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Framework

The strategies and actions outlined in the document Agenda 21 on Sustainable Construction (CIB, 1999) illustrates the learning process of continual improvement of sustainable practices in the built environment sector. This course of action (Figure 1) underpins the framework of this Guide for university academics and curriculum developers to integrate sustainability issues and facilitate innovation of sustainability education in built environment disciplines.

The emphasis will be on the learning process of integrating sustainability thinking and practice into the built environment curricula and the key role the professions play in the creation of sustainable built environments. The iterative and continual learning process hinges on addressing the key challenge of building sustainability progress on the local and regional contexts and the academic strengths of higher education institutions rather than on generic approaches.

Structure of Guide

The Guide is structured in four sections with a view of facilitating rather than directing change:

Section 1
A framework, which outlines the priorities in the professional development program; contextualising these priorities and strategies for capacity building for the different stakeholders are presented.
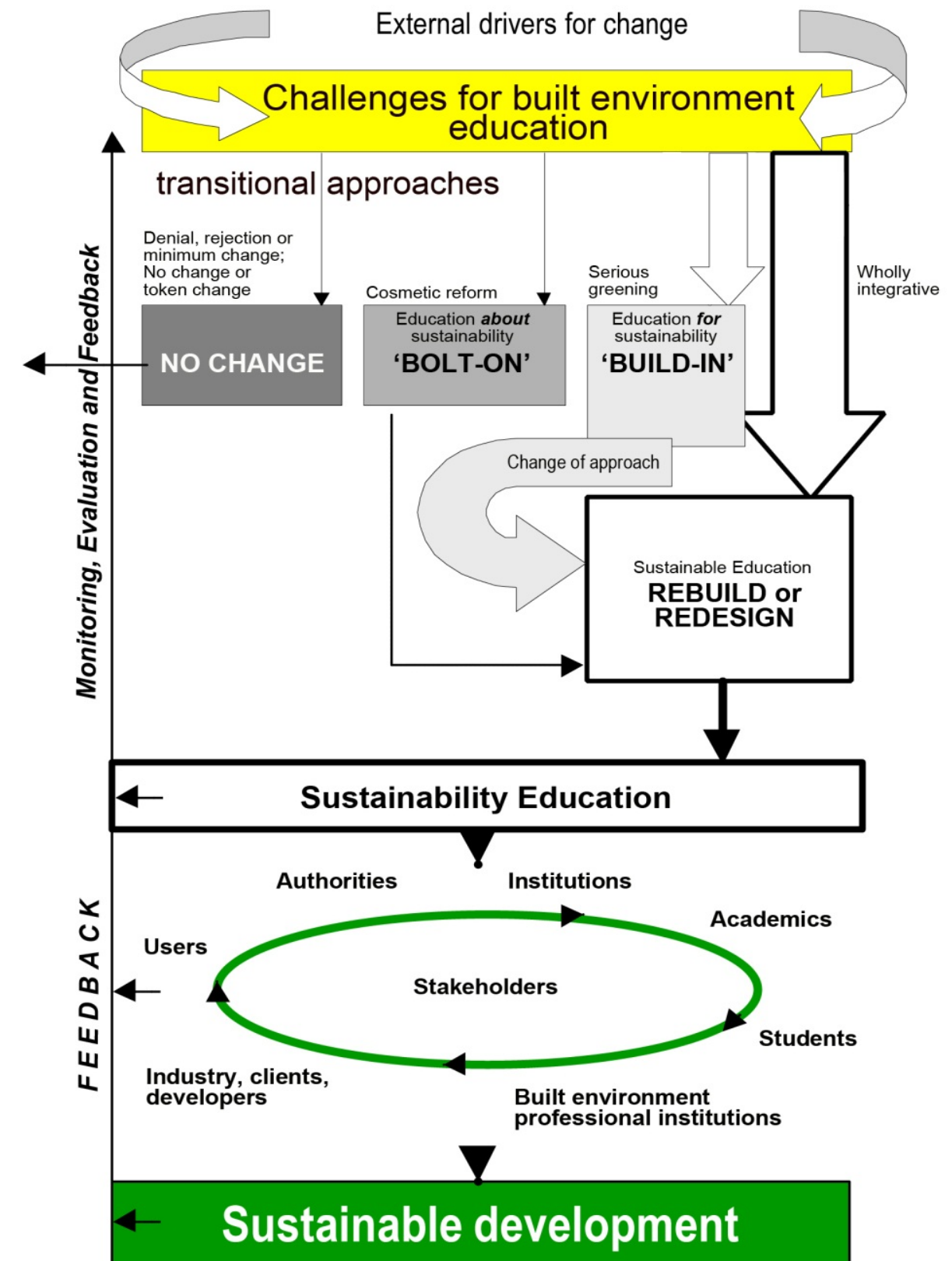
Section 2
The broad framework established and development of Section 1 provides a rationale for the guiding principles for teaching and learning issues, identifying learning aims and developing learning outcomes; transformative sustainability approaches and methods.

