What do we teach them when we don’t even know what it will look like?

Robert Tait
Department of Building Technology
Unitec
Auckland, New Zealand.
rtait@unitec.ac.nz

Abstract

It has taken forty years for sustainability to become mainstream. Forty years ago the publication of ‘Limits to Growth’ forecast a collapse somewhere between 2010 and 2075. Our students are staring this in the face. The resources of the Earth are finite and the economic theories driving our economies are finite. We do not know what form business will take.

This paper looks at embedding sustainability into building trade related diploma and bachelor qualifications at Unitec. A sound base of fundamental building skills must be augmented with an understanding of ecological and technological skills. The traditional apprenticeship model, practice based and learning on the job supported with MOOCs.

Sustainability of buildings requires a building to be flexible in use and for longevity, built to a good standard. The main piece of legislation controlling this industry in New Zealand has in section 3 a purpose requiring ‘sustainable building’. The traditional business model requires a profit and profit is only achieved in a growth model economy. There is only one planet and our industrial model uses one and a half, even more in some western counties. We are using our resources at an unsustainable rate and there is a case here for education to lead industry.

Sixty per cent of the buildings standing in 2050 are already in place. There is a worldwide population shift to urban environments and our students will live in these buildings. They will need the skills to determine what they want. The Built Environment uses 40% of the world’s energy and there is a high possibility of being able to reduce that.

Future practitioners obtain the knowledge through their learning. The discussion will be around how this is done in the ‘classroom’ and some of the interesting results achieved.

Keywords: Learning, Sustainability, Industry, Finite
1. Introduction

Old ways are not adequate any more. There is the sense of an unknown threat, a danger ahead. Food prices have spiked, the world population has surged, energy prices are soaring, tornadoes rip through cities, and typhoons affected by ocean temperatures decimate coastal areas. Governments have and are borrowing heavily to get us out of the financial crisis. The only way to pay back this debt is to have significant economic growth. Supply constraints have forced commodity prices to a new and permanently high level. Higher commodity prices limit economic growth.

The global reservoir of fossil energies, in particular oil, is approaching exhaustion with increasing speed. Peak oil has already occurred and now, all attention will be on the hard-to-access deposits. The depletion of these reserves will lead to actual or supposed shortages which will in turn result in economic upheaval or even armed conflict. It is obvious: we are living at the expense of future generations. This also applies to the greenhouse gas problem. The carbon dioxide concentration in the atmosphere has increased by 35 per cent in the last 125 years. Re-orientation is urgently required.

On reflection the MOOCs part of this strategy has been modified to be simply online tuition and support with students compiling an electronic portfolio.

This paper looks briefly at the current global predicament as a driver for education for sustainability at a vocational training institute level. There is consideration for the needs of industry and how that is met in the classroom. More importantly is the encouragement through the learning process to participate and co-operate, to be flexible enough to adapt to change.

It concludes by showing that the tools used in the learning process support their work environment and encourage ideas of a regenerating built environment.

The Oxford dictionary defines

**Sustainability**

*Adjective*

- able to be maintained at a certain rate or level: *sustainable economic growth*
- conserving an ecological balance by avoiding depletion of natural resources: *our fundamental commitment to sustainable development*
- able to be upheld or defended: *sustainable definitions of good educational practice*
Sustainable development:

*Noun*

- Economic development that is conducted without depletion of natural resources: *international policies should support sustainable development. Sustainable development has become the guiding theme in much environmental literature*

Sustain

*Verb*

- strengthen or support physically or mentally,
- bear (the weight of an object) without breaking or falling:
- undergo or suffer (something unpleasant, especially an injury):
- cause to continue for an extended period or without interruption:
- uphold, affirm, or confirm the justice or validity of:

Currently the planet’s resources are being used at a rate of 1½ planet. To maintain a free market North American economic model takes 5 planets. Other western nations are somewhere in between these figures. Some large corporations and industry giants spend millions of dollars on climate denial. The issue is so complex that any understanding of the global ecosystem requires many scientific disciplines to be considered together.

When we consider these dictionary meanings in relation to how we currently use the planets resources we have gone past this phase and must look at ‘Regeneration’. Sustainability is not possible if the use is greater than the supply. International policies are not working and are more often focused on making trade-offs or complying with rules and legislation.

