

# **TOWARDS GREENING CONSTRUCTION MANAGEMENT TERTIARY EDUCATION**

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This study advocates the integration of sustainability into undergraduate construction management programs in South Africa. Sustainability with the color ‘Green’ is presently reshaping the built environment and construction professionals are challenged to implement ‘Green Building’, ‘Green Construction’, and ‘Green Infrastructure’ within the context of a ‘Green Economy’. Likewise, academia is faced with the expected challenge of adding these trends and topics to existing curricula so as to produce graduates that will address these trends. A review of existing construction management programs in South Africa shows a major gap that must be closed in order to evolve a standardized ‘Green’ curriculum that will enable students to integrate knowledge gained into future jobs. To close the gaps, the current trend among schools affiliated with the Associated Schools of Construction (ASC) has been used to recommend curriculum renewal that would provide the industry with benefits of sustainability in the built environment.

*Keywords:* Building, Curriculum, Higher education, Sustainability.

## **1 INTRODUCTION**

Buildings are responsible for a major share of energy-related carbon emissions worldwide. In South Africa, the operation of non-residential and residential building sectors account for an estimated 23% of carbon emissions (Construction Industry Development Board (cidb) 2009). On the global stage, the International Energy Agency (IEA) (2007) notes the major impact of building stock on carbon emissions. To tackle the extent of carbon emissions coming out of existing building stock, and future development, a radical ‘greening’ of buildings is required. The greening paradigm shift thus demands green construction methods for new buildings; and the retrofitting of existing buildings in terms of efficient and renewable energy technologies. As the paradigm shift serves more than carbon emission purposes, new approaches to the training and education at various post higher school institutions are required. New skills and the up-scaling of existing skills are required. As a result, construction management education has sought to respond to the demands of green buildings. This paper is therefore aimed at discussing the ‘ways’ in which South African tertiary construction management education should respond to the knowledge and skills requirements of green buildings. The aim is set on the premise that deficiencies in the supply of skills and competences

for green buildings are important barriers to progress (International Labor Organization (ILO) 2011).

## 2 MAIN SKILL RESPONSES TO THE GREEN BUILDING REQUIREMENT

In a green building construction value chain, a range of professionals forms the project team. The ILO (2011) notes that the value chain in this context is not limited to actors that produce and maintain green buildings, but include actors involved in the production and distribution of required materials used in buildings. These actors would be involved in policy making, education and research, building controls, clients / employers, conception and planning, manufacturing and distribution of materials, and the construction, installation and maintenance requirements for green buildings (Figure 1). Occupations involved in the elements illustrated in Figure 1 will need technical skills (such as understanding and applications related to passive design techniques and use of renewable energy technologies) and soft skills (sustainability awareness and response related to the society, environment and economy). However, country specific needs may determine the priority placed on a particular set of skills and occupation. For instance, skills required for designing, conceiving and erecting new green buildings are more likely to be prioritized in developing economies, such as South Africa (cidb, 2009); whereas, skills required for retrofitting and adaptation of existing building may be prioritized in Australia (Bullen and Love 2011).



Figure 1. Conceptual green building value chain (adapted from ILO, 2011).

In effect, green building brings with it a new set of construction techniques, methods, procedures, and systems in which construction management graduates cannot afford to ignore. Major skills would have to address the rapidity of change in processes and systems as exemplified in adaptability, regeneration, and other environmental issues that are in a constant state of flux. Given the enabling roles that the public sector plays, it is important to ensure that policy-makers are properly equipped with the skills they need to initiate and sponsor green buildings. Clients are responsible for the type and trajectory of contract data and they determine the features of delivered products. It is therefore crucial for policy makers and employers of construction services to be intelligent concerning scope of works and other product considerations (Emuze and

Smallwood 2011). The various tiers of training and education would also have to produce a strong supply of people with skills on energy efficiency assessment, advice, design and quality assurance across the cluster of roles indicated in Table 1. As earlier mentioned, appropriate ways to respond to the skills requirement for green buildings will depend on targeted occupations based on country specific situations.

Table 1. Main skills responses to green building implementation.

Cluster of Roles	Main Skills Responses
Conceiving, planning, designing, and advising on green buildings	University degree: specialized undergraduate and graduate education on energy efficiency, renewable energy, and building codes. Certification: training offered, short learning programs by employers, professional association on building performance, and green tools
Construction, installation, and maintenance of green buildings	The adaptation of courses in technical and vocational education and training (TVET) institutions Formal apprenticeship systems offered by employers, workers associations, employer associations, and non-profit organizations
Controlling services	University programs (degrees, diplomas, and certificates) Technical education, which is inclusive of work integrated learning Training and assessment for specific certification
Enabling services	Training for teachers in secondary schools, lecturers in higher education, policy makers in government, and financial providers
Manufacturing and distribution of materials for green buildings	Training in green building material and product development
Green building clients	Training related to green procurement, energy management, and renewable energy.