Section 3
This section provides a template of program and curriculum content, sustainability pedagogies for built environment courses and references and useful references. The outline of themes for the curriculum content and the list of references are not exhaustive but provide a general guidance to curriculum design.

Section 4
Platform for curriculum dissemination and distribution, best practice models of curricula and case study examples. This section outlines the available knowledge networks for faculty development and provides a platform for reporting and monitoring of progress and evaluation.

Learning process to sustainability education
Adapted from Agenda 21 on Sustainable Construction (CIB, 1999, p21)

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Section 1 - Framework for engineering and built environment sustainability education

Objective: A common framework for developing curriculum for engineering and built environment programs

1.1. Sustainability thinking in engineering and built environment
- Clarify definitions and sustainability terminology used within the context of built environment :
  - Technical definitions: construction of built environment as site activities, comprehensive cycle of building projects
  - Non-technical definitions: sustainable development – built environment as a sector of the economy, sustainable human settlements – construction of built environments as human settlements (physical structure, use patterns, social patterns, operational patterns)
- Define/clarify/outline knowledge base on sustainable built environments (efficiency, climate change adaptation, mitigation, etc.)
- Demonstrate where possible with practical examples/case studies

1.2. Priorities in the professional development program – establish requirements and issues (challenges) for
- Governments (local, regional and national) – policy-makers, bureaucrats, professionals
- Industry and private sector
- Communities
- Tertiary education institutions with engineering and built environment programs
- Nurture networks and encourage cross sectoral discussions

1.3. Contextualise priorities and requirements
- Global governing policies
- Local / community governing policies (including education policies)
- Industry marketplace (local, regional and national) –
  - building industry
  - design professions – architecture, engineering, planning, surveying, landscape architecture, interior design and urban design
  - built environment professions – construction management, property management, construction economists, quantity surveying, cost planning

1.4. Strategies for capacity building
- Curriculum review
  - audit of existing curricula; identify gaps and learning opportunities
- Networks and partnerships
  - Identify network and partners within schools, departments and university
  - Form national and international teaching and learning partnerships
  - Promote inter-disciplinary teaching and research
  - Strengthen links between teaching, research and community engagement
- Student involvement
  - Engage and involve students in curriculum design and review; seek feedback
  - Monitor attributes/learning outcomes post graduation
  - Encourage on-the-job training
- Industry engagement and collaboration
  - Contextualise knowledge via community based engagement case studies and projects
  - Incorporate industry and community engagement programs/projects in courses
- Professional accreditation
  - Cooperation with relevant professional associations
- Continuing education for educators
  - Develop CPD courses, work-placements, training programs and resources
  - Mentoring staff and students

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Section 2 - Built environment curriculum design and structure

Objective: Outline a program design format and content using a civil engineering program as case study

Case study: Civil Engineering course (4-year/5-year curriculum) offered at the International University -
Vietnam National University (IU-VNU)

2.1. Guiding principles for sustainability education: teaching and learning issues
- Values-based
- Learner centred; learning in context
- Holistic in scope and practice
- Future-oriented and action-oriented
- Experiential and collaborative
- Inter-disciplinary, intra-disciplinary, trans-disciplinary
- Critical, participatory and self-reflective
- Locally relevant
- Culturally appropriate
- Inclusive of minority and community knowledge, wisdom and opinion

2.2. Identifying learning aims (case study format: 4-5 year engineering course)

	YEAR	Semester	Learning Aims
Inter/cross disciplinary built into the programs	YEAR 1	One	• Understanding the concepts of sustainability
		Two	• Systems thinking + critical thinking / life-cycle thinking
	YEAR 2	One	• Critical thinking + systems thinking
		Two	• Communication skills
	YEAR 3	One	• Problem-based approaches
		Two	• Interactions (e.g., architecture, engineers, allied professions)
	YEARS 4/5	One	• Application for industry
		Two	• Life / social / communication skills
**Holistic: systems thinking / life-cycle thinking / critical thinking			

