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COMPARATIVE STUDY ON THE IMPLEMENATION OF IDE IN AFRICAN COUNTRIES

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Abstract

Human resources development by means of training, education at universities and schools, and skill development within industry projects will be essential to foster product innovation within the African industry. In order to make them more competitive, innovative and competitive, the general objective of capacity development in Africa for product innovation will be to reduce over-dependence on imported technical and scientific personnel, while at the same time providing entrepreneurial capabilities and high-level managerial, engineering, technical and operational skills. It is expected, therefore, that investments in Industrial Design Engineering (IDE) in (higher) education can contribute to the innovation capacity of African industry and thus stimulate the development of new and appropriate products. As a result, new businesses can arise and the market share of African products can increase considerably, both on the internal and external market.

Since three years now a collaboration project is running between UDSM and TU Delft through which part of the IDE courses, adapted to the local situation, is introduced in the UDSM program while at the same time 'demonstration projects' in Tanzanian industry have been conducted with the help of Delft IDE students.

From this Tanzanian project a study has been conducted evaluating the needs and possibilities of African countries and benchmarking the educational programmes of universities in different areas.

Keywords: Industrial Design Engineering, Knowledge Transfer, Africa, Developing Countries, Curriculum Building

1 Introduction

Many countries in Africa do not have any significant industrial past, dating back to pre-independence years. The primary driver of industrialization was domestic demand volume and consumption pattern, whereby major attempts were to create industries that would integrate agriculture with manufacturing industries notably in the textile, leather, pulp and paper, and wood related products. However, all these efforts were largely inward looking, based on import substitution to save foreign exchange, rather than export oriented to earn foreign exchange [1].

The last three decades has also been characterised by a rapid expansion of knowledge, science and technology and their application to production, communications and management. The improvement of the productivity, the competitiveness and the standard of living of the population is more and more determined by the individual and collective capacity to create, adapt and use effectively new scientific knowledge and information technologies and not on the availability of natural resources, raw materials and cheap labour. However, there still is a big technology gap between developed and underdeveloped countries. Recent developments of newly industrializing countries in the Pacific rim, and in Latin America, suggests that this gap can be narrowed, through combinations of technology transfer, reverse-engineering, and new creation [2].

IDE Human Resource Development

Human resources development by means of training, education at universities and schools, and skill development within industry projects will be essential to foster product innovation within the African industry. In order to make them more competitive, innovative and competitive, the general objective of capacity development in Africa for product innovation will be to reduce over-dependence on imported technical and scientific personnel, while at the same time providing entrepreneurial capabilities and high-level managerial, engineering, technical and operational skills. In the meantime this should also result in significant improvements in competitiveness, as measured by higher productivity levels, better product quality, increased production and sales (both locally and international) and improved market access. The ultimate goal is to create a shift away from commodity dependence towards adding value, manufacturing at more advanced technology levels [4].

It is expected, therefore, that investments in Industrial Design Engineering (IDE) in (higher) education can contribute to the innovation capacity of African industry and thus stimulate the development of new and appropriate products. As a result, new businesses can arise and the market share of African products can increase considerably, both on the internal and external market. Training and promotion are key aspects of the programme, because they are considered the only way to achieve a change of attitude among the stakeholders in the country [5].

In the late nineties a number of African countries became aware of the importance of 'Industrial Design Engineering' as a possible academic discipline. Industrial Design Engineering (IDE) is a multidisciplinary field of practice that is intended to spearhead the industrial innovation process through contribution to knowledge, skills, methods and professional attributes in integrated product development. In contrast to the classical Mechanical Engineering Design, IDE addresses the whole industrial innovation process, i.e. all activities that precede the adoption of a new product in a market. Most important is the fact that the actual designing is strictly done on the basis of the integrated interests of multiple users, industry, society and the environment.

Until recently, within the Southern African Development Community (SADC) region, which is composed of fourteen member states there were only three known institutions (though not universities) that offer Industrial Design. Also in most of these countries there are no Industrial Design Engineering consultancies or freelancers [6].