For New Zealand Maori the theme or concept of custodial occupation (Kaitiakitanga) and a belief that the environment should be maintained in a fit state for future generations is embedded in the Treaty of Waitangi signed by the Maori (tangata whenua) and colonial British powers in 1840. Ecological messages and environmental ethics were passed down through generations of Maori by a rich tapestry of narratives. These are the guiding principles of the Resource Management Act (RMA), New Zealand’s principal piece of environmental legislation. The RMA incorporated ‘sustainable management’ as an explicitly stated purpose at the heart of the regulatory framework. This purpose is to direct all other policies, standards, plans and decision making to be considered under the RMA. It was a unique concept worldwide in 1991 but now under review by the current National led government.
Some European counties are looking at Eco management and audit schemes for the construction sector. Environmental assessment schemes mooted in Germany are largely covered in New Zealand by the RMA. The build process requires a resource consent administered by the local territorial authority. It will look at any aspects of the natural environment and require reports on how these will be mitigated. Often contractual documents will make requirements of the construction firm especially in regard to waste, dust from cutting material, water run-off and noise levels for example.

While academics focus on environmental assessment tools for buildings, life cycles analysis of buildings and integrating climate targets with planning strategies others are looking at the paradigm shift needed in thinking to create an ecological urban environment. At present in this world, the human species and nature are considered separate systems. “An ecological worldview holds that as humans are an integral part of nature, they are participating in and co-evolving through its processes and therefore subject to its laws. Effective action would then learn from and follow the laws of nature, and cooperate with and participate in its processes so that the outcomes of actions contribute to the well-being, nourishment and regeneration of the world.” (Du Plessis 2011)

Such a shift requires co-operation and participation. It requires an ability to learn, understand and adapt. It requires a certain dynamic and flexibility. The science of ecology must have a greater importance. Ecological design and engineering for a biophysical environment will be united with processes and tools for a common language and an understanding of social-ecological systems that make our cities.

There are echoes here of the ideals that drove the hippie or counterculture movement back in the 1960s and 1970s. That was the time of ‘Limits to Growth’ and the ‘Whole Earth Catalog’. The Whole Earth Catalog served as a guide to a new way of being an individual. It expounded an anti-technocratic reintegration with nature and offered new ways of being in community. Later in ‘Out of Control’ Kelly suggested networked systems, particularly computer systems that would lead humanity in a reintegration with nature. This he said would happen in the corporate world. It did and business looked at how groups learn best. The notion is one of distributed learning where individuals are elements of a system and they had the computer with which to keep the emerging networks working and communicating. Corporate business had the cyber net for the interdisciplinary work and computing for the unifying theories and collecting data. It is the environment into which students enter as apprentices although somewhat more advanced now. The construction industry works in groups or teams and for some organisations 80% of the time is spent in team work.
To survive construction businesses like any other business need a core set of beliefs and values that match clients or suppliers. Students will have to consider what their needs are and where they align with those of industry. Is the role of the tutor one of provocateur? Or is this all a progression of time? We are seeing the power of collective computing and the rise of social media as the destruction of political hierarchy like in the Arab spring. Sustainability has become a mainstream subject and at a pace similar to social media. There is a worldwide movement and demand by students for sustainable campuses. Education as a business means the institutes must compete to attract students. Academia needs to sow the seed. ‘The power of collective computing has the faded images of the New Communalism of the hippies and the counterculture movement. Levelled, collaborative, linked by invisible signals and shared feelings.’ (Turner 2006).

Back then in Europe and America a lot of the new ideas originated in institutes of learning so if Kellenberger et al (2010) propose a 2000watt society, 1500watts renewable energy and 500watts fossil fuel we need our students to understand what it means. We need to generate discussion with our students, ask what they will give up. Currently western society is using 6500watts per capita per annum. Greenhouse gas emissions shall be reduced from 8.7 ton today to 1 ton CO² equivalents in the future by 2150. By 2050 it is forecast the CO² emissions from the Asia Pacific region will reach the same level as North America. It will take a very concerted multidisciplinary effort to affect this type of change. CO² emissions today have an effect on global mean temperature lasting more than 100 years. Any resulting rise in sea level due to the thermal expansion will last at least 1000 years. Current urban design will suffer from a heat island effect where the buildings of the urban areas absorb more heat due to materials and proximity to one another. In the summer of 2003 in Paris this was 4 -5 ºC higher during the heat wave.

Ecological design could help in reducing this effect. There is a potential for business to take a lead in this as they realise the economic benefits of a green economy. Sustainable businesses currently provide as good as or better return for investors. Huang (2010) defined the green economy as ‘a new economical pattern with an orientation of harmonious development of economy and environmental protection; an outcome of the requirement that industrial economy shall not hurt human health and the earth environment forming a new state of social development.’ Business has the networking systems and the organisational skills are in place to develop a green economy. Academia at the behest of the business community needs flexibility to provide the required skills.