Adapted from: ILO (2011)

Notwithstanding the situations, universities are gradually developing / renewing their curricula to meet the increasing demand for green building savvy / informed professionals. The ILO (2011) notes that specialized postgraduate programs are beginning to address the skills requirement. For example in:

- Latvia, Riga Technical University integrated principles of green buildings into basic courses for architects and engineers,
- Spain, the curriculum for an advanced technical degree in energy efficiency and solar thermal energy has been developed in 2010, and
- Denmark, Bachelor qualifications in Architectural Technology and Construction Management can now specialize in Energy Efficient Sustainable Design and Construction (ESDC).

Tertiary education is not alone in responding to the skills requirement for green buildings. The ILO (2011) also notes that many TVET now offer programs that include green building related topics. Such learning outcomes include energy

certification, solar thermal installation, and sustainable materials for existing and future plumbing and electricity artisans.

### **3 GREEN IN TERTIARY CONSTRUCTION MANAGEMENT EDUCATION**

International construction management tertiary education is also responding to the needs of green buildings from the training and education angle. In Europe and the United States of America (USA), the literature alludes to the fact that contemporary undergraduate construction management curricula are gradually incorporating major elements of sustainability in general and green buildings in particular. Some programs opt to create stand-alone courses that cover various strands of a green building. Other programs integrated various strands through a university program curriculum. Thus, it is apparent that approaches differ, but the focus on sustainability is gaining traction in tertiary construction management education (Hyatt 2011). In particular, construction management programs in USA have embedded sustainability in various forms in the curricula. To support this view, Johnson and Gunderson (2009) report that 80% of construction management programs in the USA have implemented sustainable construction, and various authors concur with the success recorded so far while noting that sustainability content in most curriculums remain diversified and inconsistent. These observations from the USA programs show that tertiary construction management programs have responded to the skills challenge through various strategies. The positive side is the recorded rate of incorporation of sustainability into the curricula, and the worrisome aspect is the lack of standardization in the manner of incorporation of topics and learning materials into the curricula.

### **4 SOUTH AFRICAN CONSTRUCTION EDUCATION CONTEXT**

When reports from government and agencies in South Africa are examined, it is clear that the construction industry must turn green (cidb 2009; Department of Environmental Affairs (DEA), 2010, United Nations Environmental Program (UNEP) 2013). This process of change will require construction firms to adapt and modify their work and practices, which impact on both the business and project aspects of the practice of construction management. It is therefore imperative for construction educators to respond to the change by providing a curriculum that covers all aspects on sustainability in the built environment. The behavior and aspirations of existing and future construction professionals would have to consider various sustainability impacts of their decisions and actions (Emuze 2015). As noted by Tinker and Burt (2003), there is a moral and financial responsibility involved in the education of future construction management professionals on green issues. A sampling exercise of the current undergraduate construction management in South Africa in a related study (Emuze and Smallwood 2013) shows that limited / no university is taking the lead to offer either individual courses on green buildings or incorporating green ideas in the curriculum of a program. This is a major gap that cannot be allowed to persist as there will be increasing need to prepare graduates for the world of work. In addition, leading construction firms and emerging firms are gradually embracing green construction methods and materials to the extent that the provision of novice graduates in green aspects is tantamount to dereliction of the responsibility of tertiary education. Leading

South Africa construction firms and the ILO introduction of the Start and Improve Your Green Construction Business (SIYGCB) in Southern Africa, mean the face of the industry is set to change. These reasons suggest that construction firms will be looking for graduates who are suitably qualified to apply sustainability ideas and practices. In fact, it is imperative for undergraduate construction management programs in South Africa to address all aspects of green building projects to ensure that future employment and graduate placement is not marginalized by this gap. Just as reported in the USA (Tinker and Burt 2002), educated clients shall be demanding environmentally friendly buildings and green builders will locate a progressive trajectory in South Africa.

To meet this need, Mead (2001) suggests that construction educators in South Africa could develop new curricula and techniques by embracing the development of 'whole building' education. Unlike conventional buildings, green buildings utilize an integrated 'whole building' approach that optimizes a building's energy efficiency, indoor environmental quality, and resource and material use. For instance, an increase in the thermal efficiency of a building envelope will often reduce the tonnage of air conditioning required to cool the building. Similarly, increasing the thermal efficiency of a building often reduces fresh air intake, which in turn can lead to sick building problems. Green Building thinkers realize that building systems are inter-related, and that many design solutions may lead to other design problems. Consequently, Green Building disciples advocate the use of inter-disciplinary teams that focus on a systems approach to building design and construction. However, in the interim, green building concepts can be included in specific subjects or short professional courses. Clearly, materials and specifications for green buildings can be incorporated into construction materials and methods / construction technology subjects.

## 5 CONCLUSIONS

Boosting the supply of construction management graduates with the skills required to deliver green building projects, both with regard to numbers and capabilities, demand a shift in tertiary education focus. The renewal of existing construction management curricula should embed skills and knowledge needed for producing green buildings in the South Africa construction environment. The literature review is a structured attempt to initiate a case based research project that will address the integration of sustainability issues into the contemporary construction management curricula in South Africa. This is necessary to embark on the project as the current construction management programs use a modular approach to education, which is similar to the design and construction process without a significant inclusion of sustainability topics in the curricula.

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