Universities such as in South-Africa, Tanzania and Botswana become convinced that the local industries and especially the SMEs could not survive the emerging stiff competition without the service of IDE engineers. As Kumar [7] states. 'A lack of understanding of the cognitive processes of design is perhaps responsible for so few designers being produced in relation to management and maintenance professionals. Furthermore, whatever designs originate from Africa, they are devoid of an African sense of aesthetics, cultural values, etc. Typically, industry takes up design as teamwork between engineers, technologists and industrial designers but there is a complete lack of industrial designers in the region'.

Comparative study

Since three years now a collaboration project is running between UDSM and TU Delft through which part of the IDE courses, adapted to the local situation, is introduced in the UDSM program while at the same time 'demonstration projects' in Tanzanian industry have been conducted with the help of Delft IDE students [8].

From this Tanzanian project a study has been conducted evaluating the needs and possibilities of African countries and benchmarking the educational programmes of universities in different areas. Aims of the research project were to study (1) in which way IDE can contribute to the economical and social sustainability of the country; (2) how the IDE situation in Tanzania is compared to other African countries, both analysing the needs for IDE and the already existing initiatives; (2) which progress countries have made in their IDE curricula, and (3) the possibilities for an African network of universities and those industrial organisations which somehow involved in industrial design engineering.

2 Method

Six African countries were selected on the basis of the following criteria: (1) countries which already had started educational programs at their universities (Botswana, South Africa, Tanzania); (2) neighbour countries of Tanzania in order to view the possibilities of creating regional collaboration and joint capacity (Kenya, Uganda); (3) countries which are in the same developmental state as Tanzania and have special focus of the Dutch government regarding collaboration in higher education (Mozambique); (4) two institutions were also selected, the Cleaner Production Centre in Uganda and the Design Institute in South Africa, both having a special supporting function in stimulating industrial innovation.

The methods of observing and discussing IDE activities were:

- Workshops organised for this purpose by local institutes.
- Interviews with university staff: people from engineering departments (mostly mechanical engineering or IDE), institutes and some companies.
- Presentations on IDE and discussions.
- Questionnaires among companies and TU Delft students involved in the Tanzanian 'demonstration projects'.

3 Results

In this paragraph the experiences of the countries within the sample of this study will be presented.

3.1 Uganda

In July 2002 a workshop has been organized at Makarere University in Kampala in Uganda to explore the potential for IDE in Uganda. The main aim of this meeting was to create awareness to the stakeholders on the benefits of implementing IDE concepts in the Ugandan industries and to the University Teaching. The department of mechanical engineering already carries out some design activities, however they are not market oriented and hence lack the element of innovation. Most of the student projects are not industrial or market oriented as it should be. This means that marketing and adopting the design products is a problem. It was also noted that the level of interaction between the Faculty of Technology and the Ugandan industries is low. This makes it difficult for mutual cooperation and acceptance of each other's ideas between the two groups. There is also the problem of Ugandan entrepreneurs not appreciating the benefits of implementing the principles of IDE. They are averse to innovation and are likely to perceive IDE as tedious, lengthy, costly and without any significant financial returns. Furthermore, in most cases, the students placed on industrial training with the industries are not fully accepted. It was noted that a strong pillar for IDE is the element of teamwork, which is lacking in the current education system in the Department of Mechanical Engineering. Hence, there is need to develop and improve the Design Engineering methods at Makarere University, by working together on the following issues [10]:

- Developing and incorporating IDE courses into the engineering undergraduate core curriculum.
- Awareness campaigns; this should start with staff and students of the Department of Mechanical Engineering and then followed by the Ugandan industrialists.
- More interactions between the Department of Mechanical Engineering and the entrepreneurs; having more students' attachments in the industries, more discussions between the academic staff and the industrialists, and developing more IDE projects for the industries can achieve more interactions..
- Industrial based projects; the IDE projects worked on by the students should be customer oriented, i.e. developed after conducting market studies. The students working as a team could be a group of students from the Department of Mechanical Engineering, Makerere University and Delft University of Technology. Co-supervision of these projects by staff from both Universities is recommended.
- Team Work commitment; the saying that two or more heads are better than one is appropriate for students working on IDE projects. Brainstorming and putting all ideas together to forge ahead is a very important method of work for improvement.
- Develop IDE expertise amongst the academic staff members to be able to handle teaching and supervision of IDE projects.