This relationship between academia and industry has not been easy with regard to sustainability. Vocational training is seen as not necessary to have these skills. It could be argued that it is absolutely necessary as these students are in the future installing the systems or the structure holding a bio-

...
physical environment. Sharma (2011) found that industry in New Zealand plays a key role in determining what is incorporated into trade training curricula but it needs to provide support to go with this. So far the emphasis has been on universities rather than the vocational and training institutes which are seen to have less relevance. Vocational education provides important skills which are applied in industry and as such need more support due to increasing technical complexity.

Buildings are using 40% of the world’s energy and many models exist to improve this. Students entering the industry now will see a quantum leap in new technology and bio-mimicry as buildings and materials replicate nature. For many in industry sustainability is seen as an extra cost and for many academics at vocational training institutes it is outside their expertise.

Faced with the global outlook does industry know what it needs? Historically in New Zealand there have been seven year cycles in the building industry. Seven year boom and bust cycles with 2007 the last boom year and starting in 2008 a prolonged recession. The construction industry is focussed on survival for much of the time but it now needs to think of sustaining its position in the light of climate change.

2. Research

2.1 Research Objectives

The purpose of this qualitative research is to determine the relevance of teaching sustainability to building vocational and trade studies in New Zealand.

• Determine what the driving forces are

• Investigate the skills required by future building practitioners and current training.

2.2 Methodology

This body of work aims to gain insights into what a modern trade qualification should encompass. The building trade and related professions have for decades traversed an industrial landscape as nomad and technocrat.

Buildings could be described as technical objects attaining a meaning within social and historical contexts. In New Zealand this could range from a light timber framed holiday shack, crafted from recycled material or whatever material was gathered together to an architectural masterpiece making
the cover of glossy magazines or succeeding in an international competition. The former might not even have formal building consent but still providing shelter and a small ecological footprint.

The training for a carpentry qualification starts with a one year pre-trade course. This is a certificate course encompassing the entry criteria for the diploma and bachelor courses. In the course of the first year students build a one level three bedroom house under the guidance of their tutors. Theory classes are organised to provide students with prior knowledge of each step in the construction process. On the building site a large monitor screen is set up for class tutorials. The material introduced here is reinforced around crucial points on the site by the use of Quick Response codes (QR codes). The students access information or instruction with their smart phones or tablets.

Students have to submit all assignment work as a Google document. This is shared with the tutor who can view the students’ progress and provide feedback. All course content is presented using Moodle software and can be downloaded by the students. Online quizzes can also be facilitated through Moodle. At the end of the course students have all their work as an electronic portfolio.

The construction of a building is achieved through the organisation of a large group of people. The idea of working in groups or teams introduced in pre-trade course and continues through the diploma or bachelor course. Students enter this next phase of their learning with a basic understanding of light timber frame construction and principles of construction. The Diploma/Bachelor stage of the building education involves more complex building and an introduction to multi-storey, multi-unit developments. The majority of students are now in apprenticeships learning the practical aspects of their trade on site. The attendance at the technical institute is part–time and mostly for theory.

Throughout this course the concept of sustainability is embedded. Each paper has an outcome referring to the ‘Te Tiriti o Waitangi’ (Treaty of Waitangi) as per the institute charter. Group work is continued in the communication and problem solving paper. Here each group must develop a product or process using less resources but more sustainable than what is currently available and is specific to the building industry. This is presented to the class along with individual project for their portfolio. The focus is on an ability to think laterally and to communicate ideas. Google + enables the tutors to follow the participation of the group members. Regular feedback is possible and the role of the tutor becomes one of support and mentor.

Other technical papers use plans of existing buildings and students are required to develop or find systems or materials that will reduce the environmental footprint. Investigative research appropriate to level 6 is required. Students’ progress is monitored through the sharing of documents with their tutors and appropriate feedback given. Group exercises are monitored using circles in Google + (Plus). By
adding the tutor to the circle the level of emotional maturity of working groups can be seen. This is another area of research distinct from the built environment but relevant to ecological regeneration. The new communalism and the ‘back to the landers’ of the 1960s and 1970s were social laboratories that did not work. We have to trust business and its adaption of communal networking to help provide the skills for working in teams.

For the diploma, the final year paper Technology Project requires the student to investigate a problem, material or system within the industry. This is not a chance for them to tell us what we know because we taught them so. This is to generate thoughtful lively discussion and to question the status quo and using a lateral thinking problem solving approach. It is pretty scary for a lot of students and often the initial feedback needs to sell the idea back to them so they take ownership. Environmental issues and sustainability are their main focus reflecting on discussions through the technical subjects and a perception of their working environment as an apprentice.