2.3. Developing learning outcomes – translate concepts/learning aims into outcomes hinged on the following (but not limited to) capability requirements

Knowledge and understanding of	Skills in:	Values and attitudes:
• Social justice and equity; • Diversity; • Globalisation and interdependence; • Sustainable development; • Peace and conflict	• Critical thinking; • Ability to argue effectively; • Ability to challenge injustice and inequalities; • Respect for people and things; • Cooperation and conflict resolution	• Sense of identity and self-esteem; • Commitment to social justice and equity; • Value and respect for diversity; • Concern for environment and commitment to sustainable development; • Belief that people can make a difference

Source: Parker et al (2004) cited in Sterling and Thomas (2006, p361)

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Section 3 - Built environment curriculum content

Objective: Outline a program design format and content using a civil engineering program as case study

Case study: Civil Engineering course (4-year/5-year curriculum) offered at the International University -
        Vietnam National University (IU-VNU)

3.1. Curriculum Content (Themes)
● Knowledge - concepts
● Issues (in the built environment)
● Perspectives (global, national, local)
● Skills
● Values (formation of attitudes)

3.2. Transformative sustainability pedagogies (approaches/methods) for building environment courses – establish / outline the following:
● Strategies for curriculum design
● Integrated 'learning' activities for built environment courses
● Assessment for learning

3.3. References and Useful Resources
● Summary of references and resources on sustainability education in built environment and higher education

Template to outline a course curriculum:

YEAR	
Semester 1– *Identify learning aims for the semester* **Semester 2 –** *Identify learning aim for the semester*	**Resources** *Identify references and resources to achieve learning aims*
	How *Identify methodology / teaching approach, learning activities, assessment*
Issues: *Identify challenges and issues; limitations, seek feedback through surveys, etc.*	

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Section 4 - Curriculum dissemination and distribution

Objective: Identify a platform for curriculum dissemination and distribution

4.1. Exemplars – models of curricula and programs (engineering and built environment)
● Best practice / case study examples

4.2. Knowledge networks
● Faculty development

4.3. Reporting and monitoring
● Closing the loop/seeking feedback for improvements

4.4. Evaluation and Update
● 'Sustainability content' checklist evaluation

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Mapping out the curriculum content hinges on the selection of knowledge that will support the sustainability vision and goals of the university (school/department) program.

3.1. Curriculum Content (Themes):

Knowledge - Concepts - Principles

- Broadscope views of environmental issues and sustainable development (Brundtland 1987; Daly 2005; UNEP 2009)
- Principles of sustainable development (Bardi 2011; Chiras 2005a; Daly 2005; Meadows, Meadows & Randers 2004; Meadows et al. 1972; Merkel & Litten 2007)
- Understanding of the principles of sustainability and sustainable development in the context of the built environment (Graham 2009; Orr 2011a, 2011c, 2011d; Williamson, Radford & Bennetts 2003)
- Metrics and meaning for environmental sustainability (Thompson & Creighton 2007)
- Concepts defining sustainability and sustainability knowledge:
   - Triple-bottom-line model (Elkington 1997)
   - Hierarchical model – integration of ecological thinking into all social and economic planning (Lowe 1996)
   - Panarchy framework and theory of adaptive change (du Plessis & Cole 2011; Holling 2004; Holling & Gunderson 2002)
- Sustainability and economics (Kats et al. 2003; Pittman & Wilhelm 2007)
- Sustainability mindset:
   - Systems thinking (Bateson 2000; Cook 2004; Robèrt 1997; Senge et al. 2008)
   - Academic and practical grounding (Orr 2011b)
   - Ethically motivated (Cohen 2007; Fox 2000)