3.2 Tanzania

To fulfil this need for IDE in Tanzania the University of Dar-es-Salaam (UDSM) in collaboration with the Delft University of Technology have taken the initiative to introduce Industrial Design Engineering within the UDSM College of Engineering and Technology. The IDE approach can be described as a multiple approach taking into account the need for a high level educational IDE programme, the retraining of staff and a programme of awareness raising in industry. Success of the IDE programme will depend on the awareness in industry that the IDE approach really contributes to economic growth. Therefore, companies have to be activated to take part in IDE training sessions and in practical projects. Moreover, in order to enhance the effect of the IDE approach, a sustainable co-operation should be established between higher education and the participating companies [8].

The major deficiency in the engineering programmes at Dar-es-Salaam University (UDSM) currently offered is the lack of training in integrated product development embracing marketing methods, engineering methods, ergonomics, aesthetics and styling methods of industrial design. The UDSM College of Engineering and Technology therefore intends to play a proactive role to face the new challenges. In the short term, the arrangement should be to train graduate engineers in basic IDE concepts through the introduction of IDE courses in the UDSM undergraduate curriculum to fill gaps in knowledge in important areas of product design, marketing, innovation management and entrepreneurship. Under this arrangement, the graduates will be able to perform both IDE and classical engineering tasks and hence enhance their effective deployment. The educational programme, which starts with an introductory course and after 4 years, will lead to a separate IDE stream within the College of Engineering and Technology.

Before they started with IDE courses, a train-the-trainer course for four UDSM-teachers was provided by Delft University. After a year this same course was arranged by these four teachers for nine colleagues at UDSM. This course was only partly supported by Delft staff. In this way IDE expertise could be spread among an increasing number of UDSM staff members.

Pilot projects in industry

Imparting expertise among academic staff and future designers and engineers in Tanzania is a necessary but not a sufficient condition for improving innovative entrepreneurship and product development in industry. The approach has to involve the other stakeholders, and mainly the industry that is going to be the recipient of the graduates. Therefore, raising awareness in industry about the relevance of the IDE-approach was a major objective. The industry has to be sensitised to appreciate and understand what IDE can do for them to facilitate a successful business under the emerging stiff competition. This was achieved by two activities:

- Pilot projects in Tanzanian industry focussing on the different disciplines of Industrial Design Engineering. Teams existing of Delft IDE students together with Tanzanian UDSM students execute the projects.
- Workshops for local company managers. To enhance the awareness among a growing number of companies yearly workshops have been organised.

The following three cases are meant as examples for the type of awareness raising projects in industry executed by IDE students from Delft University of Technology in Tanzania.

Simba Plastics
Simba Plastics is the biggest plastic manufacturer of Tanzania and one of the few companies that recently has set up a Product Development Department. They attract their design staff from abroad but have shown serious interest in locally educated Industrial Design Engineers. Within this IDE demonstration project one of the DUT students together with a UDSM student worked on the design of a booth for the east African market (see figure 1). The project started with a innovation management traject inside the company and fieldwork to get a better understanding of the design brief. Three concepts have been developed by using brainstorming, brain writing and brain drawing techniques. Especially these creativity approaches were an eye-opener for the company. The final concept has been worked out in pro-engineer ready for production. The company has been very satisfied with the results and want to continue to collaborate with UDSM and TUD and to give future local IDE graduates a job opportunity within the company.

Figure 1. The traditional and newly developed booth for the East African Market.

