is required at university level;
- Public funds for higher education have decreased in recent years, and faculties are fighting government policies determining higher education funding for engineering programmes.

This problem will not be resolved soon, and faculties will have to place much more emphasis on contract research, partnerships, and other third-stream income initiatives; and

- A growing concern is the decrease in the number of prospective students that view engineering studies as their first choice of study. Engineering educators and faculty leaders must work together to restore engineering to one of the top choices of study for prospective students.

It is clear from the above that engineering education has started to engage itself in the major "facelift" that is required, as has been argued above, so that it can meet the aforementioned challenges and changed demands. However, engineering faculties will need to stay focused and relevant and continually adapt if they are to stay at the forefront of innovation.

7. REFERENCES

Feagin, J., Orum, A., & Sjoberg, G. (eds). 1991. A case for case study. Chapel Hill, NC: University of North Carolina Press.

Fick, J. 10 September 2010. Interview at NWU with Dean of Faculty of Engineering, North-West University (NWU), Potchefstroom, South Africa.
Grindel, T. (ed.). 2006. In search of global engineering excellence. Hannover: Continental AG.

Gruhler, G. 20 May 2010. Interview at RU with the Vice-President of Research and Professor in Engineering and former Dean at Reutlingen School of Technology, Reutlingen University of Applied Sciences, Reutlingen, Baden-Württemberg, Germany.

Koczy, L.T. 14 June 2010. Interview with Dean of Faculty of Engineering Sciences at Széchenyi István University, Győr, Hungary. Interview was held at the Nelson Mandela Metropolitan University during a visit to South Africa.

Loui, M.C. 2006. Moments of inertia: Toward an agenda for sociological research on why engineering professors resist changes in pedagogy and curriculum. In: R. Spalter-Roth, N.L. Fortenberry & B. Lovitts (eds). The acceptance and diffusion of innovation: A cross-curricular perspective on instructional and curricular change in engineering. Washington, DC: American Sociological Association: pp. 71-77.

Morell, L., Borri, C., Hoyer, H.J., Rajala, S.A., Ramakrishna, S., Fouger, X., Laporte, B., Quadrado, J.C., Larrondo Petrie, M.M., & McKenzie Fraser, D. 2006. IFEES: Enhancing engineering education on a global scale. [Accessed online]:[http://www.ifees.net/publications/documents/IFEES_EnhancingEngEduGlobalScale.doc]

National Academy of Engineering. 2010. Introduction to the Grand Challenges for Engineering. Accessed online: [http://www.engineering-challenges.org/cms/8996/9221.aspx]

National Academy of Engineering. 2004. The engineer of 2020: Visions of engineering in the new century. Washington, DC: National Academies Press.

Ramakrishna, S & Narayanamurti, P. 2008. The justification for a global engineering deans' council. Accessed online: [http://www.gedcouncil.org/-sites/default/files/GEDC_1May2008-SRamakrishna.pdf]

Siller, T. & Johnson, G. 2009. Management structure designed to facilitate changing engineering curricula. International Journal of Engineering Education, Vol. 25, No. 6, pp. 1218-1225.

Sjoberg, G., Williams, N., Vaughan, T., & Sjoberg, A. 1991. The case study approach in social research. In J. Feagin, A. Orum, & G. Sjoberg (eds). 1991. A case for case study. Chapel Hill, NC: University of North Carolina Press: pp. 27-79.

Spalter-Roth, R. & Meiksins, P.F. 2008. Advancing educational reform: Lessons from a collaborative workshop among engineering educators and sociologists. Research in Social Problems and Public Policy, Vol. 16: pp.165-195.

Stake, R. 1995. The art of case research. Newbury Park, CA: Sage Publications.

Udpa, S. 4 May 2010. Interview at MSU with Dean of College of Engineering at Michigan State University. East Lansing, Michigan. USA.

Viral, O. 1997. The Case Study as Research Method. Unpublished article: Mauritius Institute of Education. Accessed online: [http://www.mieinline.org/-home/article/21/1/The-Case-Study-as-a-Research-Method/Page1.html]

Yin, R. 1984. Case study research: Design and methods. 1st ed. Beverly Hills, CA: Sage Publishing.