The bachelor course is heavily focussed on sustainability. This is concurs with research done by Williams (2009), Sharma (2010) and Packard (2010). In New Zealand universities are more focused on sustainability than vocational training institutes. Architecture programs consider ideas of regenerative buildings and real time and sustainable design as essential knowledge. Their drawings are coupled to BIM modelling to enhance construction costing and management. Civil engineering students take papers in environmental science and obtain a broad understanding of eco systems. For trades, teaching sustainability is stepping outside the prescribed curriculum which is based on attaining competency

3. Findings and Discussion

A number of themes start to emerge from the feedback of students, industry and academia. Up until 2010 sustainability was contained as one of the themes of the New Zealand Government’s education policy. The review of this policy by the centre-right National led government omitted this completely for the period 2010 - 2015. A review of the building trade related qualifications begun in 2013 has so far omitted to include any education for sustainability. Trade training is shaped at a national level as a vehicle for implementing New Zealand Government policies. In contrast Education for sustainability is part of the Australian curriculum and much better organised.

The advantage of an electronic portfolio is the ownership remains with the student. It will enable a student to show a prospective employer what has been covered and how well they have performed
over the course of their studies. Ideally it would be linked to the institute so that grades could be seen as well.

Quick Response code originated in the Japanese automobile industry and was quickly adapted by other industry as a way of disseminating information. It has proven to be very successful in the practical classroom situation where one or two tutors oversee a large group. They offer a quick way of giving instruction for installation or health and safety requirements for a building site use. Potentially of regenerative buildings could be more complex as far as the number of systems installed. The QR code can give instruction with regard to trades following behind reducing the chances of replicating work.

Google+ monitoring supports working in groups. Students as digital natives are often supporting tutors with this technology. However it comes naturally to the Facebook generation and is a normal way of communicating with their peers. This is a social system held together by information exchange into which at any time individuals can insert themselves. The computer, smart technology etc is helping individual users to integrate more easily with “laws” of nature. Google+ is a way of communicating through an organisation. Construction firms that operate over several sites can use this for communicating with and between teams. It is more appropriate for the overall update on progress than for day to day operations but still an important communication tool.

More and more businesses are relying on groups of specialised skills to put a project together. These are precisely the skills needed for a construction project. The polytechnic/vocational training institute needs to create a work readiness aligned to the industry. That is the language of the global shift in tertiary education. Industry readiness and acceptance of people who can introduce new approaches is just as important. Such skills are considered desirable in the creative industries but need encouraging in the rest of the built environment. The ‘Living Building Challenge’ is a good example requiring active participation.

Students struggle with the concepts because they cannot see it happening in front of them. This issue is slowly evolving so it is sometimes difficult for students to realise the urgency. Active engagement in the classroom and peer pressure that comes from group work can be the trigger.

To quote Senator Daniel Patrick Moynihan “everyone is entitled to his own opinion, but not his own facts”.
4. Conclusion

There is a very disorganised and scattered approach to sustainability in New Zealand. Vocational Students need sound core skills for their discipline and the tools to be able to participate in teams or groups. They need the ability to find information and how to use it and be able to action or build collaborative networks. Industry has shifted from a vertical hierarchy to a more horizontal model incorporating interdisciplinary teams working together. This structure was used for the development of radar and nuclear weaponry. If it could transform the outcome of a World War then interdisciplinary teams working together could have a chance to regenerate our planet.

The main focus of vocational institutes is working towards every student understanding and applying sustainable practice in their workplace and everyday activities. For building related trades it is an imperative. The world’s population is becoming increasingly urbanised an in the process is turning bio-diverse and productive land into bio-absent systems of hard surfaces, retaining heat, diverting water and increasing pollution. Green buildings are often designed and built for optimal performance as a standalone and not considered within the broader social and environmental context.

As a result it is important that younger building practitioners are not disconnected to the consequences of their decisions and are able to find information and use it appropriately. Nature must be a partner in any development. Eco effectiveness, regenerative design such as living walls and roofs, modular structure, off-site construction and deconstruction are all concepts applicable to their learning.

The Natural environment will survive without mankind but humans cannot survive without a natural environment. Any advance and regeneration of our current state will require active participation and communication. Vocational training for the built environment must equip students with the awareness and skills to take this journey.

References


Du Plessis, C. 2011. Shifting paradigms to study urban sustainability. World Sustainable Building Conference (WSB11) Helsinki, Finland. Theme1 4-17