Design for public transport map 'Dala Dala'
In Dar-es-Salaam a serious part of the passenger transport takes place by 'Dala Dala', a well organized public transport system by private owned minibuses that drive continuously on specific routes. The goal of this demonstration project was to develop a map of the routes of the Dala Dala's for foreign tourists in Tanzania. Secondly there was the goal to commercialize the map by looking for sponsors and media to publish the map. After analyzing the transport system and the market (potential users and sponsors) a first series of graphical visualizations of the Dala Dala network was developed. As a next step the visual interface design has been improved to make the extended network of Dala Dala understandable for the different users. Finally the Dala Dala map was ready made for printing and is now being published in the monthly free tourist magazine 'Dar Guide'. The main learning experiences for the Tanzanian team were how to set up a commercial project and how to work out the graphical interface in a user-friendly and aesthetical way.

Figure 2. Map of the Dala Dala transport system

Innovation management project for Textile Manufacturers Tanzania Ltd. (TMTL)
TMTL originally produced textile products but lost the market because of stiff international competition. The new management started in 1998 with product diversification by starting to produce Mosquito nets. The challenge of this demonstration project was to extend the range of diversified products of TMTL. The Delft student in Collaboration with the UDSM student started with an extended Product Innovation Management trajectory by making a SWOT analyses of the companies and its products and to create 'earch fields' for potential product diversification. As an opportunity market the tourist safari's was identified. The design brief was to develop a 'product' to protect tourists against mosquitoes during their night sleep on safari's. As an end result a mosquito net tent was developed. The company was sensitized by the total IDE process from goals finding until the sketches of the proposed design concepts. On the short term the company is interested to continue to attract students from both UDSM and Delft.

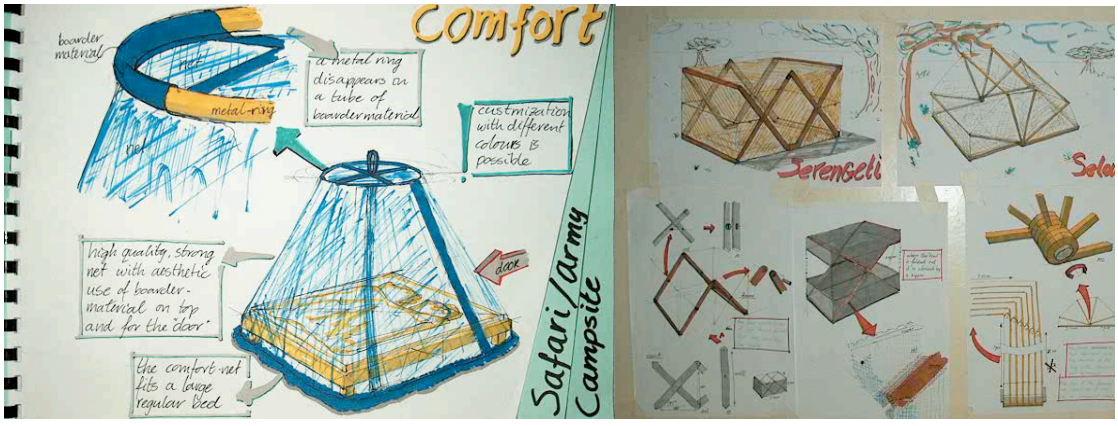

Figure 3. A mosquito net tent for TMTL

3.3 Botswana

Most engineering institutions and universities in Africa offer programmes leading to first degrees in the three basic engineering disciplines, i.e. Civil, Electrical and Mechanical

engineering. Students of engineering are not taught basic design concepts. Typically, industry takes up design as teamwork between engineers, technologists and industrial designers but there is a complete lack of industrial designers in the region.

For the University of Botswana it was reason to start with a major on IDE at the Faculty of Engineering. But last year this Faculty implemented a parallel programme leading to an Industrial Design Engineering Degree. This programme started last August. Their mission is that design Education should become an integral part of all engineering, technology education in particular and all disciplines in general. This can be achieved by offering a core course in Design Methodology across the board, which should also touch upon elements of African aesthetics and cultural values. Case studies should be employed in order to critique and learn from other people's designs. It should be topped up with a student-initiated capstone project on designing a need-based product. It is also necessary to initiate design studies at school level in order to create awareness in young students to take up industrial design careers. It is also necessary to launch programmes of study to produce industrial designers with undergraduate and postgraduate degrees to work hand in hand with several other professionals to design and make functionally sound, aesthetically pleasant, ergonomically appropriate, economically viable, environmentally friendly, easy to manufacture, safe, secure, sustainable and marketable systems and products. Such efforts would go a long way not merely to alleviate the poverty in the region but also to accelerate the process of African Renaissance. One of the biggest problems the university is facing is the shortage of experienced staff.