Issues in the built environment

- Major social, economic and environmental issues were identified in the 1992 Rio Earth Summit – understanding and addressing these issues are central to sustainability (UNEP 1992).
- Contemporary issues in architecture, engineering and built environment programs (CIB 1999; du Plessis 2002; IPCC 2007b)
- Key discursive issues that impact architecture, engineering and the built environment:
   - Climate change and global warming (Garnaut 2008; Samuels & Prasad 1994; Steffen 2013; Stern 2007; UNEP 2007; Washington & Cook 2011)
   - Climate change impacts and actions (Flannery, Beale & Hueston 2012; Potsdam Institute for Climate Impact Research and Climate Analysis 2012; Smith 2009)
   - Adaptation and mitigation (Australian Government Productivity Commission 2012; Larsen et al. 2011; Lyth, Nichols & Tilbury 2007)
   - Energy and energy efficiency (Cheng et al. 2008; Hall & Klitgaard 2012; OECD & IEA 2004)
   - Design and Construction (Birkeland 2002; Kibert 2005; Vale & Vale 1991)
   - Low-carbon buildings/zero-energy buildings (OECD 2003; Torcellini & Crawley 2006; Torcellini et al. 2006; UNEP 2009)
   - Life-cycle assessment (Berge 2000; Graham 2009; Horne 2009; Horne, Grant & Verghese 2009; Kotaji, Schuurmans & Edwards 2003)
   - Digital revolution (Kotkin 2001; Rifkin 2011)
   - Cultural heritage (Hawkes 2001; Janes 2009)
   - Sustainable cities and urban development (Brown 2003; Haughton & Hunter 2003; Newton 2008)

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Perspectives

● Understanding of global issues as well as national and local issues in a global context. (IPCC 2007a, 2007b;
  Kamal-Chaoui & Robert 2009)
● Ability to consider issues from a perspective or viewpoint of different stakeholders essential to education for
  sustainable development – partial list of perspectives that students should understand (Sanusi et al. 2011, p193):
  - Social and environmental problems change through time and have a history and a future (Elkington 1997)
  - Contemporary global environmental issues are linked and interrelated between and among themselves
  - Humans have universal attributes (i.e., they are social, they love their children and care for their future)
  - Look at own community as well as look beyond the confines of local and national boundaries to understand
   (Larsen et al, 2011)
  - Acknowledge and understand that every issues has multiple points of view, depending on who are involved
   (who are the stakeholders effected by or affecting the issue)
  - Considering differing views before reaching a decision or judgement is necessary
  - Economic values, religious values, and societal values compete for importance as people of different interests
   and backgrounds interact (Stern 2007)
  - Technology and science alone cannot solve all our problems (Petroski 2010, Rifkin, 2011)
  - Individuals are global citizens in addition to citizens of the local community
  - Individual consumer decisions and other actions effect resource extraction and manufacturing in distance places.
  - Employing the precautionary principle by taking action to avoid the possibility of serious or irreversible
   environmental or social harm even when scientific knowledge is incomplete or inconclusive is necessary
   for the long-term well-being of the community and planet.
● Overview and understanding of sustainable public policy (Chiras 2005b)
● Sustainable building policies (OECD 2002, 2003)
● Energy efficiency policies (IEA 2011)

Skills

● Broad skills – critical thinking, etc. (Holmberg & Samuelson 2006; Svanström, Lozano-García & Rowe 2008;
  Wals & Jickling 2003)
● Discipline skills: Built environment specific skills (ILO 2011; Larsen et al. 2011; Lyth, Nichols & Tilbury 2007)
● Global practice approach (Parker, Wade & Van Winsum 2004; Steiner 2010)

Values and Attitudes

● Sustainability values (Leiserowitz, Kates & Parris 2004)
● Misconceptions on the concept of sustainability (Leal Filho 2000)
● Value change (Guo, Vale & Vale 2010)

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Sustainable development requires practicing designing and testing mutually beneficial social, economic and ecological relationships in built environments, rather than simply limiting the vision to creating 'less-harmful' designs (Graham & Booth 2010, p52).
What is taught in the built environment discipline will need to change with both time and place but how educators teach should be examples of sustainability. Curriculum reform should not only be in content, but in the process and context of education – framing sustainability as a way of thinking and acting and as a quality of the mind of the built environment professional.

3.2. Transformative sustainability pedagogies (approaches/methods) for building environment courses

Strategies for curriculum design
● Designing constructively aligned outcomes-based teaching and learning (Biggs & Tang 2011;
  Jones, Selby & Sterling 2010)
● Education in the age of technology (Collins & Halverson 2009)
● Education strategies for built environment (Graham & Booth 2010)

Integrated learning activities for built environment courses
● Effective teaching for higher education (Biggs & Tang 2011; Ramsden 2003)
● Practical pedagogy (Cotton & Jennie 2010; Cruickshank & Fenner 2012; Hopkinson & James 2010; Segalàs,
  Mulder & Ferrer-Balas 2012)
● Integration of sustainability (Thomas, Kyle & Alvarez 1999; Thomas & Nicita 2002)

Assessment for Learning
● Assessment for understanding and learning (Biggs & Tang 2011; Ramsden 2003)

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