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Equipment Maintenance Challenges and Solutions for Capacity Building and Sustainability in the Training of Engineers: the Case for the University of Zimbabwe

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Abstract

Engineering equipment in some Higher Education Institutions (HEIs) in Sub-Saharan Africa is underutilized, obsolete or in poor working condition owing to lack of expertise, aging or maintenance-related challenges respectively. A research initiated by the Network of Users of Scientific Equipment in Eastern and Southern Africa (NUSESA) and funded by the Swedish International Development Cooperation Agency (Sida) was carried out by 4 faculties of engineering in Southern Africa to establish common challenges, their causes and to propose solutions. The study revealed that the faculties shared similar problems such as no proper maintenance documentation, no local suppliers for spares and inadequate expertise. The importation of spares usually leads to prolonged lead times and delays in timely repairs to malfunctioning equipment and thus obsolescence. This paper proposes smart procurement partnerships between industry and HEIs, based on the findings from the University of Zimbabwe (UZ). Following the survey and analysis of data obtained, recommendations were made and implemented and have assisted in building capacity in acquisition, maintenance and management of laboratory equipment and sustaining these in the training of engineers.

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Keywords: Acquisition, Analysis, Data Collection; Maintenance; Repair; Training; Utilization

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1. Introduction

Most HEIs in Sub-Saharan Africa equipped their engineering laboratories during the colonial era (1960 – 1980) when they were managed as colleges of universities, mainly from Europe. The equipment came along with academic and technical staff who had the capacity to use them in the training of engineering students. However, these colleges became fully fledged universities and were weaned off to operate independent of the parent universities [1]. Most of the expatriate lecturers and technical staff returned to their home countries having trained a few of the local academics and technicians but unfortunately they did not leave any sustainability plans in place for either replacement or repair of the donated equipment. This led to deterioration of some of the laboratory equipment because of lack of maintenance or utilization [1]. This problem prompted and brought together universities with Science and Engineering faculties in Sub-Saharan Africa to develop solutions to these challenges, thus giving birth to NUSESA in 1989, with 5 founding members, i.e. Malawi, Mozambique, Tanzania, Zambia and Zimbabwe who later secured financial support from Sida and by the turn of the new millennium, there were 14 members [2]. Research output may have been seriously affected by laboratory equipment challenges, prompting the regional bloc to come up with long term strategies for sustainable development through the broad objectives of; improving acquisition, use and maintenance, enhancing capacity building and sustainability, stimulating a maintenance culture and developing collaborative training, research and exchange of staff among the faculties of engineering [3]. A regional task force from 4 universities of Dar es Salaam, Eduardo Mondlane, Makerere and Zimbabwe was set up to carry out surveys and establish common challenges and proffer solutions for the maintenance of scientific equipment in the region. The findings were consolidated into a regional report, the basis on which this paper is developed, focusing on the Faculty of Engineering at UZ, with occasional reference to the other 3 universities while drawing inferences from the analysis and stakeholders' recommendations on developing effective maintenance policy frameworks for training, capacity building and sustainability.

2. Literature review

Due to high costs associated with the replacement of parts or equipment failing due to lack of preventive maintenance, equipment owners are increasingly emphasizing the need to maintain and calibrate equipment as well as replace parts in an organized manner [4]. Traditionally, not many organizations emphasized the need for planned maintenance in order to enhance the life spans of their equipment [5]. Development and aid organizations such as the British Overseas Development Authority (ODA), German Technical Cooperation Agency (GTZ, now GIZ), and Sida provided support for the purchase of new equipment and left the maintenance of such equipment to the recipients, who in most cases were local governments responsible for funding HEIs. Unfortunately these authorities rarely found the funds to maintain the equipment, in some cases leading to obsolescence [5]. The need to maintain equipment has been receiving attention from researchers and practitioners in recent years [6]. Due to rapid changes in technology, engineering and scientific equipment has been evolving at the same pace. The traditional supplier companies are in developed countries that have the potential and capacity to keep pace with these rapid changes, which technologies have brought some degree of complexity that require continuous training of practitioners. [7, 8]. Unfortunately, recipients of such equipment in the developing world have evidently lagged behind owing to lack of financial capacity, resulting in the continued reliance on expertise from the developed countries. In a research to ascertain challenges in transforming manufacturing organizations into product service providers, it was observed that manufacturing output in the UK had remained fairly stable but profitability had been declining, attributed to global competition which forced Original Equipment Manufacturers (OEMs) to cut down their costs in order to maintain or improve profitability [9, 10]. This resulted in rapid changes to their new equipment and the technology that drives them, hence the need to adopt flexible systems management that are adaptive, responsive and agile for an organization's key functions including maintenance [11]. Sustainability is often referred to as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs [12, 13], thus it is the capacity to withstand any setbacks that may arise in the use and maintenance of the equipment.

Developing countries can utilize engineering activities in education and research to introduce appreciable added value to their resources through income generation such as consultancy work in addition to training students and the funds generated can be invested in training users [14]. However, to implement this, requires changing the mind-sets