3.4 South Africa

In a review of Design Studies in South Africa by the Design Education Forum of South Africa, it is noticed that design-related programmes are offered at Cape Town, Fort Hare, Potchefstroom, Pretoria and Stellenbosch universities and at several Tecknikons (similar to Polytechnics). Any full-fletched IDE-programme can only be found at these Technikons.

Although South Africa is far ahead with such programmes compared to other African countries there is still the challenge of involving and supporting local industries, making them aware of the added value of innovative entrepreneurship. Most of the educational programmes in IDE focus more on industrial design than on industrial design engineering, reason why there is still a gap with the other engineering disciplines.

The Design Institute of South Africa is a pioneering establishment, which undertakes the promotion of design-related programmes by way of dissemination and design awards. This Institute plays an important role in setting up networks with other countries in the region, but also with Western organisations. In 2003 it hosts the meeting of the ICSID Board. The South African IDE departments at universities and Technikons keep up close relations with the Institute.

3.5 Mozambique

Thinking about the implementation of IDE programmes at universities in Mozambique is still in its infancy. In discussions with university staff at engineering departments they show much interest in setting up programmes, but sofar there was no money to take

initiatives in that direction. Mozambique also faces the problem of a shortage of expertise and trained staff. So, any implementation of IDE related activities would be dependent on foreign funding and support by universities from Europe.

4 Conclusions and discussion

A number of conclusions can be drawn from the roundtrip along five African countries.

First, there is an enormous need for education and training on IDE regarding innovative product development and its management, but on a more detailed level the different countries show different needs. East Africa and Mozambique are quite the same in their need for support in the transition from an agricultural based to an industrial based economy. Botswana on the other hand is looking for diversification of the industrial sector. South Africa, being far ahead compared to the other countries, has sofar been focused on engineering and wants to spread its attention over (consumer) product design and engineering design.

Second, the countries included are in different stages of developing IDE curricula, with South Africa having full-fleshed curricula on polytechnic's level already, Botswana starting a separate IDE programme at the University of Botswana in Gabarone, while the University of Dar es Salaam (Tanzania) sofar introduced only some IDE courses in the curriculum of the Engineering programme. The other countries didn't start yet but want to do so in the near future.

Third, the 'demonstration projects' in Tanzanian industry are successful in that they create awareness and expertise among company management and product development departments within industry. In a recent evaluation of these projects companies express their strong need for multi-skilled engineers. However, the same companies say they are still lacking support from the university staff at UDSM. Sustainable change can only be achieved if there is a ground for long-lasting relations between universities and industry [9]

Fourth, there is a need for collaboration and networking among the African countries involved.

All countries face the same kind of problems in implementing and continue the IDE approach, such as a lack of awareness on the governmental level, lack of qualified staff at the university, lack of collaboration between universities and industry, lack of course material in the appropriate context and so on.

The number of initiatives on industrial design engineering in Africa is growing as is the awareness of the need for capacity building in this area. There is a challenge for universities to innovate both on the level of educating their students in innovative product development abilities and on the level of collaboration with industry outlining paths for training industrial people, for implementing demonstration projects and exchange of knowledge and experience. With respect to the educational programme on IDE the African countries should develop their own appropriate version while now the existing programmes are either too technology-oriented or art-oriented and sometimes imitations of European examples.

Collaboration between countries on university level should be stimulated on the level of exchange of teaching staff, of course material and experience on industry project. For this purpose the internet could be of help in implementing e-learning and other applications of knowledge transfer and data management.

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